Interaction of Real and Financial Variables in an Oil-Based Economy: The Case of Kuwait

A thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

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Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

Ibraheem Alaskar

12 October 2020

Dedication

To Sarah, Khaled and Homoud

Acknowledgments

Throughout my doctoral studies, a number of people played an important role, and I would like to take this opportunity to state my appreciation to them.

First and foremost, I would like to express my sincere gratitude to my senior supervisor, Professor Imad Moosa, for his continuous support and guidance throughout the course of my PhD journey. I am profoundly grateful to Professor Moosa for his comments and constructive suggestions which were invaluable in completing this thesis. He inspired me with his unique way of thinking and immense knowledge of finance, economics and econometrics. Despite his busy schedule, his door was always open to me. I am honoured to be one of his students. Also, I would like to thank my associate supervisor Dr Larry Li.

There are no proper words to convey my deep gratitude and respect for my family. I would like to thank my parents, Haifa and Tareq, for their unconditional love and support. Heartfelt thanks go to my aunt, Loluwa, for her encouragement and motherly love. Also, I would like to express my sincerest gratitude to my lovely wife, Sarah, for her eternal support and understanding of my goals and aspirations. And last but by no means least, I am deeply grateful to my children, Khaled and Homoud, for bringing so much joy and happiness into my life.

Abstract

This research presents a macroeconometric model describing interactions between real and financial variables in the economy of Kuwait, which has distinctive characteristics. While Kuwait is considered to be a developing country, it enjoys the benefits linked with developed economies. The objective of developing this model is to trace the relationship between financial, monetary, and real variables in the economy. The model provides an analytical tool to determine how the monetary and real sectors affect each other, make it possible to quantify the connection between prices, income and money in a macroeconomic framework.

The model is a recursive system of equations that is estimated in three forms: autoregressive-distributed lag (ARDL), static long-run relation, and the error correction model (ECM). The predictive power of the model is examined by generating out-of-sample forecasts by utilising the recursive approach (expanding window). The accuracy of the forecasts is assessed by estimating several forecasting accuracy measures based on the magnitude of the error, such as the root mean square error ($RMSE$) and Theil's inequality coefficient, in addition to measures of direction accuracy. Furthermore, to measure the profitability of trading based on the forecasts, several forecasting-based trading strategies are applied to stock prices and interest rates. Subsequently, the profitability of the trading strategies is measured by estimating the average annual compound rate of return (AACRR) and the cumulative return on the portfolios.

The empirical analysis is performed by using quarterly time series data covering the period from 1995 to 2017. The estimation results reveal that the model is well specified and that it has a high explanatory power. While several equations pass all of the diagnostic tests, some of them do not pass the normality test, which is attributed to the presence of outliers. Moreover, cointegration tests reveal the presence of cointegration between the variables in all of the equations, indicating that there is a stable long-run relation between the variables. The main conclusion to be drawn from the forecasting accuracy measures is that the random walk cannot be outperformed in terms of the measures based on the magnitude of the error, which is in line with the findings of Meese and Rogoff (1983). Furthermore, the findings indicate that most of the equations have a direction accuracy of more than 50%, which means the model's predictive power for directional changes is by far better than that of the random walk, which always predicts no change. The trading results indicate that, when the appropriate trading strategy is applied, the model is capable of generating profits. In terms of profitability, trading based on the interest rate forecasts yields better cumulative returns than trading based on stock price forecasts. Nevertheless, political instability in the region and the global financial crisis negatively affected the results of trading based on the forecasts of the stock prices.

It must be stated at this early stage that this is a finance rather than economics thesis, in which case emphasis is placed on the use of predictions generated by the model to trade on the basis of variations in stock prices and interest rates. This procedure allows us to judge the predictive power of the model in terms of profitability, which is more appropriate than judging it by the statistical measures that depend on the magnitude of the error. The model is not built for its own sake or to conduct policy analysis, as in economics, but rather to trade, as in finance. Yet, the model can be used to derive some policy implications, particularly the estimated elasticities. The use of a multi-equation model that incorporates real and financial variables is a reflection of the belief that financial markets do not operate in vacuum and that financial variables affect and are affected by the real economy. This is not typically emphasised in the finance models of stock prices and interest rates.

Keywords: Macroeconometric Model, Developing Country, Monetary Sector, Real Sector, Money-Income Relation, Monetary Aggregates, Recursive Model, Oil-Based Economy, Emerging Economy, Forecasting, Forecasting-Based Trading.

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List of Abbreviations

2SLS	Two-Stage Least Squares
AACRR	Average Annual Compound Rate of Return
ADF	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lag
BBME	British Bank of The Middle East
BP	British Petroleum
CGE	Computable General Equilibrium
CPI	Consumer Price Index
DSGE	Dynamic Stochastic General Equilibrium
EC	Error Correction
ECM	Error Correction Model
FMOLS	Fully Modified Ordinary Least Squares
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GNP	Gross National Product
IBK	Industrial Bank of Kuwait
IMF	International Monetary Fund
KD	Kuwaiti Dinar
KFH	Kuwait Finance House
KOC	Kuwait Oil Company
KREB	Kuwait Real Estate Bank
KSA	Kingdom of Saudi Arabia

KSE	Kuwait Stock Exchange
LM	Lagrange Multiplier
MAE	Mean Absolute Error
MSE	Mean Squared Error
NBK	National Bank of Kuwait
OLS	Ordinary Least Squares
OPEC	Organization of The Petroleum Exporting Countries
PCA	Principal Component Analysis
PV	Portfolio Value
RESET	Regression Equation Specification Error Test
RMSE	Root Mean Squared Error
RW	Random Walk
TVP	Time-Varying Parametric
TYDL	Toda, Yamamoto, Dolado and Lutkepohl
UAE	United Arab Emirates
UK	United Kingdom
US	United States
USD	United States Dollar
VAR	Vector Autoregression

CHAPTER 1

INTRODUCTION

1.1 Background

The effect of the monetary sector on the real economy has been a subject of debate amongst economists for a long time. The term "real economy" is used by economists to refer to the sector in which the production of goods and services takes place through collective utilisation factors of production (labour, land and capital). On the other hand, the monetary sector is the sector that comprises the institutions that create money, which are the central bank and depository institutions. It follows that the monetary sector is a subset of the financial sector, which encompasses other (non-depository) institutions and financial markets. While the emphasis in this thesis is on the monetary sector, we refer to "financial variables" for two reasons. The first is that monetary variables (such as cash and deposits) are financial variables. The second is that non-monetary financial variables, such as stock prices, are also considered and included in the model.

Economists have long believed that there are feedback connections between the real and monetary sectors. Over the years, several methods have been utilised to examine the possibility of feedback between the two sectors. Interaction between financial and real variables in the economy can be investigated by tracing how the two sectors affect each other—specifically, through the transmission mechanism of the monetary policy impulses and the intermediation role of financial institutions. Several economists, such as Goldsmith (1969), McKinnon (1973), Shaw (1973) and Fry (1995), argue that the most critical factors in supporting economic development are financial institutions and financial markets. Furthermore, they identify a strong positive empirical relationship between the level of development in the financial sector and economic growth. The real sector produces better outcomes if it is supported by a developed financial sector, because the development of the financial sector influences the growth of the real sector.

The relation between the monetary sector and the real sector plays a dominant role in the design of monetary policy. While interaction between real and financial variables in an economy is not a new topic per se, to the best of the authors' knowledge, no study has been conducted to investigate the topic, as it pertains to the economy of Kuwait, in the past three decades. Therefore, this thesis fills gaps in the knowledge on this subject since the available studies do not reflect the current state of the Kuwaiti economy.

This study aims to address several critical questions, which are important to understand interaction of real and financial variables in the economy of Kuwait. These questions pertain to: (i) the theoretical and empirical definition of money, (ii) the appropriate specification of the demand for and supply of money functions, (iii) the effect of the monetary sector on the real sector, and (iv) the role played by these macroeconomic relationships in the economy of Kuwait. To deal with these issues, we aim to specify and estimate a macroeconometric model that allows us to understand the interaction of real and financial variables in the economy of Kuwait. The model will provide an analytical framework for tracing the effect of the monetary sector on the real sector, and vice versa. The model will allow us to quantify the relationship between several financial and real variables (such as prices, income, and money) in a macroeconomic context.

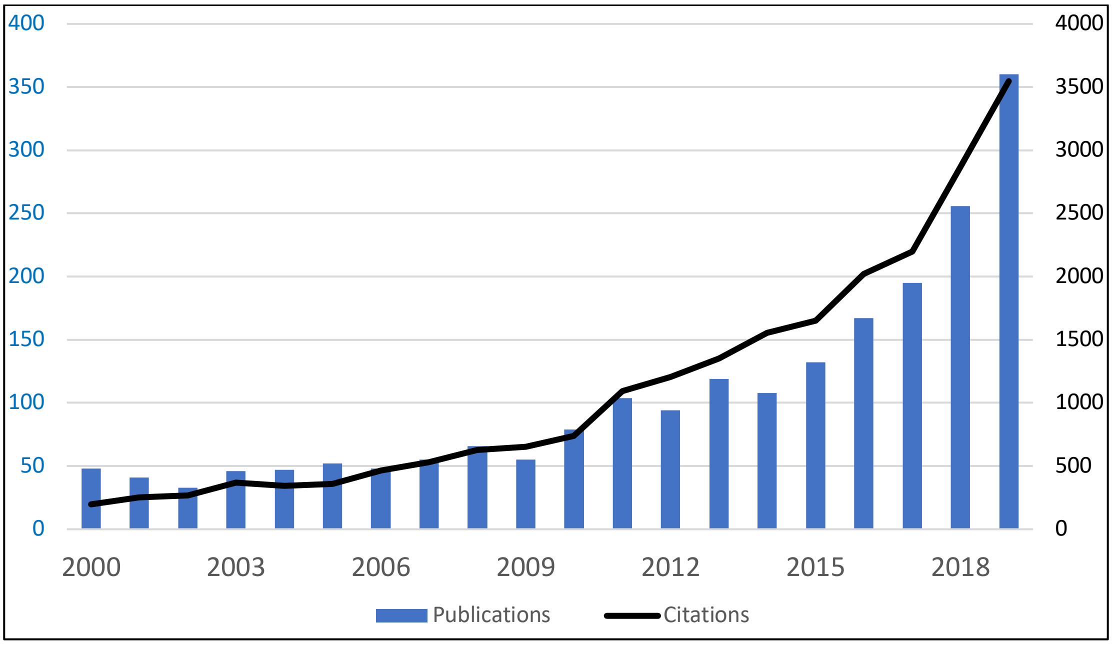
The empirical work is based on quarterly data series covering the period 1995 to 2017. The data sets were obtained from three sources: (i) Thomson Reuters DataStream, (ii) Bloomberg, and (ii) the quarterly reports published by the Central Bank of Kuwait. Since the GDP figures are reported annually, the quarterly series was obtained by interpolating annual series, which is a common practice when the required frequency of data is unavailable. The interpolation feature in EViews 10 was utilised for this purpose.

1.2 Research Importance and Contributions

Macroeconometric modelling has been gaining momentum as a research area in the past two decades. Figure 1.1 illustrates the statistics of publications and citations of macroeconometric modelling related research over the period 2000 to 2019. Publications increased from less than 50 in 2000 to more than 360 in 2019. Likewise, the citations increased from less than 650 in 2000 to more than 3500 in 2019. However, research on macroeconometric modelling remains scarce and mostly covers the developed countries. While the number of publications is increasing over time, only a modest number of studies cover developing countries and emerging economies, particularly Gulf Co-operation Council (GCC) countries.

The main contribution of this research is to provide more in-depth analysis of interactions between the monetary sector and the real sector in the economy of Kuwait. Furthermore, this research will make a significant contribution to the literature on modelling developing countries and emerging economies. The model can be used for hypothesis testing, policy analysis and forecasting. Most of the previous macroeconometric work on the economy of Kuwait was done in the period 1970-2005, and most of that work has not been updated recently. This is why these models do not apply to the current state of the economy, which means that they are in need of restructuring to reflect the changes in the economy.

Figure 1.1: Publications and Citations



1.3 Thesis Structure

This thesis contains eight chapters, which are described in more detail below. The first chapter is an introduction. Chapter two is concerned with the history and structure of the economy of Kuwait. It sheds light on the major economic events in the history of Kuwait and reviews how the economy was transformed from a trade-based economy to an oil-based economy. Several economic issues are discussed such as Kuwait's dependence on oil, size of public expenditure, dependence on international trade, and the lavish social welfare system. Furthermore, the chapter presents an overview of the monetary sector and the latest long-term plan.

Chapter three discusses the money-income relation in the economy of Kuwait where an attempt is made to find the best definition of money in Kuwait. Several monetary aggregates are derived by following the Friedman and Meiselman (1963) approach to defining monetary aggregates by adding sequentially one asset at a time. The presence of a stable long-run relation between monetary aggregates and economic activity is investigated by conducting cointegration analysis. Furthermore, the Granger (1969) causality test is used to investigate causal relations and to determine the direction of causality between monetary aggregates and economic activity. To test the predictive power of the bilateral money-income relations, recursive regressions are used to generate out-of-sample forecasts. Forecasting accuracy is judged in terms of measures of the forecasting error and direction accuracy.

Chapter four is about the specification of the model, where the objective is to specify a model describing interactions between real and financial variables in the economy of Kuwait. The specified model provides an analytical framework for learning the behaviour of several economic variables by revealing how the monetary sector and real sector affect each other. The model consists of thirteen behavioural equations that cover the following: (i) the role of government expenditure in economic activity; (ii) oil GDP; (iii) demand for money; (iv) the effect of foreign interest rates on domestic interest rates; (v) demand for reserves; (vi) supply of deposits; (vii) the effect of imports and money supply on the price level; (viii) imports; (ix) demand for and supply of credit; and (x) stock prices. The excursiveness of the model is identified followed by the derivation of the reduced-form equations and equilibrium conditions.

Chapter five is about the estimation of the model, starting with an explanation of the estimation method. The estimation results are presented and discussed. Moreover, the estimated equations are validated by using a set of diagnostic tests for serial correlation, functional form, normality, and heteroscedasticity. The estimated elasticities are presented at the end of the chapter.

Chapter six examines the predictive power of the model by investigating its ability to generate accurate forecasts. The forecasts are generated by applying the recursive (expanding window) approach, which is preferred over the rolling (fixed window) approach, particularly when dealing with macroeconomic variables. Chapter six discusses the Meese-Rogoff puzzle pertaining to the inability to outperform the random walk in terms of the root mean square error ($RMSE$) and other measures based on the magnitude of the error. Furthermore, the chapter discusses other measures of forecasting accuracy such as direction accuracy and Theil's inequality coefficient. The results of the forecasting accuracy measures, in addition to the prediction-realisation diagrams for the structural and reduced-form forecasts, are presented at the end of the chapter.

Chapter seven builds upon the findings of chapter six by examining the ability to make profit by trading based on the forecasts. In chapter seven, five trading strategies are utilised for trading stocks and two strategies for trading a hypothetical fixed-income asset, based on the structural and reduced-form forecasts. The results of the trading strategies are presented, and the profitability of each portfolio is measured by estimating the average annual compound rate of return and the cumulative return.

Chapter eight summarises the thesis and draws conclusions. A recapitulation of the main findings is presented, and the limitations of this study are discussed. Moreover, the potential extensions to this study are presented at the end of the chapter.

CHAPTER 2

THE HISTORY AND STRUCTURE OF THE ECONOMY OF KUWAIT

2.1 Introduction

The main objective of this chapter is to present an overview of the history and structure of the economy of Kuwait. This may seem to be unrelated to this study, which involves the development and estimation of a macroeconometric model, but this is untrue because the model should include the behaviour of several sectors of the economy. The model will allow us to enumerate the connection between financial, monetary and real variables. Furthermore, several economic variables (such as oil GDP, imports, exports, and non-oil GDP) are used as explanatory variables in the model.

Kuwait is a wealthy country with plenty of oil that is entirely owned by the government. In an effort to redistribute the oil wealth, the government has developed a lavish welfare system funded almost entirely by oil revenues. The welfare system in Kuwait provides various benefits, including the following: (i) citizens have access to public employment programmes; (ii) stability of public service prices; (iii) the prices of essential products are maintained at a relatively low level; (iv) the provision of residential lands at low prices and interest-free mortgages to home buyers; and (v) free medical care system.

Kuwait is considered a developing country because most of the income comes from exporting a single commodity, which is a common feature of developing countries. The volatility of oil prices keeps the country at the risk of getting economic challenges, as fluctuations in oil prices can have dramatic effects on the economy because oil revenue and prices determine GDP and the budget surplus/deficit. For Kuwait to have a more stable economy, the oil market must be stable.

The economy of Kuwait has some distinctive attributes that make it stand out. Even though Kuwait is fundamentally a developing country with an emerging economy, it possesses the characteristics of developed economies, including the following: (i) Kuwait has a high level of GDP per capita that is even above what can be found in developed economies; (ii) it does not have any capital constraints on development; and (iii) it has a budget surplus most of the time, except when there is a slump in oil prices.

The chapter is divided into eleven sections. The first section is an introduction, whereas section two looks at the history of the economy of Kuwait. The third is dedicated to a discussion of how Kuwait is dependent on oil, and section four deals with economic growth in Kuwait. The fifth section looks at public finance, and section six is about foreign trade. Section seven contains a discussion of the labour force in the economy of Kuwait, and section eight is about the social welfare system in the county. Section nine is concerned with the monetary sector, and section ten illustrates the new long-term plan for the economy of Kuwait, also known as the State Vision Kuwait 2035 or “New Kuwait”. Finally, section eleven presents a summary of the discussion.

2.2 The History of the Economy of Kuwait

The State of Kuwait is a small country located in the northeast part of the Arabian Peninsula. The total area of Kuwait is about 17,820 km^2 with a population of 4.5 million according to the latest census, of which 1.37 million (30%) are Kuwaiti citizens, and 3.13 million (70%) are non-Kuwaitis. The southern border is shared with the Kingdom of Saudi Arabia (KSA) and the northern border is shared with the Republic of Iraq.

The economic history of Kuwait began with the first migration wave arriving in the eighteenth century, and with it began the accumulation of wealth through trade-based activities, especially by the wealthy merchant families. Kuwait had a relatively stable political environment at that time, which facilitated the economic stability required for the development of a trade-dependent economy. During the initial stages of economic development, Kuwait did not have any form of welfare.

Because of the strategic location of the country, several trade routes were diverted to Kuwait during the eighteenth century, particularly the Indian trade routes to Baghdad, Aleppo, and other cities. As a result, the economy of Kuwait thrived and the country became a trading centre between west and east. The primary sectors of the economy were trading, pearl diving, and sailing, all of which were under the control of affluent merchant families (Al-Sabah, 1980). According to Crystal (1995), at a time when the ruler of Kuwait was financially reliant on taxes and tariffs, the merchant families had control over the economy by being the main tariffs and taxes payers. Consequently, this gave the merchants leverage to gain political influence in the country, which created a political balance between the ruler and the subjects.

Kuwait faced a series of economic problems such as: (i) the trade blockade that was imposed by the British Empire during the first world war as a response to the ruler of Kuwait supporting the Ottoman Empire; (ii) the trade blockade imposed by KSA in the 1920s after the Kuwait/Najd war; (iii) the great depression which affected Kuwait when the demand for goods from India and Africa declined in Europe; and (iv) the collapse of the pearl industry due to the shrinking demand for pearls caused by the global depression and the creation of cultured pearls. Consequently, people left Kuwait because of the prevalence of economic hardship in the country.

The modern economic history of Kuwait revolves around the oil industry. It is safe to say that the economy of Kuwait has been dependent on oil ever since it was discovered in 1938. The ruler of Kuwait signed a document in 1934 that changed the country's financial status. The concession agreement was given to the Kuwait Oil Company (KOC) which was formed by British Petroleum (BP), formerly the Anglo-Persian Oil Company, and Chevron Oil, formerly Gulf Oil Corporation. The search for oil started immediately, and Burgan (which is the world's second-largest oil field) was discovered in 1938. While oil was discovered in 1938, exports did not start until 1946—the main reason for the delay was the second world war which lasted from 1939 to 1945.

Kuwait's oil production and revenue increased dramatically in the following decades, particularly during the 1970s. According to Khouja and Sadler (1979), the production started with 5.9 million barrels in 1946 and increased rapidly to 1.2 billion barrels in 1972. Oil revenue increased from $760,000 in 1946 to $9.802 billion in 1976.

Since the discovery of oil, Kuwait gained its oil revenue through the taxes and royalties paid by the foreign oil companies. In the early 1970s, Kuwait began negotiations to have control over its own oil industry, and an agreement was reached in 1975. A new era of Kuwait's economy began with the nationalisation of the oil industry, and with it the country gained total control over the economy and had a massive income that made Kuwait extremely wealthy. Thanks mainly to oil revenues, Kuwait has one of the highest per capita incomes in the world.

2.3 Dependence on Oil

The discovery of oil transformed Kuwait within years from being a trade-dependent state into a modern country. Benefiting from the rise of oil prices, Kuwait has been one of the fastest-growing countries in the world over the past decades. The citizens of Kuwait enjoy numerous services, including education, medical care, housing and social security, all of which are available because of the egalitarian economy that was created after the discovery of oil. Hence, it is safe to assume that the state has used the oil wealth positively to benefit the citizens.

Kubursi (2014) indicates that "were oil supplies everlasting, and the demand for oil strong and continuous, economic diversification would be pointless" and that "the governments of the region would instead need only to ensure the distribution of oil revenues among the population". Nevertheless, in reality, oil reserves are not infinite, and the demand for oil is volatile. That is why diversifying the economy is a critical issue in Kuwait.

The extent of the dependency on oil in the economy of Kuwait is illustrated by the following measures: (i) percentage of oil GDP; (ii) percentage of oil revenue; and (iii) percentage of oil exports.

Table 2.1: Measures of Dependence on Oil

Measure	Average
Percentage of Oil GDP	48.58%
Percentage of Oil Revenue	90.67%
Percentage of Oil Exports	92.86%

Table 2.1 shows the measure of oil dependence for the period 1995-2017. Kuwait has an average of 48.58% Oil GDP, which shows that almost half of the country's GDP is generated by the oil sector. The average oil revenue for the period 1995-2017 is 90.67%, and the average percentage of oil exports is 92.86%. It is clear that the country is entirely dependent on oil, and that it is in need to diversify its economy.

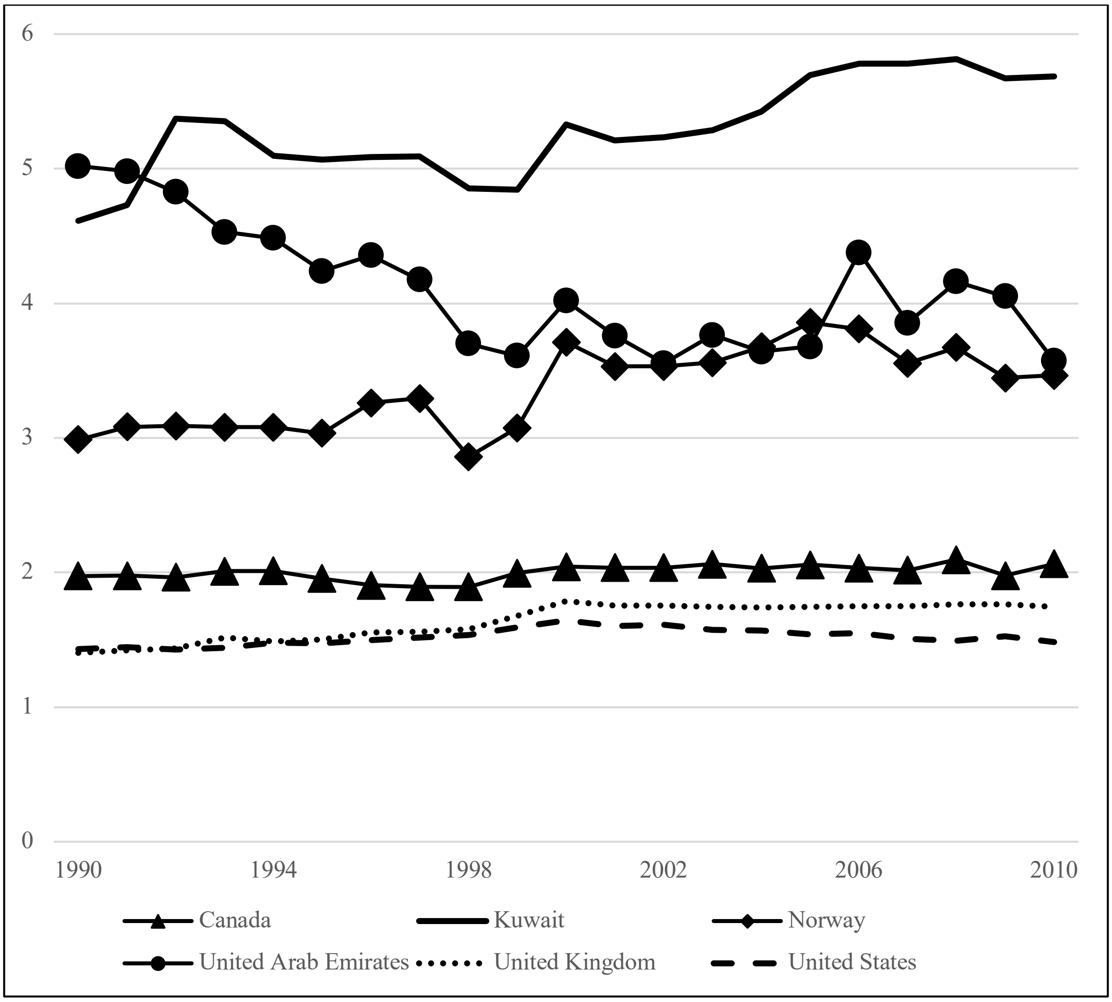
Callen et al. (2014), Papageorgiou and Spatafora (2012), and Lederman and Maloney (2012) indicate that economic diversification is associated with sustained economic growth. Love (1986) concludes that there is a strong positive association between the diversification of output and exports with higher GDP per capita and lower volatility. Furthermore, according to Henn et al. (2017), higher income levels are associated with improving export quality and sophistication. Kuwait needs to diversify the economy because diversification makes the country less dependent on oil revenues and enables the establishment of a non-oil economy that will be needed when there is a slump in oil prices or when oil reserves are exhausted.

Since the release of the first long-term economic plan in 1967, diversification has been a key objective, along with investing in human capital and the distribution of income. The volatility of oil prices keeps the country at the risk of getting economic challenges, as fluctuations in oil prices can have a dramatic effect on the economy because oil revenues and prices determine GDP and the budget surplus/deficit. For Kuwait to have a more stable economy, the global oil market must be stable. According to Al-Ojayan (2016), Kuwait must come up with a plan to minimise the uncertainties and volatilities caused by relying on oil revenues to fund government activities.

Export diversification has been very limited for a long time. During the study period, the average oil exports to total exports ratio in Kuwait is 92.86%. The economy relies on oil exports as the primary source of fiscal revenues. According to Al-Ojayan (2016), the International Monetary Fund export diversification index shows that Kuwait is one of the lowest-ranked oil-exporting countries. Figure 2.1 displays the export diversification index for Kuwait and other oil-exporting countries.

In Kuwait, the government is the dominant force in the economy. After receiving oil revenues, the government redistributes it to the citizens. A significant share of the revenues is allocated to provide citizens with public sector jobs, investment in the country's infrastructure, and maintaining the welfare system, whereas the rest is transferred to the saving funds. The main issue in this regard is that it is becoming gradually expensive for the government to employ citizens in the public sector.

Figure 2.1: IMF Export Diversification Index



The government wage bill as a percentage of GDP has been increasing over the years. Moreover, it is projected that the labour force will grow in the coming years, which will make it difficult for the government to employ new entrants—this is predicted to cause an increase in the unemployment rate. According to Callen et al. (2014), when oil revenues decline, the government will not be able to support the economy as the increasing number of citizens employed in the public sector will consume a larger portion of oil revenues, leaving less for public investments and future generations.

2.4 Economic Growth

The growth model of Kuwait has made huge enhancements in living standards and welfare for the citizens of Kuwait. However, this model is draining Kuwait's public budget. Public-sector salaries represent a relatively high percentage of government expenditure, and the subsidisation of essential goods is depleting the budget. The government of Kuwait has been calling for economic reform for a very long time—these calls encounter strong opposition from members of parliament and the public. Many believe that this opposition is caused by the citizens getting used to having a lavish welfare system that provides "cradle-to-grave" care for them.

The dramatic increase in oil prices has led to significant growth in Kuwait's GDP during the period 1995-2017. In 1995, Kuwait's GDP at current prices was KD7925.3 million when the oil price was $16.86 per barrel, whereas in 2016, GDP was estimated to be KD36260.70 million when the oil price was $40.68. This indicated that between the years 1995 and 2017, Kuwait's GDP grew at 7.11%, whereas oil prices rose at an average rate of 4.28%. The range for the average annual OPEC basket price during the study period is $16.86-$109.45. According to Moosa (1986a, 1986c), the volatility of Kuwait's GDP is due to the fluctuations in the oil sector which are triggered by external factors. Figure 2.2 and Figure 2.3 show the average annual OPEC crude oil price from 1995 to 2017 and the percentage change in GDP and oil prices respectively.

According to Hoque and Al-Mutairi (1996), the growth of nominal GDP is caused by the increase in the oil revenues, and the rise in oil prices has led to a growth in the demand for imports, expatriate labour force, and assets held overseas. This has made the economy of Kuwait highly dependent on exogenous factors such as oil revenues, expatriate labour force, investment income, and imports.

Figure 2.2: Average Annual OPEC Crude Oil Price from 1995 to 2017

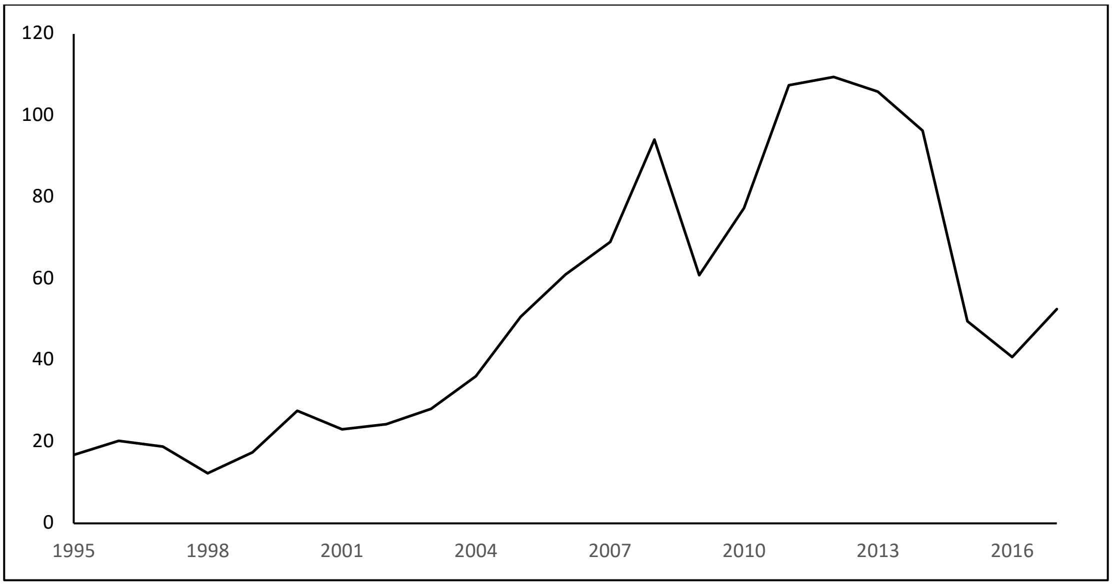
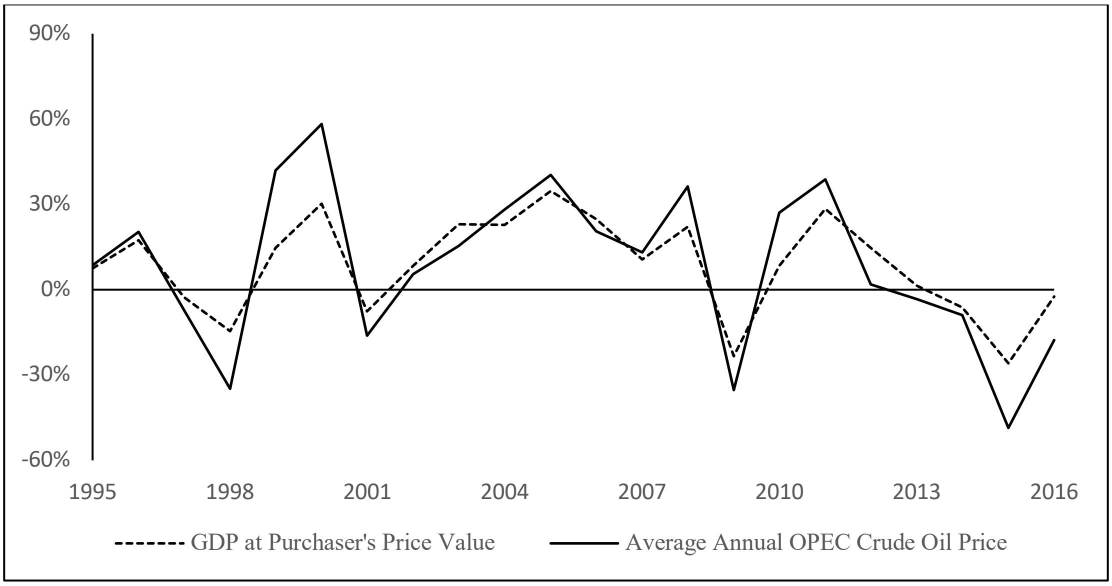


Figure 2.3: Percentage Change in GDP and Oil Prices



Eltony (2007) argues that to keep the economy going, oil revenue is crucial and instrumental. However, it is not under the control of the government of Kuwait because the oil market is constantly affected by international developments. On the other hand, the non-oil sectors depend on government expenditure and subsidies. Therefore, the government of Kuwait plays a dominant role in determining the level of economic activity and the rate of growth (or contraction) in non-oil sectors.

2.5 Public Finance

The economy of Kuwait is heavily dependent on the oil industry. Moreover, oil revenues are the primary source of government revenues. High oil revenues facilitated a rapid increase in public expenditure, which in turn created modern infrastructure and public services. The operation and maintenance of the infrastructure and other avenues of public expenditure, financed by oil revenues, created an ever-increasing budget. Accordingly, the government of Kuwait needs increasingly more revenues to sustain the growth of expenditure.

Public revenues are divided into tax revenues and non-tax revenues. Tax revenues include a tax on net income and profit, taxes and duties on properties, entry and registration fees, and taxes on international trade and transactions. The non-tax revenues include oil revenues, operating revenues of government enterprises, the sale of government properties, and other revenues. After exporting the first oil shipment in 1946, Kuwait became highly dependent on oil revenues. In the last two decades, oil revenues comprised nearly ninety per cent of total revenues, with the remaining contributions coming from the other revenue items. Kuwait's dependence on oil means that the only way for revenues to increase is to increase the oil price, which is not under the control of the government. As a result of oil addiction, the state became more and more reliant on oil revenues to finance growing expenditure.

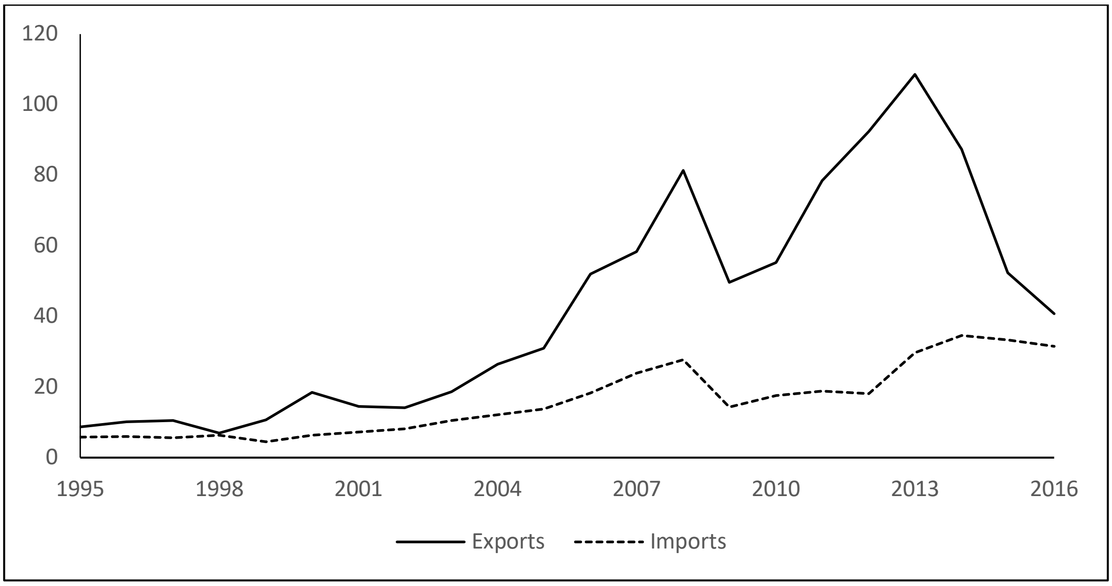
The expenditure items are divided into current, capital, construction, land acquisition, and other expenditures. Current expenditure includes consumption expenditure and transfer payments. The largest item of current expenditure is consumption expenditure, which includes the purchase of goods and services, and the payment of wages and salaries. The government of Kuwait is the largest employer in the economy, as the vast majority of the labour force is employed in the public sector mainly because the government is required by law to employ the citizens of Kuwait. Consequently, the government is stuck with a hefty bill to pay, a bill that goes up over time.

2.6 Foreign Trade

Kuwait depends heavily on international trade—according to the World Trade Organization, Kuwait had a trade-to-GDP ratio of 95% in 2016. Imports have increased slowly but steadily over the years. On the other hand, exports had a staggering increase in the last two decades. The increase in trade over the years can be observed in Figure 2.4.

The increase in imports can be explained by the growth rate of the economy, which has led to an increase in private consumption demand in addition to the undertaking of huge projects in the country. Kuwait depends predominantly on the imports of consumer goods, food products, and semi-finished goods. The top import origins of Kuwait are China, the United States, the United Arab Emirates, Japan, Germany, Saudi Arabia, and India. According to the Central Statistical Bureau, the main products imported by Kuwait are vehicles and parts, agricultural and food products, as well as mechanical industrial products, electrical and electronic products.

Figure 2.4: Kuwait Imports and Exports in Billion USD



The massive increase in exports is a result of the increase in the global demand for oil. Kuwait exports 4.5% of the crude oil in the world and relies on oil exports as a major source of revenue for the country, to the extent that oil accounts for more than 90% of Kuwait's total exports. The top six export destinations of Kuwait are South Korea, China, India, Japan, Singapore, and the United States. According to the Central Statistical Bureau, the major exports of Kuwait are oil and chemicals.

2.7 The Labour Force

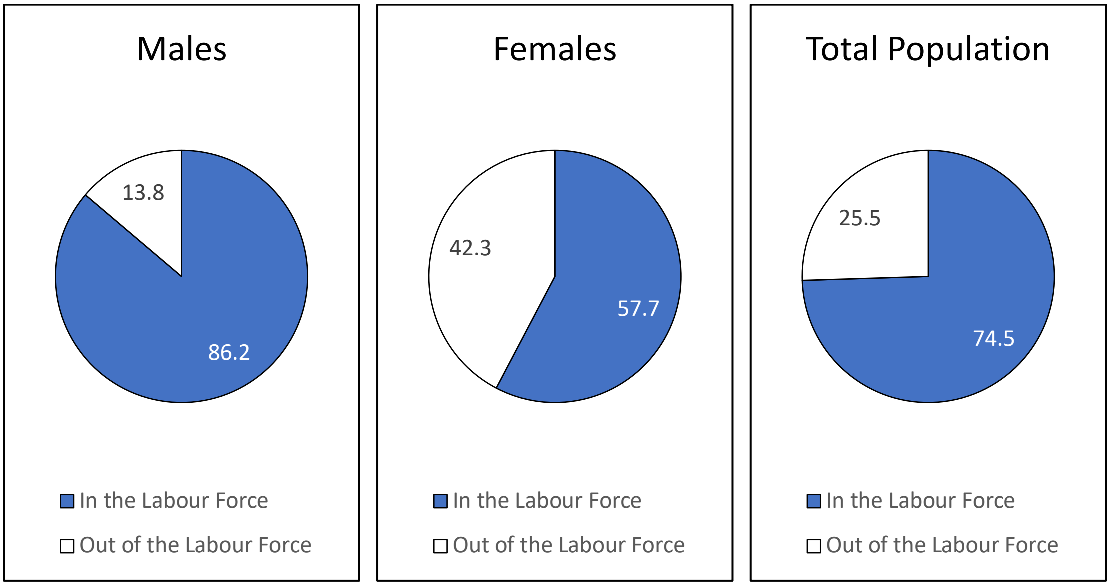
Economic growth in the last two decades has attracted an influx of expatriates to Kuwait, leading to an increase in the labour force by 262% in nearly two decades, from 745,000 in 1995 to 2.7 million in 2018. The rise of oil prices led to a period of rapid economic growth and increased spending on development programmes and projects. Accordingly, economic growth has created employment opportunities that attracted millions of expatriates to Kuwait.

The labour force to total population ratio increased from 47% in 1995 to 74.5% in 2015, while the percentage of citizens in the labour force in 2015 was 45.8%. In 2015, the percentage of females participating in the labour force was 57.7%. On the other hand, the percentage of males participating in the labour force was 86.2% while the highest participating age category in the labour force was 35-44 years with a participation rate of 89.3%. Rising education levels among females and the social changes in the country led to an increase in female participation in the labour force. The percentage of Kuwaiti females in the labour force increased from 29% in 1995 to 39.3% in 2015. The data show a smaller increase in the participation of citizens in the labour force compared to the larger increase in expatriates' participation over the years. Figure 2.5 shows the percentage of participation in the labour force.

The unemployment rate in Kuwait is relatively low compared to the rest of the world. The latest data show that the unemployment rate reached 2.08% in 2017, compared with 3.6% in 2011 and 1.5% in 2007. In 2015, the unemployment rate among nationals reached 4.7% with the rate of unemployment in Kuwaiti males at 4.2%, compared with 5.5% for Kuwaiti females. On the other hand, the unemployment rate among expatriates reached 1.8% in 2015 with 0.8% among males and 4.2% among females. It is believed that the unemployment rate among Kuwaiti males is nearly constant over the years, whereas the rate of unemployment amongst Kuwaiti females has increased over the years. Concerning the career orientation of the unemployed nationals, the data show that almost half of the unemployed nationals are not willing to take jobs in the private sector and that the other half accept any chance to work, regardless of whether the jobs are in the public sector or private sector.

Since the rate of unemployment for expatriates has always been smaller than the rate of nationals, the possibility for a foreigner to find an employment opportunity in the country is relatively high. This offers more incentive for new expatriates to come to Kuwait. Therefore, the population of expatriates will keep on increasing.

Figure 2.5: Participation in the Labour Force



The economy of Kuwait is heavily reliant on oil revenues, and government policies have led to a huge imbalance in the population and the labour force. The policies caused a massive rise in the number of foreign workers in the country, making nationals a minority in the population and the labour force. According to Merza (2007), while the policies were intended to redistribute wealth among the citizens, the government employment and wages policies have led to a dangerous imbalance between productivity and wages, resulting in the concentration of the domestic labour force in the public sector. Government spending became the driving force of economic activity, contributing to an imbalance in the population and the structure of the labour force.

2.8 The Social Welfare System

With the astonishing economic growth, the government implemented a social welfare system that can be described as providing the citizens of Kuwait "cradle-to-grave" care. Furthermore, it is safe to say that Kuwait has one of the highest standards of living in the world. In an effort to redistribute social wealth, the government created a social welfare system and focused on four primary services to provide for the citizens: (i) healthcare; (ii) education; (iii) housing; and (iv) employment.

The healthcare system in Kuwait is entirely funded by the government, in which treatment is provided free of charge for all citizens. While some of the more developed countries are still struggling with structuring their healthcare systems, the citizens of Kuwait enjoy the free healthcare provided by the government. Although the system is not perfect, it is far better than what some of the more developed countries offer. The healthcare system is divided into three main categories: (i) public clinics; (ii) public hospitals; and (iii) specialist hospitals. It is worth noting that the patients are not charged for any pharmaceuticals obtained from pharmacies in the hospitals and clinics with a valid prescription from a healthcare provider.

The government allocates a huge budget for education, resulting in an increase in adult literacy rate from 59.6% in 1975 to 96.1% in 2016 while the youth literacy rate increased from 72.2% in 1975 to 99.5% in 2016. Furthermore, Kuwait has one of the highest literacy rates in the region. Education is free and compulsory, starting from kindergarten to high school, covering students between the ages of 4 and 18 years. Kuwait also gives importance to higher education. After graduating from high school, the students are encouraged to continue their education either by enrolling at Kuwait

University, which was founded in 1966, or by joining other higher education institutions in the country. Furthermore, scholarship programmes for studying abroad are available for qualified students, including many benefits such as full tuition cover and other financial benefits.

The government of Kuwait focused on the housing welfare of the citizens from 1954 when the first urban and housing policy was announced. The state started housing welfare by providing housing for low-income families. Later on, the housing responsibilities of the government expanded to include planning, organising and developing new residential areas, cities, and governorates. The Credit Bank was established in 1960 to manage the real estate, industrial and agricultural loans to citizens, and to provide credit to public-sector employees as guaranteed by their salaries or end of service benefits.

According to the constitution of Kuwait, the state is obligated to hire the citizens in the public sector because part of the welfare system in Kuwait is guaranteeing employment opportunities to the citizens by the government. After graduating, the citizens apply in the Civil Service Commission, which handles finding vacancies in the public sector and assigning new graduates to the available jobs.

2.9 The Monetary Sector

The monetary history of Kuwait started in 1942 when the British Bank of the Middle East (BBME), or as it was recognised back then the Imperial Bank of Iran, received a licence to operate in Kuwait. The first domestic bank to operate in Kuwait is the National Bank of Kuwait (NBK) which was established in 1952. Prior to 1959 the official currency was the Indian rupee, which was pegged to the British Pound. In fact, all of the British protectorates of the Arabian Gulf used the Indian rupee before issuing their own currencies. In Kuwait, the Indian rupee was obtained by selling the British pound to the Reserve Bank of India. Furthermore, the rupee was pegged to the pound at a rate of 13.33 rupees for one pound. In 1959, the government of India introduced the Gulf rupee, which was at par with the Indian rupee at first, as a substitute for the Indian rupee for circulation only outside India. However, the Gulf rupee was devaluated against the Indian rupee in 1966.

The government of Kuwait comprehended the significance of having an independent monetary sector. The Amiri decree no. 41 of 1960 marked the beginning of a new era in Kuwait. The decree introduced the national currency, the Kuwaiti dinar, which replaced the rupee and instated a currency board responsible for issuing banknotes and coins. The first series of the Kuwaiti dinar started circulation in April 1961, and the value of the dinar was initially equivalent to one British pound, which was equal to 2.48 grams of pure gold. Initially, the currency was backed by 50% gold and 50% foreign currencies convertible into gold.

The Amiri decree no. 32 of 1968 replaced the currency board with the Central Bank of Kuwait, which was inaugurated in April 1969. The creation of the central bank was significant at that time to keep up with the local and global developments in the monetary sector and to contribute to the development of socioeconomic factors in Kuwait. Unlike the currency board, which was only responsible for issuing the currency, the central bank is in charge of more responsibilities such as: (i) setting and implementing monetary policy, (ii) regulating and supervising the baking sector, (iii) maintaining the stability of the currency, (vi) directing credit policy, (v) acting as a financial advisor to the government, and (vi) being the lender of last resort to the banks.

Furthermore, the decree changed the composition of the required reserves to back the currency. Instead of having 50% backed by gold and the other 50% backed by only foreign currency convertible into gold, the new required reserves can include financial papers guaranteed by the government, bonds, and commercial papers discounter by the central bank. However, the Amiri decree no. 130 of 1977 amended the composition of the required reserves to back the currency by having no exact percentage allocated to gold.

The Credit Bank, established in 1960, was the first specialised bank to operate in Kuwait. The bank was founded to facilitate real estate, industrial and agricultural credit for citizens in addition to lending state employees. In 1973, two specialised banks were founded: (i) the Industrial Bank of Kuwait (IBK); and (ii) Kuwait Real Estate Bank (KREB). The Industrial Bank of Kuwait was the first specialised bank to finance and support industrial development in Kuwait. On the other hand, the Kuwait Real Estate Bank was a specialised bank that focused on facilitating real estate credit.

In 1977 the Kuwait Finance House (KFH) was established as the first Islamic bank to operate in the country. Following the establishment of the Kuwait Finance House, the demand for banking services based on Islamic finance increased. However, the central bank banned commercial banks from providing any services based on Islamic finance. The high demand for Islamic banks has led to the establishment of new Islamic banks and the conversion of commercial banks and specialised banks into Islamic banks in Kuwait.

The monetary sector also includes other financial institutions besides banks such as finance companies, conventional and Islamic investment companies, and foreign exchange companies. Currently, there are twenty-three conventional investment companies, thirty Islamic investment companies, and forty exchange companies operating under the supervision of the central bank. These companies, in addition to the banks, play a significant role in the development of the monetary sector.

From the mid-1940s to the early 1970s Kuwait enjoyed a period of significant economic and monetary growth. The 1980s brought up some challenges, such as the stock market crash (Souk Al-Manakh crash) and several geopolitical problems. The stock market crash of 1982 affected Kuwait's financial and monetary sectors, and the entire economy was badly shaken by the crash. However, the authorities attempted to resolve the situation by implementing a complicated set of policies and creating the Difficult Credit Facilities Resettlement Program.

Moreover, the 1990s had the most difficult challenges for Kuwait as the decade started with the Iraqi invasion in August 1990, which lasted seven months until February 1991. During the invasion, the Iraqi dinar replaced the Kuwaiti dinar as the official currency of Kuwait. Furthermore, a massive number of Kuwaiti dinar banknotes were taken by the Iraqi forces. After the liberation in 1991, the Kuwaiti dinar was reinstated as the official currency and the central bank issued a new banknote series which allowed for the stolen bills during the invasion to be demonetised.

In the mid-1990s, Kuwait recovered from the effects of the Iraqi invasion and thrived throughout the mid-2000s. In 2008, the global financial crisis affected Kuwait like most of the world. Nevertheless, the central bank succeeded in steering the monetary system away from pitfalls and risks. Currently, the monetary sector is considered as one of the fastest-growing in the GCC. There are ten domestic banks in Kuwait, five of which are commercial banks and the other five are Islamic banks. Furthermore, ten foreign banks operate in the country and one specialised bank operates under the supervision of the Central Bank of Kuwait.

2.10 New Kuwait

Throughout previous decades, the government relied on oil revenues to fund government spending. Relying solely on oil revenues is a huge risk that the government is no longer willing to take, which is why the general secretariat of the Supreme Council for Planning and Development published the long-term plan, called the State Vision Kuwait 2035 or "New Kuwait".

The objective of the State Vision Kuwait 2035 plan is to turn Kuwait into a regional trade and financial hub for the northern Gulf through economic development, diversify the economy, and boost GDP. In order to fulfil these objectives, the government will invest in the following: (i) building a new business hub; (ii) the construction of a major deep-sea container port; (iii) building a new railway and metro systems; (iv) creating new cities to host the increase in population; and (v) improving the infrastructure and services, particularly within the health and education sectors. According to Hvidt (2013), the government acknowledges the need to reform the legislative and institutional system in the country and includes a list of amendments that must be introduced. Several policies and laws need amendment or creation in order to facilitate the implementation of the plan. One of the main objectives of the amendments is to attract domestic and foreign private investors.

The success of the plan will be measured by monitoring twenty international indicators and sub-indicators. This step will help in tracking the progress of the plan and measuring performance compared to other countries. The international indicator rank is out of a percentile of one hundred, one is the top of the rankings and one hundred is the bottom. The objective is to reach a position in all indicators within the top thirty-five per cent of countries by 2035.

2.11 Summary

Kuwait started as a trade-based country with limited resources and no welfare system. Now it is a small but wealthy country, ranked as the fifteenth richest in the world by income per capita. The latest census shows that 4.5 million people are living in Kuwait, of whom approximately 3.1 million are non-nationals and 1.4 are Kuwaiti nationals. Oil accounts for nearly half of the country’s GDP, about 90 % of the export revenues, and more than 90% of government income.

The economy of Kuwait depends heavily on international trade, where oil exports bring in more than 90% of the revenues, and the trade-to-GDP ratio was 94.6% in 2016. The increase in imports can be attributed to the increase in private consumption demand in addition to the undertaking of huge projects. Moreover, the staggering increase of exports is caused by the global demand for oil, particularly from Asian countries. The labour force is comprised of mostly foreign workers, which increased by 262% in the last two decades because of the high growth rate and economic expansion. The unemployment rate in the country is relatively low compared to the rest of the world, as the latest available data show the unemployment rate reaching nearly 2% in 2017.

The Kuwaitis enjoy one of the most lavish social welfare systems in the world. It provides them with many benefits including free healthcare, access to public employment programmes, the stability of public service prices, relatively low prices of essential products, residential lands at low prices, interest-free mortgages to home buyers, and free education and scholarships for higher education degrees.

The government of Kuwait realises that it cannot continue to depend on oil exports exclusively as the major source of revenues. This is why they are trying to restructure the economy by following the new long-term economic plan set by the general secretariat of the Supreme Council for Planning and Development, called the State Vision Kuwait 2035 or “New Kuwait”. The main objective of the plan is to turn Kuwait into a regional trade and financial hub for the northern Gulf through economic development, diversification and GDP growth. It can be seen as a significant step in the right direction for Kuwait.

CHAPTER 3

THE MONEY-INCOME RELATION

3.1 Introduction

The objective of this chapter is to examine the money-income relation and find the most appropriate definition of money. The relation between selected monetary aggregates and output is investigated to determine if the money supply has any influence on economic activity. The empirical analysis includes a unit root test to examine the stationarity of the data, cointegration tests to investigate the presence of a long-run relation between money and income, and causality testing to reveal the direction and detect feedback, if any.

The chapter is divided into six sections, the first of which is an introduction, whereas section two is an empirical literature review. Section three looks at the sample data, and section four is concerned with the monetary aggregates and economic activity. Section five is dedicated to the empirical analysis of the data, and section six contains a summary and concluding remarks. The results of the empirical work presented in this chapter will be useful for the specification of the structural model later on.

3.2 Literature Review

The relation between money and economic activity has been the focus of academics as well as policy-makers for decades because it is considered to be one of the most critical topics in monetary economics. It is crucial for policy-makers to understand the relation between money and output in the economy. The monetary authorities have some control over the money stock—therefore, if changes in the money stock cause changes in economic activity, the monetary authorities can stimulate production by manipulating the money stock (by changing the monetary base or the reserve ratio). However, if changes in the money stock do not have any effect on economic activity, then stimulating production through the money stock will only lead to inflation. Goldfeld (1989) argues that the relation between the demand for money and its determinants is a fundamental building block in macroeconomic theories and a critical component in implementing monetary policy.

Keynesians and monetarist are not in agreement when it comes to the money-income relation. The advocates of the quantity theory of money claim that the money supply is exogenous. The Keynesians argue that because of the low investment elasticity of interest and liquidity trap, money does not play any significant role in changing income. Moreover, Keynesians believe that an increase in income will cause an increase in the demand for money, which will lead to an increase in the money supply. On the other hand, the monetarists argue that there is a causal relation between money and income and that causality runs from money to income.

Friedman and Schwartz (1963a, 1963b) brought the topic into the spotlight by revealing a positive correlation between the money supply and real output in the US economy. Moreover, they proposed that changes in the money supply matter for the management of changes in nominal income. In his theoretical framework for monetary analysis, Friedman (1970) proposed that describing money as "all that matters for changes in nominal income and for short-run changes in real income" is an exaggerated statement. However, Friedman and Kuttner (1992) tested the relation between money, income, prices and interest rate in the US by including post-1980 data compared to earlier studies of Friedman. They claim that the relationship between money and income weakened after including post-1980 data in the sample. Other studies that found evidence of money leading the real sector include Sheppard (1973), and Davis and Lewis (1977). A recent study by Evans (2019) examined the relation between money, output and price level in Nigeria and South Africa by using a data set for the period 1970-2016. The empirical analysis revealed that money growth affects output in the short run but not in the long-run, which supports the monetarist view.

Cagan (1965) suggested that in the short run, the money stock is determined by changes in the real sector and that in the long run, changes in the money stock are not affected by changes in the real sector. The first empirical study on the causal relation between money and income was conducted by Sims (1972) who applied the Granger (1969) causality test to the US post-war data to find the direction of causality between money and income. The empirical findings confirm the monetarist view that causality runs from money to income. On the other hand, the Keynesian view that causality is unidirectional from income to money is rejected. However, when Williams et al. (1976) tested the causal relation between money and income in the UK, they found that causality runs from income to money, which supports the Keynesian view.

Portes and Santorum (1987) examined the relation between money and other macroeconomic variables in China by using a data set covering the period 1954 to 1983. The empirical results revealed that $M2$ causes real income and that real income causes $M2$, implying that causality between real income and money, defined as the monetary aggregate $M2$, is bidirectional. Moreover, Chen (1989) examined the causal relation between three monetary aggregates and four indicators of macroeconomic performance in China by using a data set covering the period from 1981 to 1985 and found bidirectional causality between currency in circulation and nominal income. Other studies also found that causality between money and income runs in both directions, including Lee and Li (1983), Joshi and Joshi (1985), and Bednarik (2010).

Abbas (1991) examined the relation between money and income in five developing countries.[1] The empirical results show that causality between $M2$ and income is bidirectional in Pakistan and that it is bidirectional between $M1$ and income in Malaysia (and also between $M2$ and income). In Korea, causality is unidirectional and runs from income to $M2$. In the Indian economy, causality is unidirectional and runs from $M1$ to income. In Thailand, causality is bidirectional between $M1$ and income and also between $M2$ and income. No explanation is presented for cross-country differences in the results.

Friedman (1997) examined the role of money growth in explaining fluctuations of output in the US. He revealed that the predictive power of the narrow and broad monetary aggregates deteriorated in the 1990s to become nearly non-existent. Correspondingly, Chandra and Tallman (1997) found that monetary aggregates do not contain any significant information for predicting fluctuations in output in Australia.

A study of Granger causality from money to output was conducted by Hayo (1999b) on fourteen European Union countries in addition to Japan, the US and Canada by using data from the 1960s to mid-1990s. The results revealed that the results of

[1] Pakistan, Malaysia, Korea, India, and Thailand

Granger causality tests were robust with respect to different variables, time periods and countries. The empirical findings revealed that causality is unidirectional in the case of Canada and the US, running from output to money, and bidirectional in Spain and Australia. He stated that there was no support for general statements regarding the causal relation between money and output and that the findings differ depending on the choice of monetary aggregate, country, and time period. These are the typical "mixed bag" results found in empirical studies like these.

Husain and Abbas (2010) investigate the causal relation between money (defined as $M2$) and income in Pakistan by using a data set covering the period 1959 to 2004. In their empirical analysis, they utilise the Granger causality test to examine the direction of causality between money and income. They also employed cointegration analysis to investigate the presence of a long-term relation. The results reveal that causality runs unidirectionally from income to money. Additionally, the cointegration results indicate the presence of a long-run relation between money and income. A more recent study by Jalles (2019) investigates the relation between several monetary aggregates and output in Portugal over the period 1911 to 1999. Cointegration analysis reveals that monetary aggregates and real GDP are cointegrated, implying that they have a stable long-run relation. Moreover, the Granger causality test indicates that causality runs from the money supply to real GDP.

In summary, the empirical literature on the money-income relation comprises several studies covering many countries and time periods. These studies provide mixed results on the direction of causality between the money supply and income. The results of cointegration analysis differ since some studies indicate the presence of a long-run relation between money and income, whereas others do not. Some economists argue that causality and cointegration results are sensitive to the data sample and the choice of the monetary aggregate.

Nevertheless, academics and policy-makers have always been concerned with finding the best definition of money, examining the presence of a stable long-run relation between money and income, and investigating the potential influence of money supply on output. The monetary authorities are concerned with the money-income relation because it has implications for the conduct of monetary policy. Furthermore, by understanding the causal relation between money and output, the monetary authorities can stimulate output by manipulating the money supply. Therefore, investigating the money-income relation in the economy of Kuwait should be of interest for both academics and policy-makers.

3.3 The Sample Data

The variables used in this chapter are selected in line with the relevant theory and previous empirical literature on the money-income relation. Quarterly time series observations, collected from Thomson Reuters DataStream and reports published by the Central Bank of Kuwait covering the time period from 1995 to 2017, are used in the empirical work. The time series included in the data set consist of 92 observations on the monetary aggregates and non-oil GDP. While most of the data series are available and reported quarterly, non-oil GDP is reported on an annual basis. Therefore, data for non-oil GDP was obtained by interpolating annual series because of the unavailability of quarterly figures.

The empirical work starts with deriving the monetary aggregates based on Friedman and Meiselman (1963) approach in the next section. The following step is expressing the variables as natural logarithms, followed by the univariate analysis of the variables to establish the time series properties. According to Granger and Newbold (1974), estimating time series models when nonstationarity might be present could lead to spurious regressions. In the next step we will test for cointegration between the variables by utilising the following methods: (i) the Engle-Granger two-step method; (ii) autoregressive-distributed lag (ARDL) with error correction; and (iii) the Johansen cointegration test. After examining the presence of cointegration between the monetary aggregates and non-oil GDP, we will test for causality by using the Granger (1969) causality test. In the last empirical part of this chapter, the predictive power of the model is tested by performing out-of-sample forecasting. Forecasting accuracy will be evaluated by (i) calculating several measures of predictive accuracy, (ii) testing the forecasts relative to the random walk, and (iii) measuring the direction accuracy of the forecasts.

3.4 Monetary Aggregates and Economic Activity

The money stock, or money supply, is defined as the full amount of money available in a specific economy at a certain point in time. The theoretical definition of money is based on the functions of money, which means that money is an asset that serves as a unit of account, a medium of exchange, and a store of value. However, many financial assets are highly liquid and can be easily converted into cash. The inclusion of these assets in the money stock has caused an enormous amount of disagreement among economists over what should be included when measuring the money stock.

In Kuwait, four different types of monetary aggregates are used to measure the money supply: $M0$, $M1$, $M2$, and $M3$. According to the Central Bank of Kuwait (2015), the monetary base $M0$ contains currency in circulation and local banks' deposits held at the central bank. The narrow definition of money $M1$ is composed of currency in circulation and sight deposits. Quasi-money is composed of savings deposits, time deposits, foreign currency deposits, and CDs. The broad definition of money $M2$ includes $M1$ and quasi-money. The broader definition of money $M3$ includes $M2$ and private sector deposits with deposit-accepting finance and investment companies.

We adopt different definitions for the monetary aggregates from those used by the Central bank of Kuwait. We follow Friedman and Meiselman (1963) approach for defining monetary aggregates by adding sequentially one asset at a time. Using this approach has several advantages over the monetary aggregates defined by the Central Bank of Kuwait. Since the monetary aggregates contain both interest-bearing and non-interest-bearing assets, these assets are affected differently by changes in income. Using Friedman and Meiselman (1963) approach could reveal more about the relation between money and income than using the monetary aggregate reported by the Central Bank of Kuwait.

The monetary aggregates are calculated based on the following equations:

$$M1 = C + D \tag{3.1}$$

$$M1A = M1 + S \tag{3.2}$$

$$M1B = M1A + TD + CD \tag{3.3}$$

$$M2 = M1B + F \tag{3.4}$$

$$M2A = M2 + G \tag{3.5}$$

$$M3 = M2A + P \tag{3.6}$$

where C is currency in circulation, D denotes demand deposits, S represents saving deposits, TD is time deposits, CD denotes certificates of deposit, F represents foreign currency deposits, G is government deposits in banks and deposit-accepting financial companies, and P represents private sector deposits with the deposit accepting finance and investment companies.

There are many measures of economic activity, such as GDP and GNP, but these aggregates do not provide a good measure of economic activity in oil-producing countries. Crockett and Evans (1980) argue that even though it is common to use GDP as a measure of output, it is not suitable for oil-exporting countries where the oil sector dominates the GDP. The oil sector does not provide an accurate measure of economic activity in the economy of oil-exporting countries because external factors determine oil production and prices. In the case of Kuwait, the number of oil barrels produced per day is determined by OPEC. Additionally, the price of oil and the value of the US dollar are determined by the global market. All of these factors are not under the control of the government of Kuwait. Therefore, the best measure of economic activity in Kuwait is non-oil GDP.

3.5 Methodology

This section illustrates the methodology used for investigating the relationship between the monetary aggregates and economic activity (represented by non-oil GDP). In order to investigate the money-income relation, the empirical analysis includes four steps: (i) examining the order of integration of the variables, (ii) investigating the existence of a long-run stable relation between the monetary aggregates and economic activity, (iii) causality testing to determine the causal relation between the monetary aggregates and economic activity and to determine the direction of causality, and (iv) measuring the accuracy of out-of-sample forecasting.

The first step in the empirical analysis is the Friedman and Meiselman (1963) dual criteria for choosing the most appropriate monetary aggregate. The second step is testing the stationarity of the time series, which is based on the Dickey and Fuller (1979, 1981) ADF unit root test. The third step is a bivariate cointegration analysis between the monetary aggregates and non-oil GDP, which is based on the following tests: (i) the Engle and Granger (1987) cointegration test, (ii) the autoregressive-distributed lag (ARDL) and error correction cointegration test developed by Pesaran and Shin (1996) and Pesaran et al. (2001), and (iii) the Johansen (1988, 1991) test. The fourth step is testing for causality based on the Granger (1969) causality test. The final step is testing the predictive power by using recursive regressions to generate out-of-sample forecasts. The next section presents the Friedman and Meiselman (1963) dual criteria for choosing the most appropriate monetary aggregate.

3.5.1 The Friedman-Meiselman Dual Criteria

There is no prevalent agreed-upon empirical definition of money because economists are not on the same page when it comes to what should be included in the money stock, particularly in the broad definitions, $M2$ and $M3$. Near money assets are highly liquid assets that can be easily converted into cash. However, there is a wide range of liquidity in these assets, which is one of the crucial issues that economists are in disagreement on with respect to the selection of assets that should be included in the money stock. Throughout the years, economists attempted to develop an empirical definition of money by applying different methodologies, producing, according to Kaufman (1969) and Koot (1975), widely different empirical definitions.

One of the earliest attempts to define money empirically was that of Friedman and Meiselman (1963). In this empirical approach, which is referred to as F-M dual criteria, they used correlation analysis of monetary aggregates, near money assets and income. The basic idea is to use two criteria to choose the financial near-money assets to be included in the money stock. The first criterion is that an asset Z must be included in the money stock if $M1 + Z$ has a higher correlation with income than $M1$. The second criterion is that $M1 + Z$ has a higher correlation with income than Z. It is worth noting that the second criterion was added to make sure that the increase in correlation is caused by adding the asset Z and not to the correlation between income and that asset. Formally, an asset must be included in the money stock if

$$corr(M + Z, Y) > corr(M, Y) \tag{3.7}$$

and

$$corr(M + Z, Y) > corr(Z, Y) \tag{3.8}$$

where M is the monetary aggregate, Z represents a near-money asset, and Y denotes non-oil GDP.

Table 3.1 presents the correlation coefficients between monetary aggregates, near money assets, and income represented by non-oil GDP. From Table 3.1 it can be seen that the best definition of money according to the F-M dual criteria is $M1B$, which include currency in circulation, sight deposits, saving deposits, time deposits and CDs. According to Koot (1975), many studies have shown that the F-M dual criteria test does not give consistently the same monetary aggregate as the best definition of money and that the definition changes from period to period.

Table 3.1: Correlation Coefficients of Monetary Aggregates and Near Money Assets

Monetary Aggregates / Near Money Assets	Correlation Coefficient
Currency in Circulation	0.9080
Sight Deposits	0.9568
M1	0.9522
Saving Deposits	0.9403
M1A	0.9504
Time Deposits and CDs	0.9660
M1B	0.9694
Foreign Deposits	0.8743
M2	0.9691
Government Deposits	0.9349
M2A	0.9653
Deposits with Financial Institutions	0.1400
M3	0.9652

3.5.2 Unit Root Test

It is essential to determine if a time series is a stationary or non-stationary process. According to Granger and Newbold (1974), estimating time series models when nonstationarity might be present could lead to spurious regressions. A stationary time series has a constant long-term mean and a finite variance, which are assumptions implicit in regression methods. Testing for stationarity is based on the Dickey and Fuller (1981) ADF test. The following equation is used to conduct the ADF test:

$$\Delta X_t = \alpha_0 + \alpha_1 X_{t-1} + \sum_{i=1}^{m} \beta_i \Delta X_{t-i} + \varepsilon_t \tag{3.9}$$

where X_t is the variable under investigation, t is a time subscript, m is the number of lags, and ε_t is the error term. The null hypothesis of unit root is rejected by a significant test statistic (less than -2.89), implying that the variables are stationary.[2] The results of the Augmented Dickey-Fuller test at level and first difference are reported in Table 3.2.

Table 3.2: Augmented Dickey-Fuller Test Results in Level and First Difference

Variable	Level	First Difference
C	0.36	-4.14*
M1	-0.54	-3.55*
M1A	-0.51	-3.12*
M1B	-0.75	-5.26*
M2	-0.44	-5.14*
M2A	-0.51	-4.17*
M3	-0.52	-4.15*
Y	-0.95	-5.68*

* Statistically significant at 5% significance level

The order of the Augmented Dickey-Fuller test is the lowest possible rendering the residuals as white noise. Given that the critical value at level 5% is equal to -2.89 an examination of results in Table 3.2 reveals that all the variables are nonstationary in level and stationary in first difference. Therefore, the variables are all integrated of order 1 or I (1).

3.5.3 The Engle-Granger Cointegration Test

Having established the time series properties of the variables and observing that the variables are non-stationary in level and stationary in first difference, the next step is investigating the presence of a stable long-run relation (cointegration) between the monetary aggregates and economic activity (represented by non-oil GDP).

[2] The test statistic is the t value of the coefficient of the lagged value of *X*. The regression equation may be adjusted by including a deterministic time trend. One has to bear in mind that this equation may still be misspecified as it contains no moving average in term. Another problem is that the test cannot distinguish between a unit root and a near-unit root process.

Cointegration analysis can reveal if two correlated variables are linked by a long-run relation. The main idea in a cointegration analysis in time series is that the non-stationary variables that are integrated of the same order produce stationary linear combinations. On the other hand, correlated variables that are not cointegrated cannot produce stationary linear combinations. Cointegration analysis is used to distinguish between spurious and genuine correlations.

According to the Engle and Granger (1987) two-step method, if two variables (for example X_t and Y_t) are non-stationary and cointegrated a linear combination of these two variables must be stationary. The cointegration test is based on the following equation:

$$Y_t = \beta_0 + \beta_1 X_t + \varepsilon_t \qquad (3.10)$$

where Y_t is the dependent variable, X_t is the explanatory variable, and ε_t denotes the error term. Following the estimation of the cointegrating regression, the residuals are extracted and tested for stationarity by applying the Augmented Dickey-Fuller test. Consequently, X_t and Y_t are cointegrated if ε_t is stationary, I (0). The null hypothesis H_0 is that the variables are not cointegrated also means that the residuals are non-stationary. The results of the Engle-Granger cointegration test are presented in Table 3.3.

It is worth noting that all variables are expressed in natural logs. Given that the critical value at level 5% is equal to -3.41 the null hypothesis of no cointegration cannot be rejected for C, $M1$, $M1A$, $M1B$, $M2$, $M2A$, and $M3$. The Engle-Granger test results indicate the lack of a stable long-run relation between all of the monetary aggregates and non-oil GDP. However, this result cannot be accepted without scrutiny, and robustness must be established by using alternative tests.

Table 3.3: Engle-Granger Cointegration Test Results

Monetary Aggregates	ADF (ε_t)
C, Y	-1.69
M1, Y	-2.14
M1A, Y	-1.75
M1B, Y	-1.12
M2, Y	-1.33
M2A, Y	-1.24
M3, Y	-1.25

3.5.4 The Autoregressive-Distributed Lag (ARDL) and ECM Test

The bounds test, also known as the autoregressive-distributed lag (ARDL) cointegration test, was developed by Pesaran and Shin (1996, 1998, 2002) and Pesaran et al. (2001). It was intended to find long-term relations between variables that may assume different orders of integration. According to Nkoro and Uko (2016), this approach has three main advantages: (i) it does not require all variables to be integrated of the same order; (ii) it is more efficient compared to other methods when working with small samples; and (iii) it is easy to implement since it involves only one equation. Moosa (2017) argues that at one point in time it was considered essential that all the variables must be integrated of the same order to test for cointegration, but this is not a requirement of this test as it can be applied to systems containing I(0) and I(1) variables.

The F-statistic and W-statistic are used with this test, each of which has upper and lower critical values (bounds). If the test statistic is above the upper critical value (bound), the null hypothesis of no cointegration is rejected, which means that the variables are cointegrated. Conversely, when the test statistic is below the lower critical value, the null hypothesis of no cointegration cannot be rejected, which means that the variables are not cointegrated. It is worth noting that a test statistic between the upper and lower critical values indicates that the test is inconclusive. The distributions of the two test statistics are non-standard and must be computed by stochastic simulations. The critical values generated for a sample size of 500 and 20,000 replications are reported in Pesaran and Pesaran (2009) (tables B1 and B2).

According to Moosa (2017), if cointegration analysis confirms the presence of cointegration between the variables, the relation can be represented by a valid error correction model (this is actually the Granger representation theorem).[3] The EC model combines the short-term dynamics represented by first differences and the deviations from the long-term equilibrium relation, which is represented by the error correction term. The autoregressive-distributed lag model, the corresponding long-run relation, and the error correction model are specified as follows:

$$Y_t = \alpha + \sum_{i=1}^{M} \beta_i Y_{t-i} + \sum_{i=0}^{K} \gamma_i X_{t-i} + \varepsilon_t \tag{3.11}$$

$$Y_t = \alpha + \beta X_t + \varepsilon_t \tag{3.12}$$

$$\Delta Y_t = \alpha + \sum_{i=1}^{M} \beta_i \Delta Y_{t-i} + \sum_{i=0}^{K} \gamma_i \Delta X_{t-i} + \phi \varepsilon_{t-1} + v_t \tag{3.13}$$

where X_t, and Y_t are the variables under investigation, and ε_t along with v_t denote the error terms.

[3] For a discussion of the Granger representation theorem, see Hansen (2005), Archontakis (1998) and Ogaki (1998).

For a valid error correction model, the coefficient on the error correction term ϕ must be significantly negative. The results are presented in Table 3.4. Given that the upper 5% critical values for the F-statistic and W-statistic respectively are 5.9149 and 11.8297, the ARDL results indicate the presence of cointegration between the broad monetary aggregates $M2$, $M2A$, and $M3$, in addition to the narrow aggregate $M1B$, and non-oil GDP. Moreover, the error correction model indicates the presence of cointegration between all the monetary aggregates and non-oil GDP.

Table 3.4: Autoregressive-Distributed Lag and Error Correction Results

Monetary Aggregates	F	W	t($\boldsymbol{\phi}$)
C, Y	2.436	4.873	-2.336*
M1, Y	2.312	4.624	-2.844*
M1A, Y	1.802	3.605	-2.302*
M1B, Y	10.629*	21.259*	-4.217*
M2, Y	10.936*	21.873*	-4.157*
M2A, Y	15.545*	31.091*	-4.516*
M3, Y	16.002*	32.004*	-4.522*

* Statistically significant at 5% critical Value

3.5.5 The Johansen Cointegration Test

In this part, the estimation and testing of the cointegration vectors is done with the help of the Johansen (1988, 1991) technique, which has the following merits. First, the results are invariant with respect to the direction of normalisation, because all of the variables are considered to be endogenous. Secondly, it fully captures the underlying time series properties of the data. Thirdly, it provides estimates of all of the cointegrating vectors that exist within a system of variables and offers test statistics for their number. Finally, it allows direct hypothesis testing on the coefficients of the cointegrating vectors.

The following is a brief exposition of the Johansen technique. Starting with a multivariate vector autoregressive representation of n variables

$$X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + \Pi_k X_{t-k} + \varepsilon_t \tag{3.14}$$

where X_t, is $n \times 1$ vector of I(1) variables Π_1, Π_2,…., Π_k are $n \times n$ matrices of unknown parameters, and ε_t, is a vector of Gaussian error terms. Equation (3.14) can be re-parameterized as

$$\Delta X_t = \theta_1 \Delta X_{t-1} + \theta_2 \Delta X_{t-2} + \cdots + \theta_{k-1} \Delta_{t-k+1} - \Pi \Delta X_{t-k} + \varepsilon_t \tag{3.15}$$

where

$$\theta_i = -I + \Pi_1 + \Pi_2 + \cdots + \Pi_i \tag{3.16}$$

$$\Pi = I - \Pi_1 - \Pi_2 - \cdots - \Pi_k \tag{3.17}$$

Π is known as the cointegrating matrix with a rank r, such that $\Pi X_t = 0$ represents long-run equilibrium. Now define two × matrices, α and β such that

$$\Pi = \alpha\beta' \tag{3.18}$$

The Johansen procedure is used to estimate the VAR equation subject to the condition that Π is less than full rank matrix, i.e. $r < n$. It can be shown that

$$\beta_i' X_t \sim I(0) \tag{3.19}$$

where β_i' (the ith row of the β') is one of the r distinct, linearly independent cointegrating vectors. The procedure then boils down to testing for the value of r, the number of significant cointegrating vectors on the basis of the number of significant eigenvalues of Π. For this purpose, two test statistics are used: the maximum eigenvalue test (Max) and the trace test (Trace). The critical values of these test statistics are tabulated in Osterwald-Lenum (1990). The results of the Johansen test are presented in Table 3.5.

Table 3.5: Johansen Cointegration Test Results

Monetary Aggregates	Max		Trace	
	H_0: r =0	H_0: r ≤ 1	H_0: r =0	H_0: r ≤ 1
C, Y	19.32 *	5.65	24.98 *	5.66
M1, Y	21.76 *	4.05	25.77 *	4.01
M1A, Y	21.40 *	5.64	27.05 *	5.64
M1B, Y	18.55 *	6.11	24.66 *	6.11
M2, Y	19.41 *	3.01	22.41	3.01
M2A, Y	18.92 *	4.38	23.30	4.38
M3, Y	19.22 *	3.01	22.22	3.01

* Statistically significant at 5% critical Value

The 5% critical values for the eigenvalue are $r = 0$ (18.33) and $r \leq 1$ (11.54). The critical values for trace are $r = 0$ (23.83) and $r \leq 1$ (11.54). For the currency in circulation C, $M1$, $M1A$ and $M1B$, both the eigenvalue and trace reject the null hypothesis H_0: $r = 0$. However, for the monetary aggregates $M2$, $M2A$, and $M3$, the eigenvalue rejects the null hypothesis H_0: $r = 0$ while the trace does not reject the null hypothesis in this case. Testing for cointegration by using the Johansen procedure reveals that the null hypothesis of no cointegration is rejected for all of the monetary aggregates when the eigenvalue is used as a test statistic. However, the null hypothesis is rejected for four monetary aggregates when the trace test is used. One has to bear in mind that the Johansen test tends to over-reject the null of no cointegration and that it has other loopholes (see, for example, Moosa, 2017).

3.5.6 Causality Testing

To investigate causal relations between variables, a causality test was introduced by Granger (1969). In this section, we investigate the causal relations between monetary aggregates and economic activity (represented by non-oil GDP) and the feedback effect. Testing for causality from y to x and from x to y is based on the following equations, respectively: The Granger causality test is based on the following equations:

$$\Delta x_t = \alpha + \sum_{i=1}^{m} \beta_i \Delta x_{t-i} + \sum_{i=1}^{k} \gamma_i \Delta y_{t-i} + \varepsilon_t \quad (3.20)$$

$$\Delta y_t = \delta + \sum_{i=1}^{r} \theta_i \Delta y_{t-i} + \sum_{i=1}^{s} \rho_i \Delta x_{t-i} + \epsilon_t \quad (3.21)$$

where x and y denote the variables under investigation and m, k, r and s are the lag lengths. The null hypotheses $H_0: \gamma_i = 0 \ \forall_i$ and $H_0: \rho_i = 0 \ \forall_i$ are rejected if the value of the test statistic chi-square $\chi^2(4)$ is above the critical value.

Given that the critical value at level 5% for the chi-square $\chi^2(4)$ is 9.488 the results for the causality test from Table 3.6 shows the following:

- Causality runs in one direction from C to Y.
- $M1$ and Y are independent of each other.
- $M1A$ and Y are independent of each other.
- Causality runs in one direction from Y to $M1B$.
- Causality runs in one direction from Y to $M2$.
- Causality runs in one direction from Y to $M2A$.
- Causality runs in one direction from Y to $M3$.

The results of Granger causality test reveal that all broad monetary aggregates and the narrow aggregate $M1B$ have a causal relation with income. Moreover, the causal relation is unidirectional and runs from income to the monetary aggregates which supports the Keynesian view and contradicts the monetarists view since changes in the money supply does not Granger cause changes in output.

Table 3.6: Granger Causality Test Results

Monetary Aggregates	$Y \rightarrow X$	$X \rightarrow Y$
C, Y	1.39	0.48
M1, Y	6.11	2.09
M1A, Y	5.10	2.56
M1B, Y	11.30*	1.67
M2, Y	15.21*	1.49
M2A, Y	16.46*	2.80
M3, Y	16.34*	2.79

* Statistically significant at 5% critical value

3.5.7 Testing Predictive Power

Recursive regressions are used to generate out-of-sample forecasting. The forecasts are estimated by performing a recursive linear regression with an expanding window size. In the recursive method, all the available information is included because the window expands to include new observations when forecasts are generated. According to Stock and Watson (2003) and Pesaran et al. (2006), utilising all of the available information when generating forecasts enhances the predictive performance of the model. The next step is choosing the number of increments between consecutive recursive windows, such that if it is one period, the first recursive window contains observations for period 1 through m, the second contains observations for period 1 through $m + 1$, the third contains observations for period 1 through $m + 2$, and so on.

The following equation is used to generate the forecasts recursively:

$$Y_t = \beta_0 + \beta_1 M_t + \varepsilon_t \tag{3.22}$$

where Y_t is non-oil GDP, M_t represents any monetary aggregate, and ε_t denotes the error term.[4]

To quantify the accuracy of the generated predictions, measures of forecasting accuracy are calculated and tested relative to the random walk as a benchmark. The following statistics are used to measure the accuracy of the forecasts: (i) mean absolute error (*MAE*); (ii) mean square error (*MSE*); (iii) root mean square error (*RMSE*); (iv) random walk mean square error (*MSE RW*); (v) random walk root mean square error (*RMSE RW*); (vi) Theil's inequality coefficient (*U*); and (vii) direction accuracy (*D*). The following equations represent the measures of predictive accuracy listed above:

$$MAE = \frac{\sum_{t=1}^{n} |F_t - A_t|}{n} \tag{3.23}$$

$$MSE = \frac{\sum_{t=1}^{n} (F_t - A_t)^2}{n} \tag{3.24}$$

$$RMSE = \sqrt{MSE} = \sqrt{\frac{\sum_{t=1}^{n} (F_t - A_t)^2}{n}} \tag{3.25}$$

$$MSE\ RW = \frac{\sum_{t=1}^{n} (A_{t-i} - A_t)^2}{n} \tag{3.26}$$

$$RMSE\ RW = \sqrt{\frac{\sum_{t=1}^{n} (A_{t-i} - A_t)^2}{n}} \tag{3.27}$$

[4] The recursive (one-period ahead) forecasts were generated by using the recursive regression procedure in Microfit 5.0 where the value of *m* is selected by the program. For details, see Pesaran and Pesaran (2009) who provide an exposition of the econometrics and some tutorial lessons.

$$U = \frac{\sqrt{\frac{\sum_{t=1}^{n}(F_t - A_t)^2}{n}}}{\sqrt{\frac{\sum_{t=1}^{n}(A_{t-1} - A_t)^2}{n}}} \quad (3.28)$$

$$DA = \frac{1}{n}\sum_{t=1}^{n} \alpha_t \quad (3.29)$$

where F denotes the forecasts, A represents actual observations, and n is the number of forecasts. In equation (3.29), $\alpha_t = 1$ if $(A_{t+1} - A_t)(F_{t+1} - A_t) > 0$ and $\alpha_t = 0$ otherwise. In this setting, α is equal to one if the actual change and forecasted change have the same sign, and zero if the actual change and the forecasted change have different signs. Cheung et al. (2005) set a benchmark of 50% to judge the superiority of the forecasts over the random walk, but this is wrong because (by definition) the direction accuracy of the random walk is zero. The random walk always predicts no change.

The estimated measures of forecasting performance, which are presented in Table 3.7, indicate that $M1B$ and $M1$ have the lowest errors while C and $M3$ have the highest mean absolute error and mean square error.

Table 3.7: Measures of Forecasting Performance

Variable	MAE	MSE	$RMSE$	$MSE\ RW$	$RMSE\ RW$	U	DA
C	0.149	0.0399	0.199	0.0006	0.024	8.453	0.415
$M1$	0.092	0.0113	0.106	0.0006	0.024	4.504	0.416
$M1A$	0.095	0.0138	0.117	0.0006	0.024	4.973	0.483
$M1B$	0.088	0.0126	0.112	0.0006	0.024	4.745	0.561
$M2$	0.094	0.0141	0.118	0.0006	0.024	5.019	0.606
$M2A$	0.099	0.0155	0.124	0.0006	0.024	5.272	0.595
$M3$	0.100	0.0157	0.125	0.0006	0.024	5.294	0.584

When comparing the $RMSE$ of the forecasts to the $RMSE$ of the random walk the results show that the random walk always has a lower root mean square error. Theil's inequality coefficient for all the monetary aggregates and currency in circulation is more than one, meaning that the predictions are worse than those generated by the random walk when it comes to the magnitude of the error. The findings are in line with the Meese Rogoff puzzle, which will be discussed in more detail in chapter six. However, the direction accuracy for all the forecasts is more than 40%, which means that the equation has reasonable direction accuracy. The broad monetary aggregates perform better than the narrow monetary aggregates in predicting the change in direction. Moreover, $M2$ has the highest whereas C and $M1$ have the lowest direction accuracy.

To demonstrate the predictive accuracy of the equation, two graphical tools are used. For each monetary aggregate, a prediction-realisation diagram (shown in Figure 3.1) is presented in addition to the line chart of the actual versus forecast values. The prediction-realisation diagram is divided into four quadrants, such that the points falling in the first and third quadrants imply that the direction of change is identified correctly. On the other hand, points falling in the second and fourth quadrants imply errors in predicting the direction of the change. Figure 3.2 shows the actual versus forecast line charts and prediction realisation diagrams for all the monetary aggregates.

Figure 3.1: Prediction Realisation Diagram

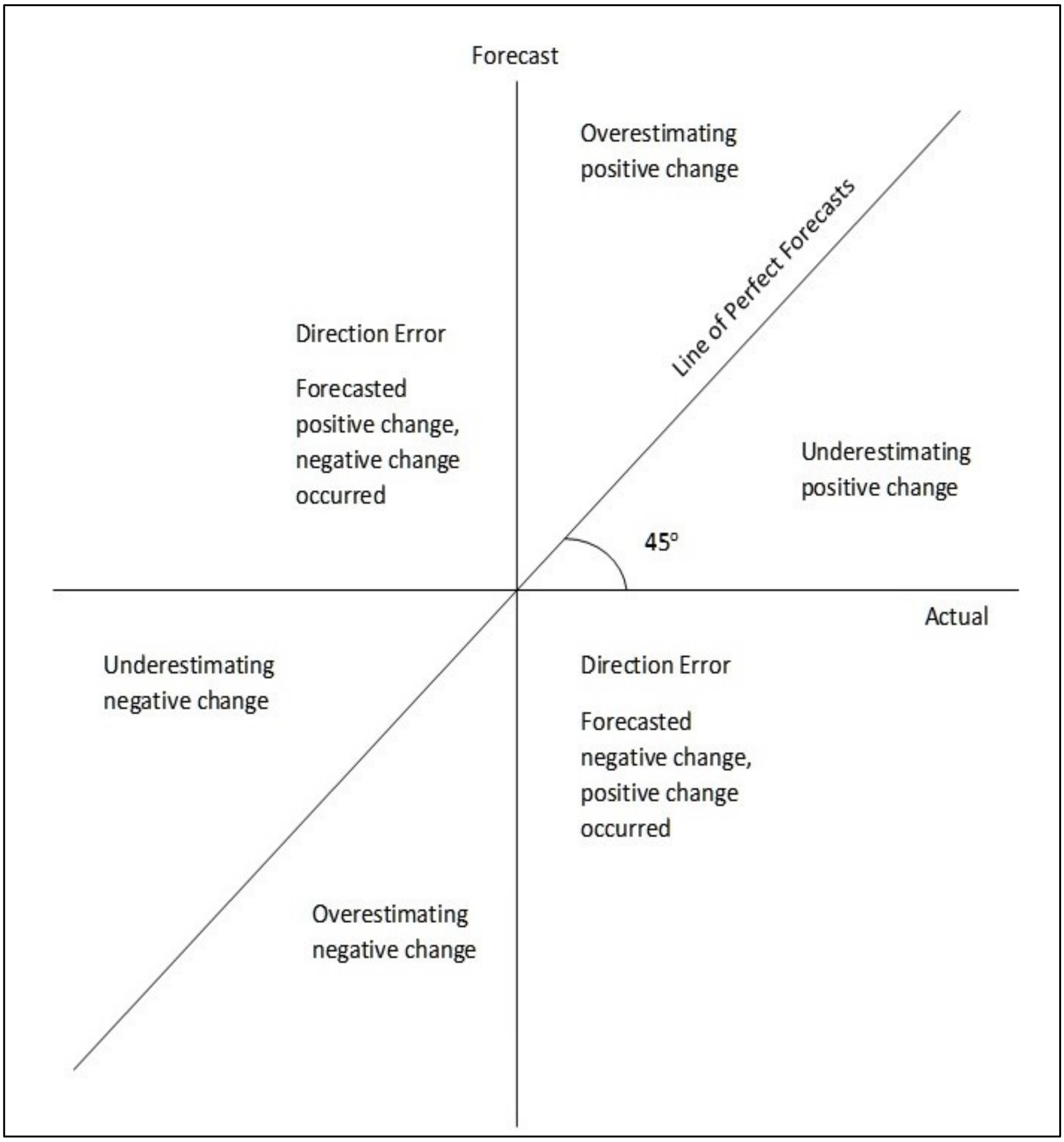


Figure 3.2: Actual vs. Forecast Charts and Prediction Realisation Diagrams

Currency in Circulation

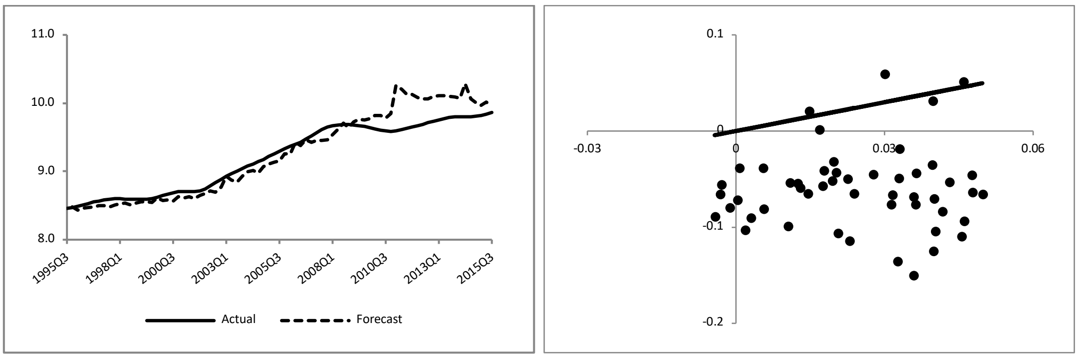
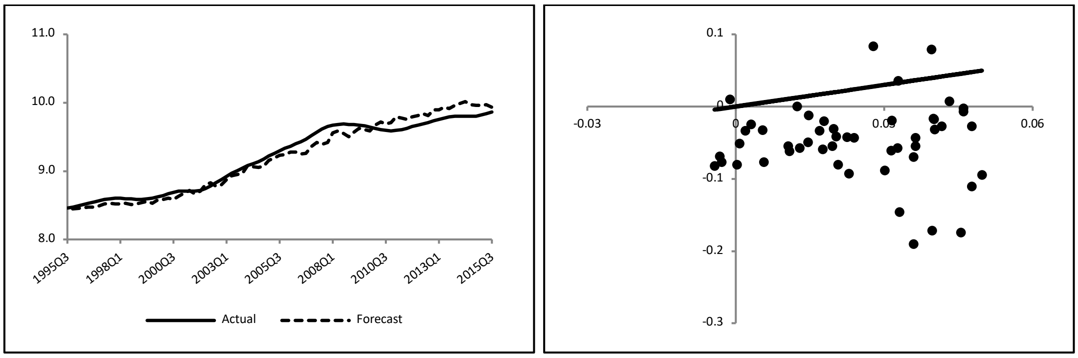
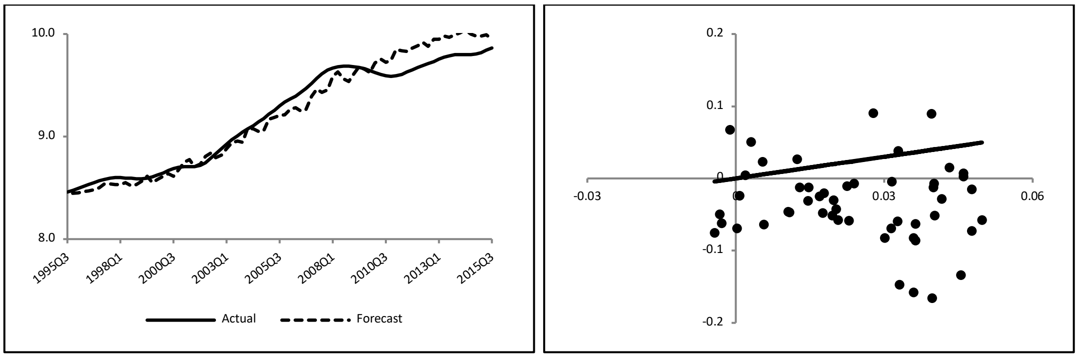


Figure 3.2: (Continued)

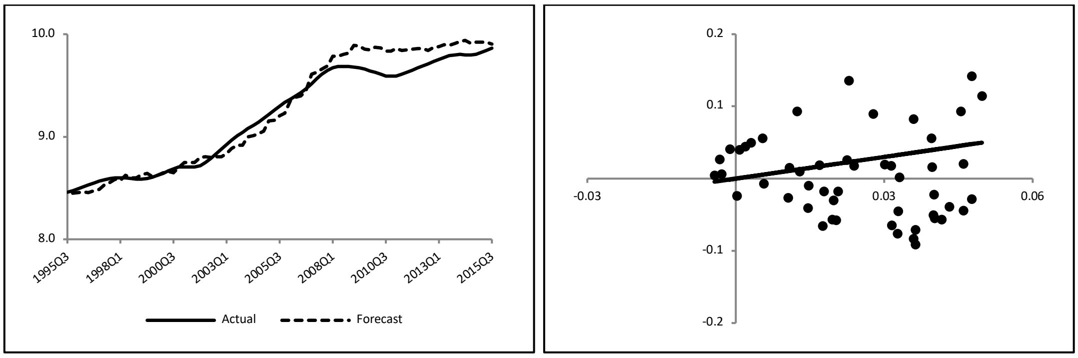
M1



M1A



M1B



M2

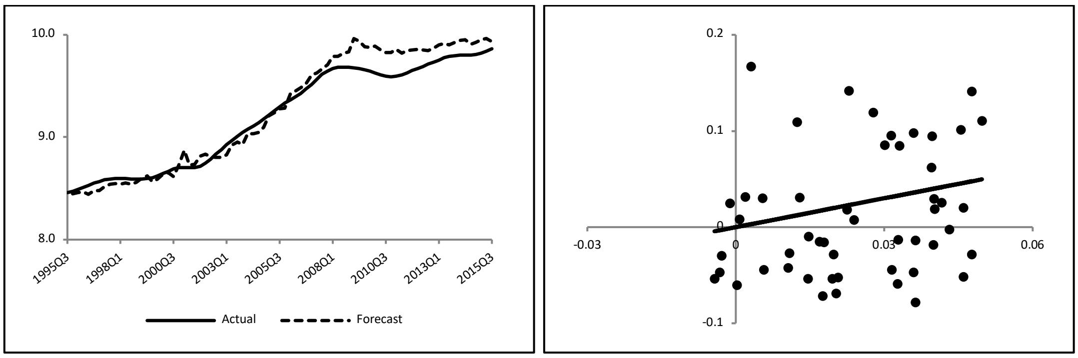
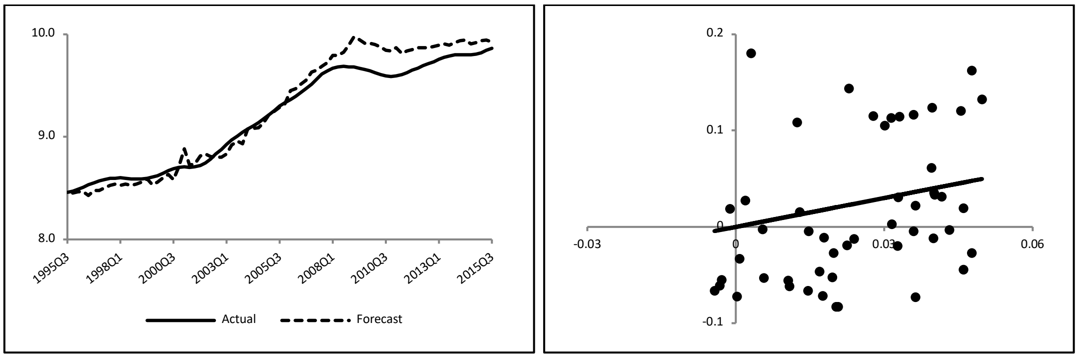
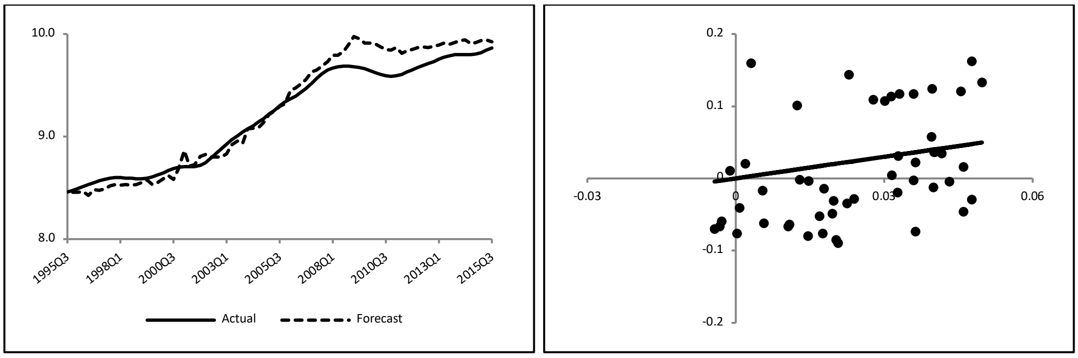


Figure 3.2: (Continued)

M2A



M3



3.6 Summary and Concluding Remarks

Studies investigating the money-income relation provide mixed results on the direction of causality and the presence of a stable long-run relation between the money supply and income. Nevertheless, finding the most appropriate definition for money in the economy is critical for conducting monetary policy because policy-makers could manipulate the money supply to influence economic activity.

The empirical work presented in this chapter commenced with Friedman-Meiselman dual criteria approach, which is one of the first methods used to define money. The second step was examining the order of integration of the variables by utilising the ADF test. The third step was investigating the presence, or otherwise, of cointegration between monetary aggregates and non-oil GDP. The following cointegration tests were performed, (i) the Engle-Granger two-step method; (ii) autoregressive-distributed lag (ARDL) and error correction models; and (iii) the Johansen procedure. The fourth step was Granger causality testing, which revealed a causal relation between some of the monetary aggregates and non-oil GDP such that causality runs from income to money, in support of the Keynesian view. The last step was testing the predictive power by generating out-of-sample forecasts and measuring their accuracy.

The empirical analysis based on the Friedman-Meiselman dual criteria shows that $M1B$ is the best definition of money in the case of Kuwait. Moreover, the time series properties of the variables revealed that all variables are non-stationary in level and stationary in first difference, which means that they are I (1). Cointegration analysis revealed that, based on the Engle-Granger two-step method, none of the monetary aggregates is cointegrated with economic activity. However, the ARDL cointegration test revealed the presence of a stable long-run relation between the broad monetary aggregates $M2$, $M2A$, and $M3$, in addition to the narrow aggregate $M1B$, and economic activity. Moreover, the ECM and Johansen procedure (eigenvalue) results indicate the presence of cointegration between all of the monetary aggregates and economic activity.

The Granger causality test reveals a unidirectional causal relation that runs from income to the broad monetary aggregates and $M1B$, which supports the Keynesian view. Testing direction accuracy revealed that all of the monetary aggregates have a relatively good direction accuracy (more than 40%). The empirical results presented in this chapter do not provide a clear-cut conclusion in favour of a single monetary aggregate.

One may legitimately wonder how the results presented in this chapter are relevant to the model that will be specified and estimated in the following two chapters. Money, however it is defined, is a financial asset—the most liquid financial asset, to be precise. In the big model, money is looked upon mainly from the demand side, in the sense that income (which is a real variable) affects the demand for this financial asset. In Chapter 3, money is looked upon in terms of its effect on the economy. The objective here is to examine the proposition that financial variables affect (as in Chapter 3) and are affected by (as in the big model) by the economy. While model can be specified and estimated without the empirical results presented in this chapter, these results latter have some value added in that they represent a different way of looking at the relation between monetary and real variables. Furthermore, the empirical work presented in this chapter is done on monetary aggregates, which overlap in the sense that each aggregate at a higher level is obtained by adding a set of assets to the previous aggregate as done by Friedman and Meiselman (1963). In the big model, the monetary assets do not overlap, in the sense that demand functions are estimated for currency, demand deposits and quasi-money.

CHAPTER 4

MODEL SPECIFICATION

4.1 Introduction

The main objective of this chapter is to specify a model describing interactions between real and financial variables in the economy of Kuwait. The model provides an analytical framework for understanding the behaviour of several economic variables by revealing how the monetary sector and real sector affect each other. The model will allow us to enumerate the connection between financial, monetary, and real variables in a macroeconomic framework.

Building macroeconometric models for developing countries began more than sixty years ago. Several economic problems in developing economies (such as trade and budget deficits, high inflation combined with high unemployment rates and a huge debt) led several countries to develop macroeconometric models. The first model built for a developing country was developed by Narasimham (1956) and supervised by Tinbergen for the Indian economy. Most of the early models built for developing economies were modified versions of the Klein (1950) model of the US economy, exhibiting the same limitation of Klein's model, which is mainly that it is demand-oriented and ignores the supply side of the economy.

When it comes to developing macroeconometric models for developing countries, economists usually fall into two conflicting sides. Corden (1987) claims that models of developed countries are not applicable to developing countries because the models are customised for economies with different constructions and specifications.

However, Park (1973) believes that models built for developed countries are valid for developing countries and that any model intended for a country, regardless of its stage of development, is applicable to another. Park concludes that models designed for developed economies could be applied to developing economies after modification to reflect differences between the two economies.

The lack of reliable data, and in some cases unavailability of data, in most developing countries is a hurdle faced by model builders. However, a solution to this problem was proposed by Klein (1989) which involves using simple and robust estimation methods that are not very sensitive to the quality of data. Klein also suggested that equation system methods of estimation, such as the maximum likelihood, should be avoided in these situations. Moreover, model builders usually tend to use interpolation and extrapolation to solve some of the problems pertaining to the availability of data in developing countries.

Econometric models have been challenged over the years by numerous criticisms, the most notable criticism being the Lucas (1976) critique of econometric policy analysis. In his paper, he claimed that macroeconometric models must be founded on a theoretical basis and not built on empirical correlations, arguing that correlations were highly sensitive to policy changes. This means that the equations must be modified as soon as the government chooses one policy in preference to another and that the models built before the policy change will not reflect the true structure of the economy after the change. Lucas suggested a new research direction, which is an analysis of structural parameters.

According to Kydland and Prescott (1982), Long and Plosser (1983), and Hurtado (2014), econometricians responded to the Lucas critique by developing dynamic stochastic general equilibrium (DSGE) models. The main features of this type of models are articulated in the name. These models are dynamic, which means that they learn how the economy progresses through time. The models are stochastic, which means that variables are distributed following a stochastic process, considering that the economy is affected by random events such as scientific and technological advances, fluctuations in oil prices, and changes in monetary policy. The models are based on the general equilibrium theory of Walras or some variation thereof.

Garcia (2011) identified three issues with DSGE models: (i) the models do not include the financial sector because they are built on the assumption of financial equilibrium; (ii) fixation on non-discretionary policy, which means that the models do not contain fiscal policies and assume that controlling interest rates with monetary policy is sufficient to keep the economy in equilibrium; and (iii) the models are structured to analyse relatively small, but not big, shocks. Kocherlakota (2010) claims that the dynamic stochastic general equilibrium models did not help in analysing or foreseeing the global financial crisis in 2008. However, he notes that the applicability of DSGE models is progressing and that there is evolving agreement among econometricians that these models need to integrate both price stickiness and market frictions.

Even though several criticisms have been directed against macroeconometric models to discredit them, they are still used by governments to analyse policies and forecast interactions among economic variables. The most important criticisms are: (i) theoretical disparity with the rational expectation theory; (ii) the Lucas critique; (iii) forecasting insufficiency; and (iv) illogical restrictions. When it comes to developing countries, model builders face more hurdles in addition to the previously mentioned criticisms. The lack of reliable sources of data, and in some cases the unavailability of data, is the most critical problem.

This chapter is divided into eight sections. The first section is an introduction, whereas section two looks at previous econometric work of the economy of Kuwait. The third section is about model development, and sections four, five and six present model specification. The seventh section looks at the recursiveness of the model and its implications. The last section is a summary.

4.2 Previous Econometric Work on Kuwait

Kuwait is a small wealthy country with plenty of oil that is entirely owned by the government. It is considered a developing country because most of the income comes from exporting a single commodity, which is a common feature of developing countries. The volatility of oil prices is challenging, as fluctuations can have a dramatic effect on the economy, given that oil revenue and prices determine GDP and the fiscal balance. Stability in the oil market is required for Kuwait to have a more stable economy.

The first econometric model of the economy of Kuwait was developed by Khouja (1973). The model contains structural and reduced-form specifications of six equations representing the real sector of the economy (based on the Keynesian theory of income and expenditure). Later on, Khouja and Sadler (1979) improved the model by incorporating definitional and behavioural equations. The improved version includes equations describing the monetary sector and the real sector of the economy. However, the explanatory variables they use in some of the equations have low statistical significance.

A model was developed by El-Mallakh and Atta (1981) in which they used a block recursive representation of the economy. The estimation was carried out by using annual data for the period 1962-1977. The model has fifteen behavioural equations and twenty-five identities, such that the equations are clustered into three blocks estimated by OLS as a recursive system. They considered several issues regarding data availability, which is why they had to use proxies and listed in more details the problems faced by econometricians while collecting data for the purpose of developing a model of the economy of Kuwait. According to Moosa (1986c), the model had two issues: (i) coefficients turned out to have t-statistics of less two, meaning the coefficients have less than twice their standard errors and were left in the specification of the model; and (ii) some of the equations have severe autocorrelation yet they did not attempt to deal with it.

Another model was developed by El-Beblawi and Fahmi (1981), who estimated a single equation that explains stock prices in terms of the eurodollar interest rate and the money supply. They found the money supply to be an essential element in determining stock prices, regardless of whether they used a broad or narrow definition of money. Another single-equation model time series was estimated by Moosa (1982) to identify trends of monetary growth. Later on, he designed three models, the first one was intended to evaluate the demand for money function in Kuwait by building a single equation model (Moosa, 1983a). The second model was designed to forecast the Kuwaiti Dinar exchange rate versus other major currencies (Moosa, 1983b). In the third model, he used the method of principal components to estimate the share of the gross domestic product arising in the oil sector (Moosa, 1986b).

The Claremont Economics Institute (1983) applied their US model to the economy of Kuwait. This evidently demonstrates a lack of comprehension of the structure and problems of the economy of Kuwait, which raises the issue of the applicability of models designed for developed countries to developing countries. It has been debated by economists throughout the years if monetary theories are applicable to developing economies since the generalisations of the theories are founded on a setting that is completely different from that of developing countries. Myint (1971) claimed that theory is irrelevant to the central monetary problems of developing countries because it is tailored to the problems of developed countries.

Ghuloum (1984) conducted an empirical study on the monetary sector of the economy of Kuwait, estimating a model by using OLS and 2SLS. However, Moosa (1986c) revealed that the empirical results were not as good as the analytical and descriptive work. The empirical findings show that the composition of the asset portfolio is significantly influenced by foreign interest rates and the endogenous variables. Khorshid (1990) developed a dynamic model, which he used to analyse the medium-term path of the economy of Kuwait. He used a CGE model, which is a class of macroeconometric models that use macroeconomic data to calculate the economy's reaction to certain changes in policy and external factors (Dixon and Rimmer, 2002). The model was built to analyse several policy scenarios of oil prices, public expenditure and the effects of investment levels on growth. Salih et al. (1991) used annual data for the period 1970-1986 to estimate a model by OLS and 2SLS, concluding that for the case of Kuwait, oil prices are the main factor that determines the level of economic activity and that a small increase in oil prices can make the difference between a budget deficit and surplus.

Hoque and Al-Mutairi (1996) developed a macroeconometric model for Kuwait's non-oil GDP. The model contains ten equations covering the non-oil production sectors, nine of which are stochastic and one identity, with ten endogenous and ten exogenous variables, as well as lagged dependent and dummy variables. They concluded that a sudden and big policy reform would lead to a significant decline in non-oil production and consumption. The policy conclusion they reached is that a more suitable strategy for the government would be applying minor and gradual policy reforms.

Ramadhan et al. (2013) developed a model to estimate the absorptive capacity of the economy of Kuwait, which is an updated version of a previous model developed by Ramadhan (2005). They used annual data, covering the period 1970-2000 and concluded that Kuwait has a limited absorptive capacity over the sample period, suggesting that new procedures must be followed to avoid facing the same problem. The procedures they suggested include the following: (i) investing regionally (within the GCC); and (ii) promoting the private sector to "offer services in trade and financial activities" which would introduce the country to new frontiers. Table 4.1 summarises the main econometric studies of the economy of Kuwait.

Table 4.1: Main Econometric Work on the Economy of Kuwait

Model	Data	Method of Estimation
Khouja (1973)	Annual	OLS
Khouja and Sadler (1979)	Annual	2SLS
El-Mallakh and Atta (1981)	Annual	OLS
El-Beblawi and Fahmi (1981)	Monthly	OLS
Moosa (1983a)	Annual	OLS
Claremont Economics Institute (1983)	Annual + Quarterly	OLS
Ghuloum (1984)	Quarterly	OLS + 2SLS
Moosa (1986b)	Annual	OLS + PCA
Moosa (1986a, 1986c)	Annual + Quarterly	OLS
Khorshid (1990)	Annual	OLS
Salih et al. (1991)	Annual	OLS + 2SLS
Hoque and Al-Mutairi (1996)	Annual	OLS
Ramadhan (2005)	Annual	OLS
Ramadhan et al. (2013)	Annual	OLS

4.3 The Model

In this section, a model is developed that describes the interaction between monetary and real variables in the economy of Kuwait. The model is estimated using quarterly time series data. The discussion in this section is divided into descriptions of economic activity, oil GDP, demand for money, interest rate, demand for reserves, the supply of deposits, price level, imports, supply of credit, demand for credit, and stock prices.

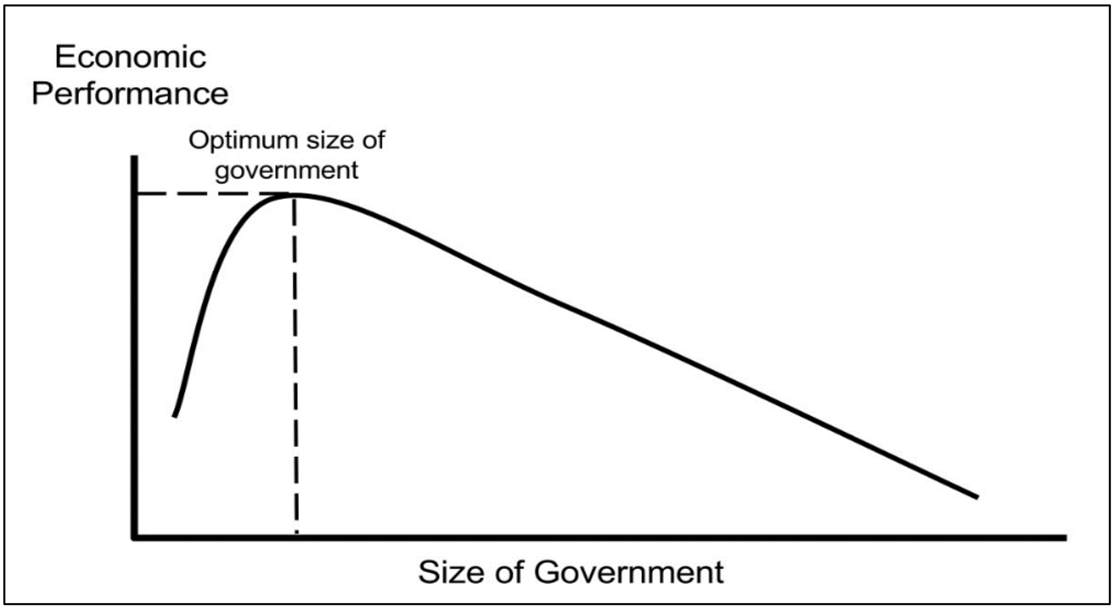
4.3.1 The Role of Government Expenditure in Economic Activity

Government expenditure (which includes government investment, consumption, and transfer payments) is one of the most vital economic tools for any government (Barro and Grilli, 1994). The basic definition of fiscal policy is the manipulation of tax rates and government spending levels to influence the economy. Generally, there are two types of fiscal policies: expansionary fiscal policy and contractionary fiscal policy. An expansionary fiscal policy involves an increase in government expenditure and a decrease in taxation. Conversely, a contractionary fiscal policy involves reduced government spending and increased taxation.

Expansionary fiscal policy is used by governments to stimulate the economy, particularly in a period of recession. An increase in government expenditure will lead directly to a rise in the demand for goods and services—as a result, economic activity and employment will increase. On the other hand, contractionary fiscal policy is used to slow down the economy to combat inflationary pressure. By reducing government expenditure and increasing taxes, households will have less disposable income, leading to a decrease in the consumption of and the demand for goods and services. It is worth noting that a decrease in government spending will directly reduce GDP because government spending is a component of GDP. However, GDP will decline even further as a result of the decrease in consumption and other GDP components through the multiplier effect.

The relation between government expenditure and economic activity is one of the most debated topics in macroeconomics. Economic theories regarding the relationship between economic activity and government spending started in the nineteenth century when Wagner (1883), among other scholars, tried to determine the relationship between government spending and economic growth. Wagner's law of increasing government spending specifies that economic growth will cause a long-term increase in government spending. An alternative economic theory related to government expenditure and economic growth was proposed by Keynes (1936) who argued that government expenditure is an exogenous economic tool that is used to boost economic growth. In other words, the Keynesian hypothesis stipulates unidirectional causality that runs from government expenditure to economic growth, whereas Wagner's hypothesis stipulates unidirectional causality from economic growth to government spending. Rahn and Fox (1996) proposed an economic theory of government expenditure and economic activity. The theory stipulates that there is a level of "optimal" government expenditure that maximises economic growth. Advocates of the Rahn theory use it as a tool to claim that government expenditure retards economic growth and to demand a reduction in government expenditure and taxes. Figure 4.1 illustrates the Rahn curve.

Figure 4.1: The Rahn Curve



Throughout the years, a huge number of empirical studies have investigated the relationship between government expenditure and economic activity. However, the empirical results of these studies produced contradicting results. One of the main differences pertains to the direction of causality as some studies advocate the Keynesian approach, whereby causality runs from government expenditure to economic activity, other studies advocate the opposite direction of causality as envisaged by Wagner's law. Another point of contradiction is the presence of a stable long-run relation between the two variables. In this regard, some studies show that government expenditure and economic activity are cointegrated, while other studies find no cointegration between the two variables.

Few empirical studies examine the relation between economic activity and government expenditure in the economy of Kuwait. Moosa (1986a) developed a macroeconometric model for the economy of Kuwait, and he examined the relation between real output and fiscal and monetary variables. He argues that real output is a function of real government expenditure and the supply of total deposits. Moreover, the empirical results revealed that out of the eleven equations in the model the real output equation had the lowest explanatory power (R^2=0.0528). Moosa attributed the low R^2 to errors in measurement in the non-oil GDP due to the interpolation of the series from annual to quarterly. On the other hand, most of the coefficients are statistically significant.

Al-Faris (2002) examined the relation between economic growth and government expenditure in the framework of Wagner's law and Keynesian theory. Multiple empirical tests were performed, including unit root, cointegration, and causality for the GCC countries by using annual data covering the period from 1970 to 1997. Based on the cointegration test results, he concluded that there is a long-run relation between income and current spending, capital spending and total spending for all of the GCC countries. Granger causality test revealed a unidirectional causality from GDP to public expenditure in the case of Kuwait, which supports Wagner's law. Additionally, unidirectional causality was found from GDP to capital spending. In conclusion, the empirical findings support Wagner's law and do not support the Keynesian hypothesis.

Burney (2002) formulated a general form for the government expenditure function to investigate the relation between public expenditure and several other economic variables, including income by using data series covering the period 1969/1970 to 1994/1995. He used several tests including unit root to test the stationarity of the time series, cointegration to investigate the existence of a long-run relation between the variables, as well as error correction modelling. He noted that most of the empirical literature on the relation between government expenditure and economic activity use GDP or GNP as indicators of economic activity, even though these variables do not reflect the level of economic activity in Kuwait accurately. As an OPEC member, Kuwait is incapable of changing oil production and the price of oil is not under the control of the Kuwaiti government because it is determined in the international market. However, this does not change the fact the oil production and exports are a dominant component of GDP. Therefore, a large portion of the economic activity is not controlled by the government—to resolve this issue, Burney proposed using alternative indicators to measure economic activity in Kuwait such real per capita government total revenue, real per capita government disposable revenue, and real per capita non-oil GDP. The empirical results do not lend support to the validity of Wagner's law in Kuwait.

To study the relation between government expenditure and economic activity in the economy of Kuwait, Ebaid and Bahari (2019) use time series data covering the period 1970 to 2015. In their model specification, they use three proxies for government expenditure: (i) total government expenditure, (ii) government expenditure per capita, and (iii) government expenditure as a percentage of GDP. Moreover, four proxies are used as a measure of economic activity: (i) GNP, (ii) GNP per capita, (iii) GDP, and (iv) GDP per capita. The empirical analysis includes two unit root tests (augmented Dickey-Fuller and Phillips–Perron) and two causality tests (Granger causality and the TYDL approach). The empirical results reveal a unidirectional causality from government expenditure to economic growth. However, causality is found only when government expenditure per capita and GDP per capita are used as proxies.

In Kuwait, the government plays a dominant role in the economy because it is the biggest and main employer in the economy, the largest investor in infrastructure, and the distributor of wealth. The government plays a significant role in controlling resources, contributing to GDP, and reallocating expenditure to different sectors of the economy. Consequently, it is essential for the government to pursue an effective fiscal policy to stabilise the economy.

Based on the previous discussion, the functional relation between non-oil GDP and government expenditure is specified as follows:

$$Y^n = f_1(G) \quad (4.1)$$

where Y^n is non-oil GDP, and G represents government expenditure. The relationship is unlikely to be purely contemporaneous rather it includes a distributed lag. Hence

$$G = \frac{1}{n}\sum_{j=0}^{n} g_{t-i} \quad (4.2)$$

which means that government expenditure as a determinant of non-oil GDP is measured as a moving average of n period expenditure.

4.3.2 Oil GDP

GDP is an economic measure of the current (market) value of the total goods and services produced in a specific period, usually a year. GDP can be disaggregated into the contribution of each sector of the economy. In the case of Kuwait, the oil sector plays a dominant role in the economy. Throughout the study period, oil GDP was on average nearly 50% of total GDP. Similarly, the majority of the county's exports come from the oil sector, which accounts for nearly 90% of total exports during the study period. The percentage of oil GDP to total GDP and the percentage of oil exports over the study period are illustrated in Figure 4.2 and Figure 4.3 respectively.

In the economy of Kuwait, the oil GDP is a function of exports. Therefore, the oil GDP function is specified as follow:

$$Y^o = f_2(X) \tag{4.3}$$

where Y^o denotes oil GDP and X represents exports.

Figure 4.2: Oil GDP Percentage

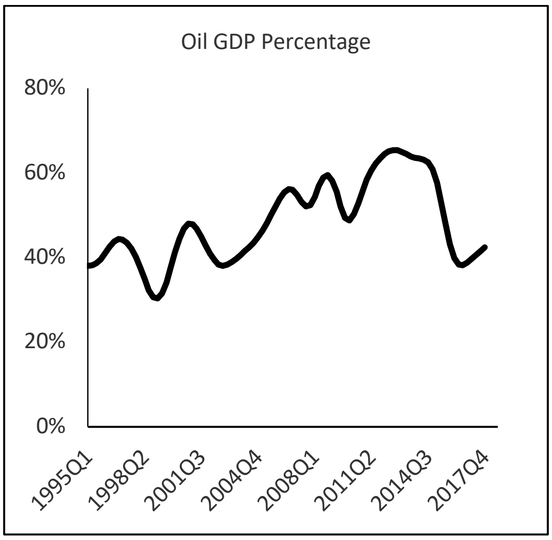
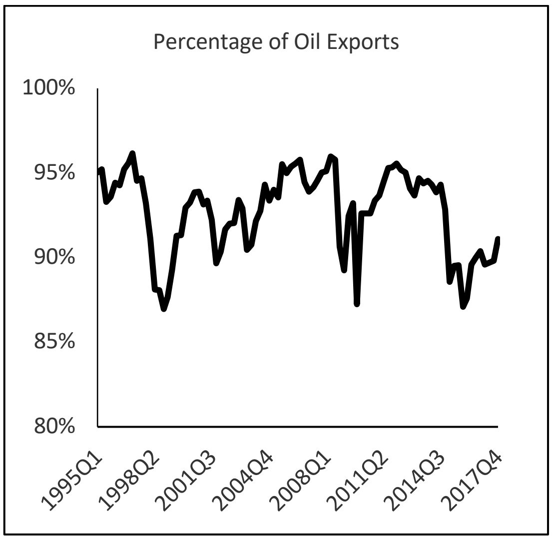


Figure 4.3: Percentage of Oil Exports



4.3.3 Demand for Money

The demand for money has always been the focus of economists to the extent that it is considered to be one of the most vital topical issues in macroeconomics. Investigating the demand for money means finding the determinants of the quantity of money demanded in the economy. The number of studies that can be found on this topic gives an indication of how much attention this topic has received from economists throughout the years. According to Hayo (1999a), having a stable long-run demand for money is crucial for the conduct of monetary policy. Goldfeld (1989) deems the relationship between the demand for money and its determinants as a fundamental building block in macroeconomic theories and a critical component in implementing monetary policy. According to Harb (2004), the money demand function is utilised by the monetary authorities as a tool in the conduct of monetary policy because it provides central banks with a forecast of the response of macroeconomic variables to a change in the money stock.

The most important theories of the demand for money are the classical monetary theory, Keynesian theory, Tobin's portfolio approach, Boumol's inventory approach, and Friedman's theory. The classical monetary theory has two versions: (i) Fisher's transactions approach, and (ii) the Cambridge cash balance theory. In Fisher's version, the focus is on money functioning as a medium of exchange. On the other hand, the focus of the Cambridge cash balance theory is on money functioning as a store of value. Fisher's equation of exchange is specified as follows:

$$MV = PT \qquad (4.4)$$

where M denotes the money stock, V represents the velocity of circulation, P denotes the price level, and T is aggregate transactions. Fisher formed his demand for money theory by making several assumptions to the equation of exchange. The money stock M is assumed to be an exogenous variable on the grounds that the monetary authorities control the money supply. T is fixed because it is a function of income as the economy is assumed to operate at full employment. The velocity of circulation V is assumed to be determined by institutional factors, in which case it is assumed to be constant since institutional factors do not change much in the short run. Based on Fisher's assumptions, the demand for money is a function of the velocity of money circulation, price level, and aggregate transactions. Therefore, the equation of exchange can be reformulated as:

$$M^d = \frac{PT}{V} \tag{4.5}$$

Fisher's transactions approach is criticised for two main reasons. First, aggregate transactions T include capital assets transactions, since the values of these assets change over time. This that the assumption of T being fixed is incorrect. Second, it is challenging to determine the price level P, which includes the goods and services currently produced as well as capital assets.

The Cambridge cash balance theory was proposed by several Cambridge economists including Pigou, Hawtrey, Marshall, Lavington, Robertson, and Keynes (before he developed his own theory). In this theory, the focus is on money functioning as a store of value, unlike Fisher's transaction approach, where money is assumed to be mainly a medium of exchange. The proposition they advance is that the demand for cash balances is proportional to the nominal money income. Therefore, the money demand equation can be formulated as:

$$M^d = kPY \quad (4.6)$$

where Y represents real income, P denotes the price level (hence, PY is nominal income), and k represents the amount of PY that is desired as cash. Even though the Cambridge cash balance theory is considered to be theoretically richer than Fisher's transaction approach, is still criticised for not including factors such as interest rate and wealth in the analysis of the demand for money.

These gaps were filled later on by Keynes in his theory of the demand for money, whereby he introduced the concept of liquidity preference. Any person decides how much of his or her income is to be kept in cash and non-interest-bearing deposits and how much is to be lent (by buying bonds)—this is generally what a liquidity preference means. According to Keynes, the demand for liquidity is influenced by three motives: (i) transactions motive, (ii) precautionary motive, and (iii) speculative motive.

The frequency of receiving income is not the same as the frequency of expenditure. People tend to spend on a daily basis, while income is commonly received monthly. Therefore, this disparity leads people to keep liquidity to guarantee basic transactions. The transactions motive depends on the level of income—with a higher level of income comes more money demanded to cover expenditure. The precautionary motive relates to the need of people to keep cash to use in case they face an unexpected problem. Consequently, the amount of money demanded by this motive depends on two factors: the level of income and the psychological mindset of a person. In the speculative motive, people tend to retain liquidity to benefit from speculation about market fluctuations. The relation between money held for speculation and interest rate is negative, which means that a decline in interest rate (increase in bond prices) leads to an increase in the demand for money which is held as until the interest rate goes up again, and vice versa.

The main contribution of the Keynes theory lies the concept of speculative motive for the demand for money which at the time was regarded as a revolutionary idea and a departure from the classical monetary theory. However, this theory is criticised for assuming that under the speculative motive, people either put their assets in 100% money or 100% bonds. This assumption is unfeasible since in reality, people tend to hold their assets in different forms at the same time and do not hold all their assets in a single form.

In the portfolio approach, Tobin assumed that people would hold their assets in multiple forms, creating a portfolio of assets comprising money and bonds simultaneously. This assumption solves the issues in the speculative motive where Keynes assumed that people hold all of their assets as money or bonds. Tobin considered the risk and reward concept in his approach. Therefore, the proportion of money and bonds in each portfolio depends on the level of risk that each person is willing to take. Consequently, people who are willing to take more risks in their portfolio (more bonds less money) expect a higher return, and vice versa.

Baumol’s inventory approach focuses on the transaction motive for money demand. A company holds inventory to sell to customers when there is demand for their products. In the same way, Baumol assumes that people hold an inventory of money to conduct transactions. People are motivated to keep the optimal amount of money inventory because having more money than they need has an opportunity cost of losing interest they could have earned if that money was invested in bonds. Both Tobin's portfolio approach and Baumol's inventory approach assume that the transactions motive demand for money is a function of the interest rate.

Friedman (1956) presented a demand for money function without assuming any motive for holding money. He investigated the determining factors of the demand for money and formulated his money demand function based on those factors. The main factors that determine the demand for money in Friedman's theory are (i) wealth, (ii) interest rate, (iii) price level, (iv) expected inflation rate, and (v) institutional factors. Thus, Friedman's money demand function can be written as

$$M^d = f(W, hw, r^m, r^b, r^e, P, I, IF) \tag{4.7}$$

where M^d represents money demand, W denotes wealth, hw is the proportion of human wealth to total wealth, r^m represents the rate of return on money, r^b denotes the rate of return on bonds, r^e is the rate of return on equities, P is price level, I denotes the inflation rate, and IF represents institutional factors.

It is worth noting that wealth is considered the most important determinant of the demand for money, defined to include human capital as well as non-human wealth such as equities, money, and bonds. However, since there is a lack of consistently reliable data on wealth, it is hard to estimate this specification of the demand for money function. Therefore, Friedman proposed to use permanent income as a proxy for wealth.

It is essential to have a stable long-run demand for money in the economy to be able to implement monetary policy. The effect of the demand for money on stabilisation policies is one of the key reasons why the demand for money is deemed important (Moosa, 1986c). According to Hayo (1999a), even in this era of inflation targeting it is still essential to have a stable long-run demand for money for the conduct of monetary policy. Moreover, the monetary authorities use money demand to control inflation by adjusting the money stock.

According to Hamdi et al. (2015), previous empirical literature –such as Arango and Nadiri (1981), Laidler (1985), Stock and Watson (1993), Bahmani-Oskooee and Shabsigh (1996) and Serletis (2007)— formulated the general money demand function as follows:

$$\frac{M^d}{P} = f(Y, r) \tag{4.8}$$

where M^d represents the money demand, P denotes price level, Y denotes income (scale variable), and r represents the interest rate (opportunity cost variable).

However, there is no consensus among economists concerning the choice of appropriate variables for the demand for money function. The money demand variable can be any monetary aggregate, so the choice of having a narrow or broad monetary aggregate is up to the economist, given that there is appropriate reasoning for the selection of any monetary aggregate. When it comes to income, which is the scale variable, some economists have suggested that wealth is the appropriate proxy, while others prefer to use permanent income or current income. The same issue arises with the opportunity cost variable, the appropriate interest rate to use as an explanatory variable. While some economists use one interest rate (domestic) others prefer to add a foreign interest rate to the function to account for the opportunity cost of holding domestic money. Additionally, there is also the question of which interest rate to use as there are many domestic rates and foreign rates to choose from.

According to Crockett and Evans (1980), who estimated the money demand function for 19 Middle Eastern countries (including Kuwait), when it comes to choosing the scale variable the availability and the quality of data play an essential role. Therefore, when the data on wealth is not of adequate quality, economists tend to rely on an income variable. However, they argue that even though it is common to use GDP as the scale variable, this is not suitable for oil-exporting countries because the oil sector in these countries comprises more than half of GDP whereas oil production and price are determined by external factors.

Another approach for estimating the money demand function is by disaggregating the monetary aggregate into its components and having a separate demand function for each component. According to Khan et al. (2000), a disaggregated money demand function has several advantages over estimating money demand by using an aggregate function. The monetary aggregates in Kuwait comprise both interest-bearing and non-interest-bearing assets. Consequently, these assets are affected by different factors such as foreign and domestic interest rates, inflation and exchange rate. Correspondingly, the components of the money demand function respond differently to a change in income. Therefore, an aggregated demand for money function is not suitable to comprehend the behaviour of economic agents in response to several monetary policy instruments. Khan (1981) alluded that disaggregating the demand for money function could reveal more about the demand for money than estimating an aggregate function in addition to allowing for more flexibility in choosing the policy variables for the conduct of monetary policy.

Moosa (1986c) developed a macroeconometric model for the economy of Kuwait that includes the demand for money. He favoured the disaggregated approach for the estimation of the demand for money function. Thus, instead of having an aggregated demand for money function, he disaggregated M2 into currency, demand deposits, and quasi-money. The scale variable that he used was non-oil GDP because he deemed GDP as an inaccurate measure because of the dominance of the oil sector. The opportunity cost variables included domestic and foreign interest rate to account for the opportunity cost of holding domestic money.

By using annual data for the period 1979 to 2000, Harb (2004) estimated an aggregate money demand function for GCC countries. He estimated individual, panel and group-mean cointegrating vectors, by using FMOLS and a modified FMOLS, and found that the individual elasticities have the anticipated signs, even though they are only significant in the scale variable. Bahmani (2008) indicated that the idiosyncratic interest rate elasticities are insignificant, possibly because the interest rates in the GCC do not reflect the true opportunity cost of holding money, proposing instead to use the inflation rate. It is worth noting that Harb (2004) used non-oil GDP as the scale variable for the five oil producers in the GCC: Kuwait, Oman, Saudi Arabia, Qatar, and UAE.

Bahmani (2008) estimated and tested the stability of the demand for money in 14 Middle Eastern countries, including Kuwait, by using annual data for the period 1971 to 2004. He claims that the previous demand for money studies on Middle Eastern countries are divided into two groups using the traditional methodology and cointegration analysis. Bahmani argued that the first group suffered from spurious regression problems. In his demand for money function, he used M2 as a measure of money, real GDP as the scale variable, while the opportunity cost variable was the inflation rate. The function also included an exchange rate variable. The estimation results revealed that almost all the countries have stable money demand.

Hamdi et al. (2015) estimated the money demand function for GCC countries by using quarterly data covering the period 1980 to 2011. They argue that the GCC countries are considered as open economies, which makes it appropriate to use an "augmented" money demand function. In addition to the domestic opportunity cost variable in the general function, they included a foreign opportunity cost variable to account for the opportunity cost of holding domestic money. They also included an exchange rate variable to account for fluctuations of the domestic currency against foreign currencies. Regarding the scale variable, they preferred to use non-oil GDP as the scale variable for the oil-producing countries (Kuwait, Qatar, Saudi Arabia, and UAE) whereas GDP was used for the rest of the countries. The empirical analysis revealed a stable long-run money function. However, it was found that the exchange rate does not have a significant impact on money demand in the GCC countries.

Based on the previous discussion, the money demand function is specified by following the disaggregated approach. Therefore, a separate demand function for each component of broad money will be specified. The components of broad money are given by

$$MS = C + DD + QM \tag{4.9}$$

$$QM = SD + TD + FD \tag{4.10}$$

where MS represents broad money, C denotes currency in circulation, DD is demand deposits, QM represents quasi-money, SD denotes savings deposits, TD represents time deposits, and FD is foreign currency deposits.

The demand for currency in circulation, demand deposits, and quasi-money is specified to be a function of permanent income, Y^p, defined as a k-period moving average of GDP. Hence:

$$Y^p = \sum_{i=1}^{k} (Y^n + Y^o)_{t-i} \tag{4.11}$$

where Y^n is non-oil GDP and Y^o is oil GDP. Given that the demand for currency in circulation is determined by permeant income, the demand function is specified as follows:

$$C^d = f_3(Y^p) \tag{4.12}$$

The demand for demand deposits is a function of the domestic interest rate and permanent income. Consequently, the demand function is specified as:

$$DD^d = f_5(Y^p, r^k) \tag{4.13}$$

where r^k represents the domestic interest rate proxied by 3-months interbank rate.

The demand for quasi-money is a function of permanent income and the foreign interest rate. Hence, the function is specified as:

$$QM^d = f_6(Y^p, r^f) \tag{4.14}$$

where r^f denotes the foreign interest rate, proxied by the three-month eurodollar rate.

The components of broad money (currency in circulation, demand deposits and quasi-money) are affected by different factors. First, currency in circulation is not an interest-bearing asset, which means that it is only affected by permanent income. Second, demand deposits are an interest-bearing asset, which makes demand a function of permanent income and the domestic interest rate. Since the quasi-money contains foreign currency deposits, it is influenced by the foreign interest rate as well as permanent income.

4.3.4 The Effect of Foreign Interest Rates on Domestic Interest Rates

Interest rates play a crucial role in the economy and one of the vital tools of monetary policy. The empirical literature indicates that domestic interest rates depend on the level of the development as well as the degree of openness of the economy. It is also known that the degree of openness is highly linked with the level of development of the economy. Hence, a developed economy tends to be more open than a less developed economy, and vice versa. Edwards and Khan (1985) argue that in an entirely closed economy, the interest rate is determined by factors affecting the domestic money market and inflation. On the other hand, in an open economy where there are no restrictions to capital flows, some form of interest arbitrage will be present, making the domestic interest rate dependent on foreign interest rates. Kuwait has an open capital market, in which case it is expected that the domestic interest rate is determined by factors that affect capital mobility.

Salih et al. (1991) developed a macroeconometric model to analyse the economy of Kuwait. They argue that the domestic interest rate in Kuwait is determined by the foreign interest rate proxied by the US rate and the expected rate of change of the exchange rate. Their empirical analysis reveals that the foreign interest rate is the main determinant of the domestic interest rate, such that a 1% change in the foreign interest rate is likely to be transmitted as a 1% change in the domestic rate. According to Moosa (1986a), the domestic interest rate depends on the liquidity position of the banking system, which is highly affected by the foreign interest rate. Therefore, it is expected that an increase in foreign interest rates will lead to capital outflows and that a decrease in foreign interest rates will cause capital inflows. Since Kuwait has an open capital market, it is plausible to suggest that the domestic interest rate is determined by factors that affect capital mobility.

Based on the previous discussion, the domestic interest rate is a function of the foreign interest rate:

$$r^k = f_4(r^f) \tag{4.15}$$

Kuwait has an open economy with zero restrictions on capital flows. Furthermore, the Kuwaiti dinar is pegged to an undisclosed weighted basket of currencies. Under these conditions, the domestic interest rate must be affected by the foreign interest rate—otherwise arbitrage opportunities will arise.

4.3.5 Demand for Reserves

Reserves are the cash holdings of banks and the deposits held in their accounts at the central bank. The monetary authority in most countries sets a minimum reserve requirement that makes banks hold cash and deposits at the central bank equal to no less than a specified percentage of their deposit liabilities. The cash and deposits held by commercial banks to comply with the minimum reserve requirements are called required reserves. Anything extra is called excess reserves.

Total reserves are the sum of required reserves and excess reserves which are held to guarantee an adequate amount of liquidity in the banking system to deliver funds to customers wanting to withdraw money from their accounts. Since reserves do not earn any interest, banks are generally not keen to hold too much reserves. Therefore, banks usually try to minimise the excess reserves and use the funds in other banking activities where they can earn interest such as giving loans and mortgages. In Kuwait, the total reserves consist of the cash reserves, balances held with the central bank, and the central bank of bills. Hence:

$$R = R_c + R_b + R_k \tag{4.16}$$

where R denotes total reserves, R_c represents cash reserves, R_b is balances with the central bank, and R_k represents central bank bills.

The net position of local banks with the monetary authority is an indicator of their liquidity position. It is the difference between the claims of the central bank on banks and claims of banks on the central bank. The claims of the central bank on local banks consist of currency swaps, discounts and rediscounts, and deposits of the central bank held with local banks. On the other hand, the claims of local banks on the central bank include deposits held with the central bank and central bank bonds held by the local banks. The net position is calculated as follows:

$$NP = CL_{CEN} - CL_{COM} \tag{4.17}$$

$$CL_{CEN} = SW + DRD + D_{COM} \tag{4.18}$$

$$CL_{COM} = D_{CEN} + CBB \tag{4.19}$$

where NP represents the net position of local banks with the Central Bank of Kuwait, CL_{CEN} denotes claims of the central bank on local banks, CL_{COM} is claims of local banks on the central bank, SW denotes currency swaps, DRD is discounts and rediscounts, D_{COM} represents deposits of the central bank held with local banks, D_{CEN} denotes deposits of local banks with the central bank, and CBB is central bank bonds held by local banks.

Based on theoretical considerations, the demand for reserves is considered to be a function of the currency in circulation, level of required reserves, and the liquidity position of banks. Moreover, the level of required reserves is determined by total deposits and required reserves ratio. However, Moosa (1986c) argues that the excess reserves of Kuwaiti banks dominate the level of required reserves, implying that total deposits and required reserves ratio do not have any explanatory power. Thus, the demand for reserves function can be written as:

$$R^d = f_7(C, NP) \tag{4.20}$$

The demand for reserves is not affected by the level of required reserves because excess reserves dominate total reserves. The central bank bills held by local banks, which represent one of the largest reserves components, are interest-bearing, which encourages banks to keep excess reserves at the central bank.

4.3.6 Supply of Deposits

Economists have investigated the supply of deposits for decades without reaching a consensus on the determinants of the supply of deposits. Some economists use a simple function whereby the supply of deposits depends on reserves and interest rate.

In this case, reserves can be proxied by total reserves, the reserve ratio, or other measures of reserves. Additionally, the interest rate can be proxied by several interest rates such as deposits rates, interbank rates, and other domestic interest rates. Other economists advocate the use of a more complex supply of deposits function where other variables are included as explanatory variables or by disaggregating deposits.

Crouch (1967) built a model of the United Kingdom's monetary sector, in which the supply of total deposits is specified as a function of the banks' reserves. He argues that not including an interest rate variable is valid in the case of the United Kingdom where banks tend to not hold excess reserves and adjust their deposits until the amount of cash demanded by the bank is equal to the quantity of cash supplied. Crouch explains that in the UK, the supply of deposits function must not be interest-responsive because UK banks do not keep reserves more than what is required to hold. However, in Kuwait banks are accustomed to holding excess reserves, in which case it is expected that the supply of deposits is interest-responsive. Moosa (1986a) attributes the desire of Kuwaiti banks to hold excess reserved to the absence of developed financial markets and to the fact that reserves include central bank bills, which are interest-bearing. Hence the supply of deposits function can be written as

$$D^s = f_8(R, r^k) \tag{4.21}$$

where R denotes the reserves and r^k is the domestic interest rate.

4.3.7 Effect of Import Prices and the Money Supply on the General Price Level

Abel et al. (2016) define inflation as a sustained increase in the general price level over a period of time. According to economic theory, import prices and inflation have a positive relationship, implying that an increase in import prices lead to an increase in the general price level—hence inflation arises.

Theories that explain inflation include the Keynesian, monetarist, and structuralist theories. Keynesian economists argue that inflation is caused by changes in interest rates, not by the money stock, which is believed to be the cause of inflation by the monetarists. The monetarists argue that an increase in the money supply will lead to an increase in spending. Consequently, the demand for goods and service will surpass the supply, which will lead to rising prices. The structuralists argue that cost pressure (import prices) and demand pressure structural factors are the fundamental causes of inflation. They claim that changes in economic structure might boost aggregate demand for goods and services, leading to an increase in prices (inflation).

Many studies identify the determinants of inflation and imported inflation in developed and developing economies. In a recent paper, Moosa and Al-Nakeeb (2020) use an augmented P-Star model to identify the determinants of US inflation. Based on the empirical results, subdued inflation is attributed to the declining velocity of circulation and the accumulation of reserves by banks. Another contributing factor is declining import prices as a result of global competition. They conclude that both monetary and real factors have roles to play in the generation of US inflation. However, relatively few empirical studies examine the determinants of inflation in the economy of Kuwait compared to more developed economies. The pioneers in this area of research are Moosa (1986a, 1986c), Salih et al. (1989), Salih et al. (1991), and Salih (1993). Moosa (1986a, 1986c) was one of the first to investigate the effect of money on output and prices. He used a quarterly data covering the period 1977 Q1 to

1982 Q4 to find that government expenditure plays the most dominant role in explaining movement in the domestic prices, followed by import prices and money supply respectively.

Salih et al. (1989) find that domestic inflation is determined by world inflation followed by the growth rate of the money supply. Moreover, Salih et al. (1991) used a Keynesian price adjustment model to investigate the determinants of the price level in Kuwait. The empirical analysis reveals that imported inflation, money supply, and lagged inflation explain 86% of changes in inflation in the economy of Kuwait. Al-Mutairi (1995) investigated the causes of inflation in Kuwait by examining the effects of the money supply and government expenditure as well as import prices on domestic inflation by using a VAR model to analyse a quarterly data covering the period from 1975 Q1 to 1990 Q2. The empirical results indicate that government expenditure plays the most dominant role in explaining inflation, followed by import prices, and the money supply.

The effect of imported inflation on the economy of Kuwait has been examined by Eltony (2001) who investigated the impact of import prices on inflation level by using quarterly data for the period 1979 to 1999. The model by Eltony contains four behavioural equations and ten variables, four endogenous variables and six exogenous variables. The endogenous variables are: (i) consumer price index, (ii) non-oil GDP price index, (iii) money stock, and (iv) net foreign assets. The results of the empirical analysis confirm that the main determinants of domestic inflation are import prices, monetary stimulus, and government stimulus. The results indicate that imports prices are the main determinant of domestic inflation, which he attributed to heavy dependence on imports. In conclusion, the findings of this study are in line with the results of Moosa (1986a)

Likewise, Al-Omar (2007) investigated the main determinants of domestic inflation in Kuwait for the period 1972 to 2004. He used three variables that are believed to affect the behaviour of the inflationary process in Kuwait: real GDP, money supply, and foreign inflation. The results of the cointegration analysis revealed a long-run relation between the (broad) money supply and inflation. However, no evidence was found of a long-run relation between domestic and foreign (imported) inflation. The study also explores the possibility of a short-run relation between the three variables and inflation by testing for Granger causality, revealing no causal relation between real GDP, money supply, foreign inflation, and domestic inflation.

Hasan and Alogeel (2008) explored the factors that affect inflation in Kuwait and Saudi Arabia by developing a model that takes into account not only domestic but also foreign factors. They gave two reasons for including foreign factors in the model: (i) Kuwait and Saudi Arabia are heavily dependent on imports, and (ii) the two countries are dependent on foreign labour. They concluded that domestic and foreign factors influence inflation in the two countries. In the long run, the major factor affecting the inflationary process is trading partners' inflation.

Al-Shammari and Al-Sabaey (2012) investigated the main sources of inflation across 59 developed and developing countries by using annual data covering the period from 1970 to 2007. The aim of this study is to show the difference between the sources of inflations in developing and developed countries by using a panel model with random-effects. The findings indicate that in developed countries, the sources of inflation are government expenditure, nominal effective exchange, money supply growth, oil prices, interest rate, and population. On the other hand, the sources of inflation in the developing countries are government expenditure, oil prices, and the nominal effective exchange rate.

In light of the previous discussion, the functional relation between the general price level and its determining factors is specified as

$$P = f_9(MS, P^m) \tag{4.22}$$

where P is the price level, and P^m is the import prices.

4.3.8 Imports

Kuwait is heavily dependent on imports to supply most of the country's needs, with an import to GDP ratio of 48%. Reliance on imports is attributed to the low productive capacity of the economy, which is caused by the lack of resources such as labour and natural resources. In developing countries, imports play an important role in the growth and development of the economy and provide the goods and services that cannot be produced domestically. Therefore, estimating the import function is vital for an economy like Kuwait.

Economic theory and empirical evidence identify imports as a function of price and economic activity. There is no consensus among economists concerning the choice of appropriate variables as proxies for economic activity and price. For example, prices can be proxied by import prices, the unit value of imports, and the ratio of the import price index to the domestic price index. Furthermore, economic activity can be proxied by GDP and GNP. Numerous empirical studies cover the factors that determine imports for developing countries such as Khan (1974) Melo and Vogt (1984) Bahmani-Oskooee (1986) Arize and Afifi (1987) Bahmani-Oskooee (1991) and Tang and Nair (2002). Additionally, Metwally (2004) and Aljebrin and Ibrahim (2012) cover the determinants of imports for the GCC countries. Bahmani-Oskooee (1986) includes the effective exchange rate in the imports and exports equations to assess the effect of exchange rate on trade flows in developing countries. The empirical findings show that income and the effective exchange rate have a significant impact on imports in some developing countries, while prices do not exert a significant impact. Metwally (2004) investigates the determinants of aggregate imports in GCC countries and concludes that relative prices do not have any significant impact on imports in most of these countries.

It follows that the imports of Kuwait are a function of income and the exchange rate. Hence, the imports function is specified as

$$M = f_{10}(Y^n, Q) \tag{4.23}$$

where M denotes the imports, and Q represent the effective exchange rate, which is calculated as

$$Q_t = W_0\left(\frac{E_t^0}{E_0^0}\right) + \sum_{j=1}^{k} W_j\left(\frac{E_t^{0,j}}{E_0^{0,j}}\right) \tag{4.24}$$

where E_t^0 is the exchange rate between the dollar and KD measured as price of one KD ($\$/KD$), $E_t^{0,j}$ is the exchange rate between the KD and currency j (X_j/KD) and W is the weight of each currency. E^0 is determined by a formula representing the basket, which can written as

$$E^0 = \alpha_0 + \sum_{i=1}^{m} \alpha_i E^i \qquad (4.25)$$

$$E^{0,i} = \frac{E^0}{E^i} \qquad (4.26)$$

where E^0 is $\$/KD$, α_0 represents the weight of the dollar, α_i is the weight of currency i and E^i is $\$/X_i$. The cross-exchange rates X_i/KD are measured as

$$X_i/KD = \frac{X_i/\$}{KD/\$} = \frac{KD/\$}{X_i/\$} \qquad (4.27)$$

which means that the cross exchange rate between the KD and currency i (X_i/KD) is calculated from the dollar exchange rate of the two currencies.

4.3.9 The Demand for and Supply of Credit

Credit is one of the most significant variables in the economy because of the effect it has on income, spending and economic activity. The basic definition of credit is a transaction between borrowers and lenders where the borrowers take the money and promise to pay it back in the future plus interest. Loans provide an opportunity to boost spending, leading to an increase in income levels. Subsequently, this will lead to an increase in economic activity, which will be reflected by a rise in GDP. There are two sides to consider when investigating the credit in any economy: (i) the demand for credit, and (ii) the supply of credit.

Banks are considered the main suppliers of credit to the private sector. According to Moosa (1986c), banks' decision to supply credit is determined by two factors: ability and willingness to offer loans. Willingness to grant loans to the private sector is determined by the domestic and foreign interest rates. Ability, on the other hand, depends mostly on the deposits held by banks for the private sector and the government. The liquidity position of the banks is also an essential factor in determining their decision to provide loans to the private sector. Certainly, when a bank is in a good liquidity position, it is more likely to provide credit while during a liquidity strain getting loans from banks becomes more difficult. Consequently, the supply of credit function can be expressed as follows:

$$CR^s = f_{11}(D, NP) \tag{4.28}$$

where CR represents credit.

The empirical literature identifies the demand for credit as a function of economic activity (proxied by GDP or GNP) and financing costs (proxied by interest rate). Friedman et al. (1993) argue that alternative sources of finance must be considered in addition to economic activity and financing costs because the demand for credit is not only determined by the financing cost but also their relative price. Calza et al. (2003) propose that most empirical studies of the demand for credit should include a measure of the cost of credit as an explanatory variable. They argue that the opportunity cost of loans must be included as a determinant of the demand for credit. Thus, the demand for credit function can be specified as

$$CR^d = f_{12}(Y^n, Y^o, r^f) \tag{4.29}$$

which means that the demand for credit depends on non-oil GDP and oil GDP as separate variables.

4.3.10 Stock Prices

The importance of stock markets stems from the fact that any volatility or a crisis in stock markets is bound to disturb other parts of the economy. According to Demir (2019), day-to-day volatility in stock markets can be caused by economic and political concerns. However, that does not mean that the stock markets are not affected by local and international macroeconomic factors.

Nelson (1976), Schwert (1981), Fama and French (1988), Asprem (1989), Chen and Jordan (1993), and Humpe and Macmillan (2009) investigated the macroeconomic determinants of stock prices and returns in developed markets. They found that stock prices are affected by variables such as interest rates, industrial production, consumer price index, and economic activity. Ibrahim (2003), Rahman et al. (2009), and Gunasekarage et al. (2004) examined the macroeconomic variables influencing stock prices in developing and emerging economies and found that variables such as the money supply, consumer price index, industrial production and exchange rate can determine stock prices.

As for the Kuwait stock market, Midani (1991) divided the determinants of individual stock prices into two sets, the first one included company performance factors (such as earnings per share, dividend per share, and debt to total assets). The second set included macroeconomic variables such as stock market index, exchange rate, and interest rate on 3-month US dollar deposits. The empirical findings revealed that only debt ratio, stock market index, and earnings per share are statistically significant. Al Mutairi and Al Omar (2007) examined the effect of macroeconomic variables on stock prices by employing a VAR technique to analyse monthly data covering the period from 1995 to 2005. The empirical findings reveal that macroeconomic variables have a relatively small effect on the behaviour of stock prices, which they attribute to the dominance of speculative expectation. Gharaibeh (2015) examines the determinants of stock prices by using a sample of companies listed on the KSE by using data covering the period 2008 to 2013. The model includes twelve firm-specific and macroeconomic variables such as dividend per share, money supply, GDP per capita, effective exchange rate, interest rate, the price to book value, and return on equity. The empirical results reveal that the main determinants of stock prices in KSE are GDP per capita, money supply, inflation rate, the tangibility of assets, profitability, and liquidity of the firm. However, interest rate, exchange rate, size of the company, and dividend per share are found to be statistically insignificant. Alshogeathri (2011) proposed to include bank loans when investigating the macroeconomic determinants of stock prices, on the grounds that credit to the private sector transmits financial shocks to the real sector through the stock market. He argues that understanding this channel can be utilised by monetary authorities by stimulating credit to the private sector in order to boost real activity.

It follows that stock prices in Kuwait depend on oil GDP, non-oil GDP and credit:

$$SP = f_{13}(CR, Y^n, Y^o) \qquad (4.30)$$

where SP represents stock prices. Non-oil GDP is used as a proxy for economic activity. Oil GDP is an explanatory variable because Kuwait is an oil-exporting country. Credit is a determinant of stock prices because it is common practice in Kuwait for investors to borrow from the local banks to invest in the stock market.

4.4 Behavioural and Definitional Equations

The model consists of thirteen equations that explain the behaviour of endogenous variables. In functional form the behavioural functional relations are as follows:

$$Y^n = f_1(G) \qquad (4.1)$$

$$Y^o = f_2(X) \qquad (4.3)$$

$$C^d = f_3(Y^p) \quad (4.12)$$

$$r^k = f_4(r^f) \quad (4.15)$$

$$DD^d = f_5(Y^p, r^k) \quad (4.13)$$

$$QM^d = f_6(Y^p, r^f) \quad (4.14)$$

$$R^d = f_7(C, NP) \quad (4.20)$$

$$D^s = f_8(R, r^k) \quad (4.21)$$

$$P = f_9(MS, P^m) \quad (4.22)$$

$$M = f_{10}(Y^n, Q) \quad (4.23)$$

$$CR^s = f_{11}(D, NP) \quad (4.28)$$

$$CR^d = f_{12}(Y^n, Y^o, r^f) \quad (4.29)$$

$$SP = f_{13}(CR, Y^n, Y^o) \quad (4.30)$$

The definitional equations and identities are listed below:

$$Y^p = \sum_{i=1}^{k} (Y^n + Y^o)_{t-i} \quad (4.11)$$

$$QM = SD + TD + FD \quad (4.10)$$

$$MS = C + DD + QM \quad (4.9)$$

$$NP = CL_{CEN} - CL_{COM} \quad (4.17)$$

$$CL_{CEN} = SW + DRD + D_{COM} \quad (4.18)$$

$$CL_{COM} = D_{CEN} + CBB \quad (4.19)$$

$$R = R_c + R_b + R_k \quad (4.16)$$

$$G = \frac{1}{n} \sum_{j=0}^{n} g_{t-i} \quad (4.2)$$

$$Q_t = W_0\left(\frac{E_t^0}{E_0^0}\right) + \sum_{j=1}^{k} W_j\left(\frac{E_t^{0,j}}{E_0^{0,j}}\right) \tag{4.24}$$

$$E^0 = \alpha_0 + \sum_{i=1}^{m} \alpha_i E^i \tag{4.25}$$

$$E^{0,i} = \frac{E^0}{E^i} \tag{4.26}$$

where the superscripts d and s denote demand and supply correspondingly. The definitions of the symbols are as follows:

Y^n = Non-oil GDP (Nominal)

G = Real Government Expenditure

Y^o = Oil GDP (Nominal)

X = Exports (Nominal)

C = Currency in Circulation

r^k = Three Months Interbank Rate

r^f = Three Months Eurodollar Interest Rate

DD = Demand Deposits

Y^p = Expected Income (Nominal)

QM = Quasi-Money

R = Reserves of Local Banks

R_c = Cash Reserves of the Local Banks

R_b = Balances of Local Banks with the Central Bank

R_k = Central Bank of Kuwait Bills Held by Local Banks

NP = Net Position of Local Banks with the Central Bank of Kuwait

D = Total Deposits

P = Consumer Price Index (Base Quarter 1995 Q1=100)

MS = Money Supply

P^m = Import Price Index (Base Quarter 1995 Q1=100)

M = Imports

Q = Real Effective Exchange rate

CR = Local Banks Credit to the Private Sector

SP = Stock Price Index

SD = Saving Deposits

TD = Time Deposits

FD = Foreign Currency Deposits

CL_{CEN} = Claims of the Central Banks of Kuwait on Local Banks

CL_{COM} = Claims of Local Banks on the Central Bank of Kuwait

SW = Currency Swaps

DRD = Discounts and Rediscounts

D_{COM} = Deposits of the Central Banks of Kuwait in the Local Banks

D_{CEN} = Deposits of the Local Bank in the Central Bank of Kuwait

CBB = Central Bank of Kuwait Bonds held by the Local Banks

4.5 Derivation of the Reduced-Form Equations

In this section, the reduced-form equations are derived and used to generate forecasts in chapter six, and the accuracy (quality) of the forecasts will be compared with the forecasts generated by utilising structural equations. Later on, the generated forecasts will be used to formulate several trading strategies and the profitability of the portfolios of the structural equations and the reduced-form equations forecasts will be compared. Figures 4.4 – 4.9 illustrate the effect of the exogenous variables in the model.

4.5.1 Non-Oil GDP

$$Y_t^n = \beta_0^1 + \beta_1^1 G_t + \varepsilon_{1t}$$

where

$$G_t = \gamma^1(L) g_t$$

and

$$\gamma^1(L) g_t = \sum_{i=1}^{k} \gamma_i g_{t-i}$$

4.5.2 Oil GDP

$$Y_t^o = \beta_0^2 + \beta_1^2 X_t + \varepsilon_{2t}$$

4.5.3 Demand for Currency

$$C_t^d = \beta_0^3 + \beta_1^3 Y_t^p + \varepsilon_{3t}$$

$$= \beta_0^3 + \beta_1^3 [\gamma^3(L) Y_t^n + \delta^3(L) Y_t^o] + \varepsilon_{3t}$$

$$= \beta_0^3 + \beta_1^3 [\gamma^3(L)(\beta_0^1 + \beta_1^1 G_t + \varepsilon_{1t}) + \delta^3(L)(\beta_0^2 + \beta_1^2 X_t + \varepsilon_{2t})] + \varepsilon_{3t}$$

$$= (\beta_0^3 + \beta_1^3 \beta_0^1 + \beta_1^3 \beta_0^2) + \beta_1^3 \beta_1^1 G_t + \beta_1^3 \beta_1^2 X_t + (\beta_1^3 \varepsilon_{1t} + \varepsilon_{2t} + \varepsilon_{3t})$$

4.5.4 KD Interest Rate

$$r_t^k = \beta_0^4 + \beta_1^4 r_t^f + \varepsilon_{4t}$$

4.5.5 Demand for Demand Deposit

$$DD_t^d = \beta_0^5 + \beta_1^5 Y_t^p + \beta_2^5 r_t^k + \varepsilon_{5t}$$

$$= \beta_0^5 + \beta_1^5 [\gamma^5(L) Y_t^n + \delta^5(L) Y_t^o] + \beta_2^5 \left(\beta_0^4 + \beta_1^4 r_t^f\right) + \varepsilon_{5t}$$

$$= \beta_0^5 + \beta_1^5 [\gamma^5(L)(\beta_0^1 + \beta_1^1 G_t + \varepsilon_{1t}) + \delta^5(L)(\beta_0^2 + \beta_1^2 X_t + \varepsilon_{2t})]$$

$$+ \beta_2^5 \left(\beta_0^4 + \beta_1^4 r_t^f + \varepsilon_{4t}\right) + \varepsilon_{5t}$$

4.5.6 Demand for Quasi-Money

$$QM_t^d = \beta_0^6 + \beta_1^6 Y_t^p + \beta_2^6 r_t^f + \varepsilon_{6t}$$

$$= \beta_0^6 + \beta_1^6[\gamma^6(L)(\beta_0^1 + \beta_1^1 G_t + \varepsilon_{1t}) + \delta^6(L)(\beta_0^2 + \beta_1^2 X_t + \varepsilon_{2t}) + \beta_2^6 r_t^f + \varepsilon_{6t}$$

4.5.7 Demand for Reserves

$$R_t^d = \beta_0^7 + \beta_1^7 C_t + \beta_2^7 NP_t + \varepsilon_{7t}$$

$$= \beta_0^7 + \beta_1^7 Y_t^p + \beta_2^7 NP_t + \varepsilon_{7t}$$

$$= \beta_0^7 + \beta_1^7[\gamma^7(L)Y_t^n + \delta^7(L)Y_t^o] + \beta_2^7 NP_t + \varepsilon_{7t}$$

$$= \beta_0^7 + \beta_1^7[\gamma^7(L)(\beta_0^1 + \beta_1^1 G_t + \varepsilon_{1t}) + \delta^7(L)(\beta_0^2 + \beta_1^2 X_t + \varepsilon_{2t})] + \beta_2^7 NP_t + \varepsilon_{7t}$$

4.5.8 Supply of Deposits

$$D_t^s = \beta_0^8 + \beta_1^8 R_t + \beta_2^8 r_t^k + \varepsilon_{8t}$$

$$= \beta_0^8 + \beta_1^8[\beta_0^7 + \beta_1^7[\gamma^7(L)(\beta_0^1 + \beta_1^1 G_t + \varepsilon_{1t}) + \delta^7(L)(\beta_0^2 + \beta_1^2 X_t + \varepsilon_{2t})] + \beta_2^7 NP_t$$

$$+ \varepsilon_{7t}] + \beta_2^8 r_t^f + \varepsilon_{8t}$$

4.5.9 The General Price Level

$$P_t = \beta_0^9 + \beta_1^9 MS_t + \beta_2^9 P_t^m + \varepsilon_{9t}$$

$$= \beta_0^9 + \beta_1^9[C_t + D_t^s] + \beta_2^9 P_t^m + \varepsilon_{9t}$$

$$= \beta_0^9 + \beta_1^9\left[\left(\beta_0^3 + \beta_1^3 Y_t^p + \varepsilon_{3t}\right) + \left(\beta_0^8 + \beta_1^8 R_t + \beta_2^8 r_t^k + \varepsilon_{8t}\right)\right] + \beta_2^9 P_t^m + \varepsilon_{9t}$$

Expanding this equation will be rather cumbersome, in which ever it is easier to use functional forms. We have

$$P_t = f_9(Y_t^p, R_t, r_t^k, P_t^m)$$

$$R_t = f_7(C_t, NP_t)$$

$$Y_t^n = f_1(G_t)$$

$$Y_t^o = f_2(X_t)$$

$$r_t^k = f_4(r_t^f)$$

Therefore, the reduced-form equation for price is written in a functional form as

$$P_t = f_9(G_t, NP_t, X_t, r_t^f, P_t^m)$$

4.5.10 Imports

$$M_t = \beta_0^{10} + \beta_1^{10} Y_t^n + \beta_2^{10} Q_t + \varepsilon_{10t}$$

$$= \beta_0^{10} + \beta_1^{10}(\beta_0^1 + \beta_1^1 G_t + \varepsilon_{1t}) + \beta_2^{10} Q_t + \varepsilon_{10t}$$

$$= \beta_0^{10} + \beta_1^{10}\beta_0^1 + \beta_1^{10}\beta_1^1 G_t + \beta_1^{10}\varepsilon_{1t} + \beta_2^{10} Q_t + \varepsilon_{10t}$$

$$= (\beta_0^{10} + \beta_1^{10}\beta_0^1) + \beta_1^{10}\beta_1^1 G_t + \beta_2^{10} Q_t + (\varepsilon_{10t} + \beta_1^{10}\varepsilon_{1t})$$

4.5.11 Supply of Credit

$$CR_t^s = \beta_0^{11} + \beta_1^{11} D_t + \beta_2^{11} NP_t + \varepsilon_{11t}$$

Again, this equation is written in a functional form as:

$$CR_t^s = f_{11}(D_t, NP_t)$$

Since

$$D_t = f_8(G_t, X_t, NP_t, r_t^f)$$

It follows that

$$CR_t^s = f_{11}(G_t, X_t, NP_t, r_t^f)$$

4.5.12 Demand for Credit

$$CR_t^D = f_{12}(Y_t^n, Y_t^o, r_t^f)$$

$$= f_{12}(G_t, X_t, r_t^f)$$

4.5.12 Stock Price

$$SP_t = f_{13}(CR_t, Y_t^n, Y_t^o)$$

It follows that

$$SP_t = f_{13}(G_t, NP_t, r_t^f, X_t)$$

Figure 4.4: Factors Affecting Price Level

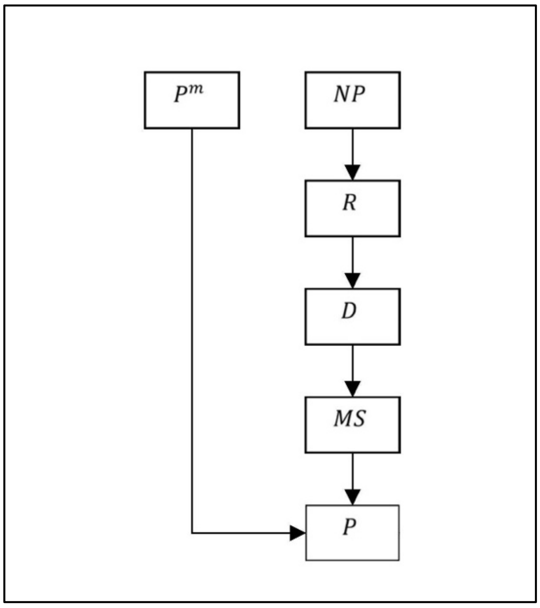


Figure 4.5: The Effect of Foreign Interest Rate

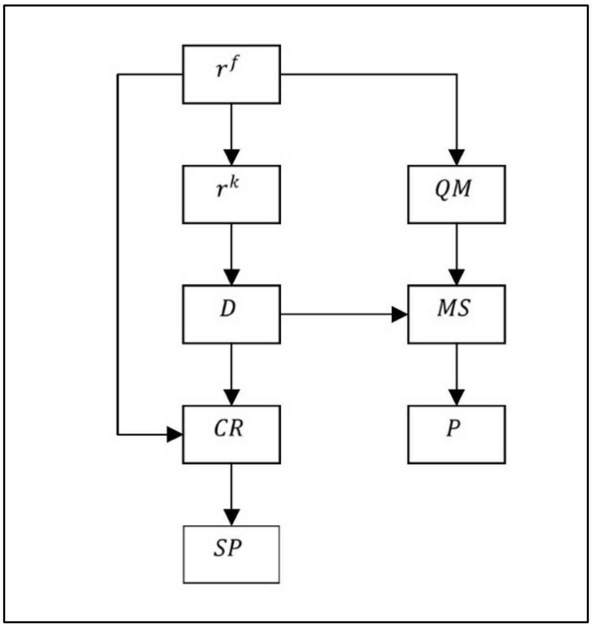


Figure 4.6: The Effect of Government Expenditure

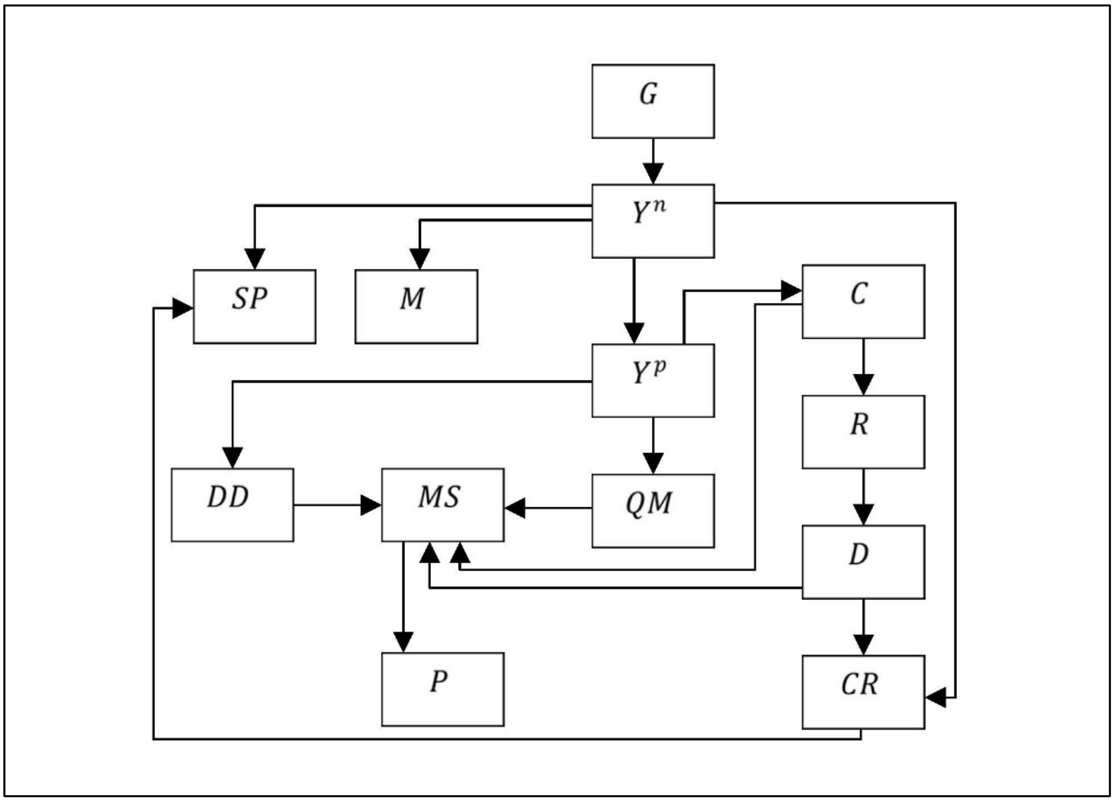


Figure 4.7: Factors Affecting Stock Prices

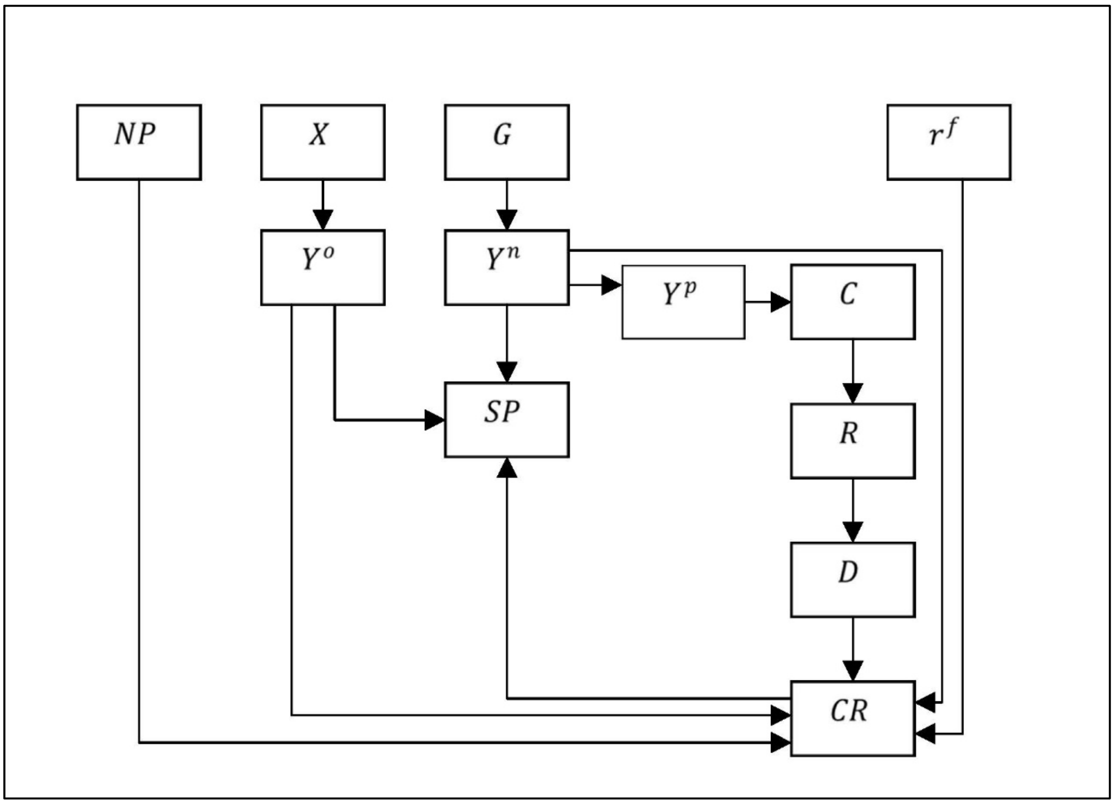


Figure 4.8: The Effect of Exports

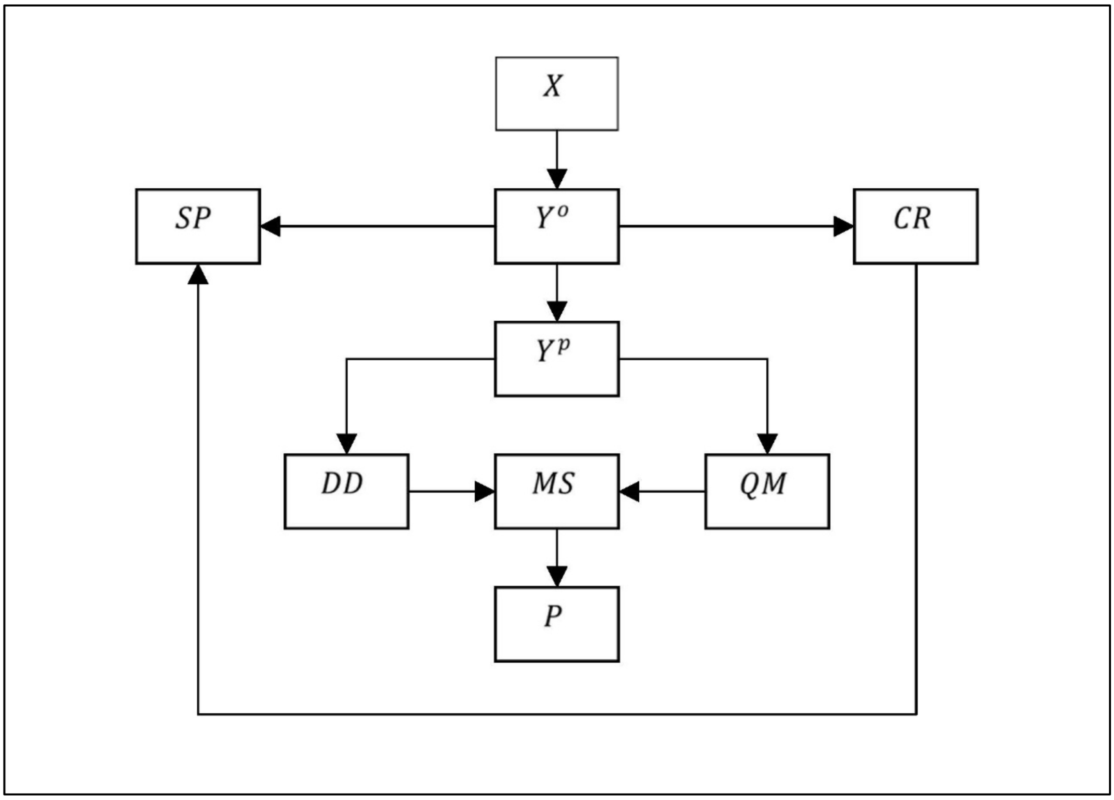
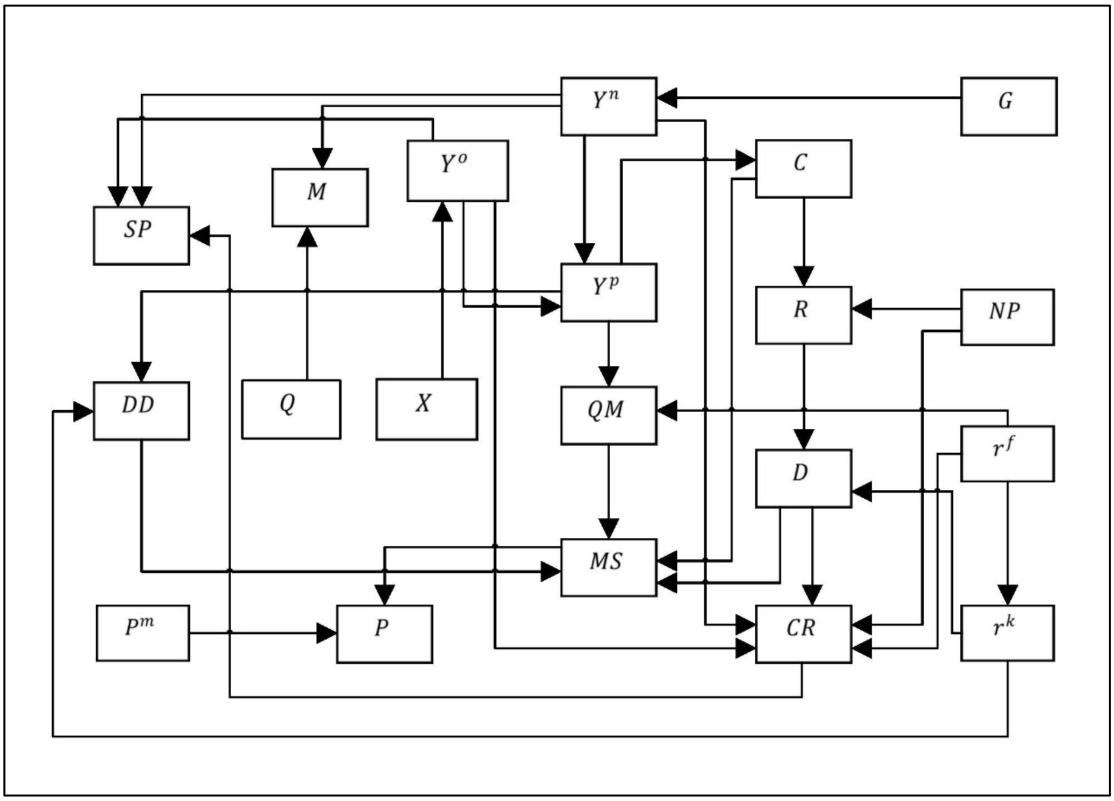


Figure 4.9: The Interaction of Real and Financial Variables



4.6 Derivation of the Equilibrium Conditions

For simplicity, time subscript and residuals will be deleted. Three equilibrium conditions are derived for the money stock, total deposits and credit.

4.6.1 Money Stock

$$C^d = \beta_0^3 + \beta_1^3 Y^p$$

$$DD^d = \beta_0^5 + \beta_1^5 Y^p + \beta_2^5 r^k$$

$$QM^d = \beta_0^6 + \beta_1^6 Y^p + \beta_2^6 r^f$$

$$MS = C^d + DD^d + QM^d$$

$$MS = (\beta_0^3 + \beta_0^5 + \beta_0^6) + (\beta_1^3 + \beta_1^5 + \beta_1^6) Y^p + \beta_2^5 r^k + \beta_2^6 r^f$$

For simplicity, the final specification is expressed in functional form. Since $Y^n = f_1(G)$, $Y^p = f_2(X)$ and $r^k = f_4(r^f)$, it follows that $MS = f(G, X, r^f)$.

4.6.2 Total Deposits

$$DD^d + QM^d = D^s$$

$$\beta_0^5 + \beta_1^5 Y^p + \beta_2^5 r^k + \beta_0^6 + \beta_1^6 Y^p + \beta_2^6 r^f = \beta_0^8 + \beta_1^8 R + \beta_2^8 r^k$$

$$r^k = \frac{\beta_0^5 + \beta_0^6 + \beta_0^8 + \beta_2^6 r^f + \beta_1^8 R}{-(\beta_2^5 + \beta_2^8)} + (\beta_1^5 - \beta_1^6) Y^p$$

4.6.3 Credit

$$CR^s = f_{11}(D, NP)$$

$$CR^d = f_{12}(Y^n, Y^o, r^f)$$

$$CR = f(D, NP, Y^n, Y^o, , r^f)$$

which means that the equilibrium quantity of credit in the economy is determined by supply and demand factors. By replacing the endogenous variables with the reduced form equations, we arrive at a specification of the equilibrium condition in terms of the exogenous variables only.

4.7 Model Recursiveness and Implication

The model consists of thirteen behavioural equations that are listed in a specific order which is highly relevant to model estimation because it is recursive. A system of equations is recursive if dependency of the endogenous variables runs in a unidirectional way. Brooks (2014) notes that, in a recursive model for known values of exogenous variables, endogenous variables could be determined one at a time sequentially rather than simultaneously. A recursive model can be estimated by OLS.

Recursive or block recursive systems appear frequently in models of developing countries. According to Duncan (1975), a system of equations is recursive when all causal effects are unidirectional. Hence, the first endogenous variable is affected only by the exogenous variables. The second endogenous variable is affected only by the exogenous variables and the first endogenous variable, and so on. For example, Given the value of r^k we can solve for D^s, and given the value of D we can solve for CD^s, given the value of CR we can solve for SP, and so on. All the disturbance terms in the model are assumed to be uncorrelated. One benefit of using recursive equations is that they are easy to estimate.

An example of how a recursive system works is the following three equations containing one exogenous variable (X) and three endogenous variables (Y_1, Y_2, Y_3)

$$Y_1 = \beta_1 X + \varepsilon_1 \tag{4.31}$$

$$Y_2 = \beta_2 X + \gamma_1 Y_1 + \varepsilon_2 \tag{4.32}$$

$$Y_3 = \beta_3 X + \gamma_2 Y_1 + \delta_1 Y_2 + \varepsilon_3 \tag{4.33}$$

It is evident from the structure of the three equations that there is a unidirectional relation between the endogenous variables. For example, Y_1 affects Y_2, but Y_2 does not affect Y_1 directly or indirectly. Correspondingly, Y_2 affects Y_3 while Y_3 does not influence Y_2 and so on. According to Wold (1959), if the error terms in a recursive model are not correlated, then this system is considered diagonally recursive or triangular. Subsequently, every equation in the model can be estimated by OLS because in a recursive system, the exogenous variables and the error terms in every equation are not correlated. According to Moosa (1986a), for the estimation of recursive models, 2SLS does not have any advantage over OLS.

Work on recursive systems can be traced back to Wold (1949) who criticised the assumption of simultaneity (the notion that everything occurs at the same time) on the grounds that a true description of economic events has to be a long a temporal sequence. For example, current consumption cannot be a function of current income since income must earned before it is spent. He even argued that simultaneity represents misspecification because what appears to be simultaneous occurrence is a consequence of data availability over long intervals. Other prominent economists and econometricians have advocated the use of recursive systems. For example, Theil (1971) argued that Wold had contributed to a better understanding of recursive models. Fisher (1970) has suggested that simultaneous models are limited approximation to non-simultaneous models in which certain time lags converge to zero. Tobin (1982) implicitly defended recursive models by stating that simultaneous equations systems are convenient representation of interdependence, but it is more persuasive to think of economic processes that solve them as taking time than as working instantaneously. Recursive systems have been used in empirical research by, *inter alia*, Andersen and Carlson (1970), Crouch (1967) and Laidler (1973). An extensive discussion of recursive models can be found in Moosa (1986c).

4.8 Summary

This chapter presented a model describing interactions between real and financial variables in the economy of Kuwait. The model consists of thirteen behavioural equations describing economic activity, oil GDP, money, domestic interest rate, supply of deposits, price level, imports, supply and demand of credit, and stock prices. The money demand function is disaggregated into currency in circulation, demand deposits and quasi-money, which makes it possible to examine the effects of different economic variables on the components of money. The model is specified in functional form and the definitions of the variables are presented. Then, the reduced-form equations are derived, and the equilibrium conditions are presented. The last section of this chapter is concerned with the implications of the model's recursiveness.

CHAPTER 5

MODEL ESTIMATION

5.1 Introduction

The main objective of this chapter is to estimate the model specified in chapter four to provide an analytical framework to determine the behaviour of many economic variables by tracing the interactions between the monetary sector and real sector and how they affect each other. The model makes it possible to quantify the connection between financial, monetary and real variables in a macroeconomic framework.

Macroeconometric models are useful in structural analysis, forecasting and policy evaluation. Intriligator et al. (1996) suggest that models must pass several parametric tests before being used. The parametric tests they suggested can be summarised as: (i) testing the statistical significance of the estimated parameters; (ii) checking the expected sign of the estimated parameters based on the relevant economic theory; (iii) conducting diagnostic tests for serial correlation, functional form, normality, and heteroscedasticity; and (iv) checking for structural breaks and using dummy variables when breaks are found in any equation. They argue that the model builder should make sure that the results of the policy simulations are in line with economic theory. However, when the results are not in line with economic theory, the model builder should provide an explanation for the results.

The chapter is divided into five sections. The first section is an introduction, whereas section two is concerned with the estimation method. The third section looks at the data and the estimation results. The fourth section looks at the elasticities, and the last section contains some concluding remarks.

5.2 Estimation Method

The functional relations will be estimated in three forms: (i) ARDL, (ii) the static long-run relation, and (iii) the error correction model. For a general functional relation, $z = f(x)$, the three forms can be written as

$$z_t = \alpha_0 + \sum_{j=1}^{n} \alpha_{1j} z_{t-j} + \sum_{j=0}^{m} \alpha_{2j} x_{t-j} + \varepsilon_t \tag{5.1}$$

$$z_t = \beta_0 + \beta_1 x_t + \xi_t \tag{5.2}$$

$$\Delta z_t = \gamma_0 + \sum_{j=1}^{n} \gamma_{1j} \Delta z_{t-j} + \sum_{j=0}^{m} \gamma_{2j} \Delta x_{t-j} + \varphi \xi_{t-1} + \zeta_t \tag{5.3}$$

The autoregressive-distributed lag method enables the derivation of the error correction model through a linear transformation. The general autoregressive-distributed lag (ARDL) is specified as

$$\phi(L,p) z_t = \sum_{i=1}^{n} \beta_i(L,q_i) x_{it} + \delta' w_t + \varepsilon_t \tag{5.4}$$

where n denotes the number of explanatory variables, L represents the lag operator (such that $L z_t = z_{t-1}$), w_t is a vector of deterministic variables such as the time trends or intercept term or exogenous variables, and $\beta_i(L,q_i)$ and $\phi(L,p)$ are a polynomial lag operators such that

$$\phi(L,p) = 1 - \phi_1 L - \phi_2 L^2 - \phi_3 L^3 - \cdots - \phi_p L^p \tag{5.5}$$

$$\beta_i(L,q_i) = 1 - \beta_{i1} L - \beta_{i2} L^2 - \beta_{i3} L^3 - \cdots - \beta_{iq_i} L^{q_i} \qquad (i = 1,2,3, \ldots m) \tag{5.6}$$

The long-run coefficients for the response of z_t to a unit change in x_{it} are calculated as follows:

$$\hat{\theta}_i = \frac{\hat{\beta}_i(1, \hat{q}_i)}{\hat{\phi}(1, \hat{p})} = \frac{\hat{\beta}_{i0} + \hat{\beta}_{i1} + \hat{\beta}_{i2} + \cdots + \hat{\beta}_{i\hat{q}_i}}{1 - \hat{\phi}_1 - \hat{\phi}_2 - \hat{\phi}_3 - \cdots - \hat{\phi}_{\hat{p}}} \tag{5.7}$$

where $\hat{q}_i$ and $\hat{p}$ are selected values (lags) of p and q_i where the lag lengths are selected based on several criteria such as Akaike and Schwarz information criteria. Correspondingly, the long-run coefficients associated with the deterministic variables (trends or intercept … etc) are calculated by

$$\hat{\psi} = \frac{\hat{\delta}(\hat{p}_1, \hat{q}_1, \hat{q}_2, \hat{q}_3, \dots, \hat{q}_n)}{1 - 1 - \hat{\phi}_1 - \hat{\phi}_2 - \hat{\phi}_3 - \cdots - \hat{\phi}_{\hat{p}}} \tag{5.8}$$

where $\hat{\delta}(\hat{p}_1, \hat{q}_1, \hat{q}_2, \hat{q}_3, \dots, \hat{q}_n)$ represents the OLS estimate of δ in equation (5.4) for the selected ARDL model. The asymptotic standard errors of $\hat{\psi}$ and $\hat{\theta}_i$ are estimated by utilising the Bewley (1979) transformation. Subsequently, the error correction model that is associated to the ARDL model specified in equation (5.4) can be derived by writing equation (5.4) in terms of the lagged levels and the first differences of the variables. The model is written as

$$z_t = \Delta z_t + z_{t-1} \tag{5.9}$$

$$z_{t-s} = z_{t-1} - \sum_{j=1}^{r-1} \Delta z_{t-j}, \quad r = 1,2,3, \dots, p \tag{5.10}$$

Likewise

$$w_t = \Delta w_t + w_{t-1} \tag{5.11}$$

$$x_{it} = \Delta x_{it} + x_{i,t-1} \tag{5.12}$$

$$x_{i,t-r} = x_{i,t-1} - \sum_{j=1}^{r-1} \Delta x_{i,t-j}\,, \quad r = 1,2,3, \dots, q_i \tag{5.13}$$

By substituting (5.9) to (5.13) into the general ARDL model in equation (5.4) and after few rearrangements, the resulting equation is

$$\Delta z_t = -\phi(1,\hat{p})E_{t-1} + \sum_{i=1}^{n} \beta_{i0}\Delta x_{it} + \delta' w_t - \sum_{j=1}^{\hat{p}-1} \phi_j^* \Delta z_t - j - \sum_{i=1}^{n} \sum_{j=1}^{\hat{q}_i-1} \beta_{i,t-j}^* + u_t \quad (5.14)$$

where E represents the error correction term that is defined by

$$E_t = z_t - \sum_{i=1}^{n} \hat{\theta}_{ix_{it}} - \widehat{\psi'} w_t \quad (5.15)$$

The quantitative importance of the error correction term is measured by the coefficient $\phi(1,\hat{p}) = 1 - \hat{\phi}_1 - \hat{\phi}_2 - \hat{\phi}_3 - \cdots - \hat{\phi}_{\hat{p}}$. The remaining coefficients ϕ_j^* and β_{ij}^*, which relate to short-run dynamics of the model's convergence to equilibrium, are given by

$$\begin{bmatrix} \phi_1^* \\ \phi_2^* \\ \phi_3^* \\ \vdots \\ \phi_{\hat{p}-1}^* \end{bmatrix} = \begin{bmatrix} \phi_{\hat{p}} \\ \phi_{\hat{p}} \\ \phi_{\hat{p}} \\ \vdots \\ \phi_{\hat{p}} \end{bmatrix} + \begin{bmatrix} \phi_{\hat{p}-1} \\ \phi_{\hat{p}-1} \\ \phi_{\hat{p}-1} \\ \vdots \\ 0 \end{bmatrix} + \cdots + \begin{bmatrix} \phi_3 \\ \phi_3 \\ 0 \\ \vdots \\ 0 \end{bmatrix} + \begin{bmatrix} \phi_2 \\ 0 \\ \vdots \\ 0 \\ 0 \end{bmatrix} \quad (5.16)$$

and correspondingly

$$\begin{bmatrix} \beta_{i1}^* \\ \beta_{i2}^* \\ \beta_{i3}^* \\ \vdots \\ \beta_{i,\hat{q}_i-1}^* \end{bmatrix} = \begin{bmatrix} \beta_{i,\hat{q}_i} \\ \beta_{i,\hat{q}_i} \\ \beta_{i,\hat{q}_i} \\ \vdots \\ \beta_{i,\hat{q}_i} \end{bmatrix} + \begin{bmatrix} \beta_{i,\hat{q}_i-1} \\ \beta_{i,\hat{q}_i-1} \\ \beta_{i,\hat{q}_i-1} \\ \vdots \\ 0 \end{bmatrix} + \cdots + \begin{bmatrix} \beta_{i,3} \\ \beta_{i,3} \\ 0 \\ \vdots \\ 0 \end{bmatrix} + \begin{bmatrix} \beta_{i,2} \\ 0 \\ \vdots \\ 0 \\ 0 \end{bmatrix} \quad (5.17)$$

The parameters of the error correction model (ECM) specified in equation (5.14) are estimated from the coefficients of the ARDL model using the above relations.

The empirical analysis is carried out using Microfit 5.5 software. To evaluate the statistical and theoretical appropriateness of the behavioural equations, the results are validated by using a set of diagnostic tests for serial correlation, functional form, normality, and heteroscedasticity. The diagnostic test for the presence of serial correlation (SC) is the Lagrange Multiplier (LM) test of residual serial correlation (the null is no serial correlation), which is distributed as $\chi^2(4)$. The test for normality (NO) is based on a test of skewness and kurtosis of residuals, which is distributed as $\chi^2(2)$. The functional form (FF) diagnostic test is based on Ramsey (1969) RESET test using the square of the fitted values, which is distributed as $\chi^2(1)$. The heteroscedasticity (HS) diagnostic test is based on a regression of squared residuals on squared fitted values, which is distributed as $\chi^2(1)$. The 5% critical values of the chi-square distribution are 3.841 for $\chi^2(1)$, 5.991 for $\chi^2(2)$, and 9.488 for $\chi^2(4)$.[5]

5.3 Data and Estimation Results

The data required for estimating the model is macroeconomic historical data. The empirical analysis in this chapter is based on quarterly data series for the period 1995 to 2017. The data are mainly collected by using the Bloomberg Terminal and Thomson Reuters DataStream in addition to the reports published by the Central Bank of Kuwait, which are publicly available on the Bank's website.

In this section, the estimation results for each equation are presented in a different subsection. The first equation is the autoregressive-distributed lag (5.1) and the figures in parentheses are the conventional t-statistics. Moreover, the diagnostic tests for serial correlation, functional form, normality, and heteroscedasticity will be

[5] The LM test for serial correlation can be found in Godfrey (1978a, 1978b), Breusch and Pagan (1980) and Breusch and Godfrey (1981) The normality test is the Jarque-Bera (1980) test. The functional form test is Ramsey's (1961) RESET test. The heteroscedasticity test can be found in Koenker (1981).

presented (underneath the t-statistics) in addition to R^2 to demonstrate the goodness of fit.

The second and third equations (5.2 and 5.3, respectively) are the static long-run relation and the error correction model respectively. Both of these equations are used to test for cointegration to detect the presence, or otherwise, of a stable long-run relation between the variables. The first one is the bounds test, where the F-statistic and W-statistic are estimated and compared to the upper and lower critical values (bounds). If the test statistic is above the upper bound, the null hypothesis of no cointegration can be rejected, meaning that the variables are cointegrated. Conversely, when the test statistic is below the lower bound, the null hypothesis of no cointegration cannot be rejected, signifying that the variables are not cointegrated. Additionally, when a test statistic falls between the upper and lower bounds, this means that the cointegration test is inconclusive. The bounds test and the error correction model are explained in more detail in chapter three.

5.3.1 Non-Oil GDP

$$Y_t^n = 61.439 + 1.960\, Y_{t-1}^n - 25.131\, Y_{t-2}^n + 0.023\, G_t$$
$$\qquad (2.51) \qquad (52.33) \qquad (-25.12) \qquad (2.29)$$
$$R^2 = 0.99 \quad SC = 7.33 \quad FF = 8.57 \quad NO = 0.86 \quad HS = 2.39$$

$$Y_t^n = 7067 + 2.702\, G_t$$
$$\qquad (3.43) \quad (4.77)$$
$$F = 2.85 \qquad W = 5.71$$

$$\Delta Y_t^n = 0.968\, \Delta Y_{t-1}^n + 0.023\, \Delta G_t - 0.009\, \varepsilon_{t-1}$$
$$\qquad (25.13) \qquad (2.19) \qquad (-2.25)$$
$$R^2 = 0.90 \qquad \bar{R}^2 = 0.89 \quad LL = -448.96$$

The estimation results show that the coefficients of all of the regressors have the hypothesised signs and are statistically significant at the five per cent level in the sense that the t-ratio is equal to or more than two in absolute value. The estimated ARDL equation is reasonably well determined in the sense of having high explanatory power (goodness of fit) and passes all of the diagnostic tests except functional form (FF).

The estimation results for the non-oil GDP function reveal that government expenditure is an important determinant of economic activity, such that an increase in government expenditure boosts economic activity. The estimated ARDL shows that government expenditure has a positive and significant effect on non-oil GDP. The results are in line with the findings of many previous studies such as Loizides and Vamvoukas (2005), Jiranyakul and Brahmasrene (2007), Attari and Javed (2013), and Ebaid and Bahari (2019). Given that the 5% critical values for the F statistic are 5.15 – 5.92 and 10.30 – 11.83 for the W statistic, the null hypothesis of no cointegration between the non-oil GDP and government expenditure could not be rejected. However, the error correction test for cointegration indicates the presence of cointegration between the variables.

5.3.2 Oil GDP

$$Y_t^o = \underset{(1.11)}{55.905} + \underset{(55.13)}{1.421}\, Y_{t-1}^o - \underset{(-22.61)}{0.630}\, Y_{t-2}^o + \underset{(10.78)}{0.469}\, X_t + \underset{(2.01)}{2.009}\, X_{t-1} + \underset{(3.14)}{0.195}\, X_{t-2}$$

$$R^2 = 0.99 \quad SC = 7.84 \quad FF = 8.06 \quad NO = 5.36 \quad HS = 1.71$$

$$Y_t^o = \underset{(1.10)}{267.757} + \underset{(69.45)}{3.773}\, X_t$$

$$F = 81.44 \qquad W = 162.88$$

$$\Delta Y_t^o = \underset{(22.61)}{0.630}\, \Delta Y_{t-1}^o + \underset{(10.78)}{0.469}\, \Delta X_t - \underset{(-3.14)}{0.195}\, \Delta X_{t-1} - \underset{(-12.50)}{0.208}\, \varepsilon_{t-1}$$

$$R^2 = 0.96 \qquad \bar{R}^2 = 0.96 \quad LL = -546.28$$

The estimated ARDL equation is reasonably well determined, in the sense of having high explanatory power (goodness of fit) and passes all of the diagnostic tests except functional form (FF). All of the coefficients are correctly signed in accordance with economic theory and are statistically significant. The results show that exports have a positive and significant effect on oil GDP, which is rather intuitive. Oil GDP is cointegrated with exports based on the error correction and bounds cointegration tests.

5.3.3 Demand for Currency

$$C_t^d = 3.222 + 0.421\, C_{t-1}^d + 0.437\, C_{t-2}^d + 0.134\, Y_t^p - 0.271\, Y_{t-1}^p + 0.143\, Y_{t-2}^p$$
(0.16) (3.98) (4.36) (3.12) (-3.15) (3.20)

$R^2 = 0.98 \quad SC = 8.17 \quad FF = 0.57 \quad NO = 82.75 \quad HS = 2.91$

$$C_t^d = 0.162 + 0.039\, Y_t^p$$
(0.16) (7.03)

$F = 4.98 \qquad W = 9.97$

$$\Delta C_t^d = -0.437\, \Delta C_{t-1}^d + 0.134\, \Delta Y_t^p - 0.143\, \Delta Y_{t-1}^p - 0.141\, \varepsilon_{t-1}$$
(-4.36) (3.12) (-3.20) (-2.67)

$R^2 = 0.31 \qquad \bar{R}^2 = 0.26 \quad LL = -459.41$

The estimated demand for currency function indicates that the autoregressive distributed lag equation has a high explanatory power since the R^2 is equal to 0.98 and it passes all of the diagnostic tests except normality (NO). However, failing to pass the normality test (NO) is attributed to the presence of outliers rather than misspecification. All the coefficients are correctly signed in accordance with economic theory and are statistically significant. Moreover, an increase in permanent income will have a positive influence on the demand for currency. The null hypothesis of no cointegration between the demand for currency and permanent income could not be rejected based on the $F$and W statistics. However, the error correction test indicates the presence of cointegration between the variables, which means there is a stable long-run relation between permanent income and the demand for currency.

5.3.4 KD Interest Rate

$$r_t^k = 0.135 + 0.738\, r_{t-1}^k + 0.773\, r_t^f - 0.517\, r_{t-1}^f$$
(1.47) (9.86) (6.57) (-3.72)
$R^2 = 0.96 \quad SC = 1.47 \quad FF = 1.12 \quad NO = 26.83 \quad HS = 0.27$

$$r_t^k = 0.516 + 0.978\, r_t^f$$
(1.67) (10.27)
$F = 6.15 \quad W = 12.30$

$$\Delta r_t^k = 0.773\, \Delta r_t^f - 0.262\, \varepsilon_{t-1}$$
(6.57) (-3.51)
$R^2 = 0.43 \quad \bar{R}^2 = 0.41 \quad LL = -51.33$

The results show that the coefficients on all the regressors have the hypothesised signs and are statistically significant at the five per cent level. The autoregressive distributed lag equation is reasonably well determined in the sense of having high goodness of fit, since the R^2 is equal to 0.96, and it passes all the diagnostic tests apart from normality (NO).

The results show that the foreign interest rate has a positive and significant effect on the domestic interest rate. The coefficient on the foreign interest rate indicates that a 1% increase in foreign interest rate leads to a 0.773% rise in the domestic interest rate. Additionally, all of the coefficients are correctly signed in accordance with economic theory and are statistically significant. The findings are in line with previous studies such as Edwards and Khan (1985) Moosa (1986c) and Salih et al. (1991). The null hypothesis of no cointegration between the domestic interest rate and the foreign interest rate is rejected based by the F and W statistics. Likewise, the error correction test for cointegration indicates that variables are cointegrated.

5.3.5 Demand for Demand Deposits

$$DD_t^d = 113.31 + 0.688\, D_{t-1} - 0.048\, D_{t-2} + 0.300\, D_{t-3} + 0.008\, Y^p - 47.158\, r^k$$
(2.80) (6.66) (-0.38) (3.06) (2.01) (-2.98)

$R^2 = 0.99$ $SC = 6.97$ $FF = 0.20$ $NO = 6.28$ $HS = 2.25$

$$DD_t^d = 5271.8 + 0.136\, Y_t^p - 782.91\, r^k$$
(2.01) (3.15) (-2.20)

$F = 5.82$ $W = 15.84$

$$\Delta DD^d = -0.251\, \Delta DD_{t-1} - 0.300\, \Delta DD_{t-2} + 0.008\, \Delta Y_t^p - 47.15\, \Delta r^k - 0.060\, \varepsilon_{t-1}$$
(-2.51) (-2.21) (2.86) (-2.98) (-2.58)

$R^2 = 0.23$ $\bar{R}^2 = 0.90$ $LL = -601.19$

The results show that the coefficients on all of the regressors have the hypothesised signs and are consistent with theoretical predictions. The ARDL equation has an $R^2$of 0.99, which means it has a high explanatory power. All the diagnostic tests are passed apart from normality (NO), which is caused by the presence of outliers not misspecification.

All the coefficients are statistically significant except for the second lag of total deposits D_{t-2} because the t-ratio is equal to -0.38. The coefficient on domestic interest rate shows a negative and significant effect on the demand for demand deposits in Kuwait. On the other hand, the coefficient of permanent income indicates a positive and significant effect on the demand for demand deposits. These findings are consistent with the results of Mark and Sul (2003), Oomes and Ohnsorge (2005), Fidrmuc (2009) and Narayan (2010).

The null hypothesis of no cointegration between the domestic interest rate and foreign interest rate is rejected based on the W statistic. However, the F statistic is between the upper bound and lower bound, meaning that it is inconclusive. On the other hand, the error correction test for cointegration indicate the presence of cointegration between the variables, which is in line with previous studies such as those of Bahmani-Oskooee and Wang (2007) and Lee et al. (2019).

5.3.6 Demand for Quasi-Money

$$QM_t^d = 28.60 + 0.94\, QM_{t-1} + 0.035\, Y_t^p - 415.04\, r_t^f + 827.40\, r_{t-1}^f - 282.63\, r_{t-2}^f$$
(0.12) (41.75) (3.05) (-3.04) (3.65) (-2.86)

$R^2 = 0.99 \quad SC = 6.81 \quad FF = 3.74 \quad NO = 3.70 \quad HS = 2.48$

$$QM_t^d = 556.909 + 0.689\, Y_t^p + 578.75\, r_t^f$$
(0.12) (4.75) (0.69)

$F = 2.85 \quad W = 8.57$

$$\Delta QM_t^d = 0.035\, \Delta Y_t^p - 415.04\, \Delta r_t^f + 382.63\, \Delta r_{t-1}^f - 0.051\, \varepsilon_{t-1}$$
(3.05) (-3.04) (2.86) (-2.62)

$R^2 = 0.26 \quad \bar{R}^2 = 0.21 \quad LL = -602.45$

The estimated quasi-money demand function reveals that quasi-money demand responds negatively to foreign interest rate and that the response is statistically significant. Furthermore, the estimated coefficient on permanent income indicates a positive and statistically significant relationship between permanent income and the demand for quasi-money. The findings are in accordance with the results of Fidrmuc (2009), Abdullah et al. (2010), and Valadkhani (2008).

The autoregressive distributed lag equation is well determined in the sense of having explanatory power since the R^2 is equal to 0.99 and it passes all of the diagnostic tests. All of the coefficients are statistically significant and correctly signed in accordance with economic theory. Furthermore, the null hypothesis of no cointegration between the demand for quasi-money, permanent income and foreign interest rate could not be rejected based on the W and F statistics. Likewise, the error correction test for cointegration indicates the presence of cointegration between the variables, which is in line with the finding of Bahmani-Oskooee and Wang (2007) and Narayan et al. (2009).

5.3.7 Demand for Reserves

$$R_t^d = -37.718 + 0.932\, R_{t-1} + 1.641\, C_t - 1.503\, C_{t-1} - 0.871\, NP_t + 0.800\, NP_{t-1}$$
$$\quad\; (-0.49) \qquad (25.47) \qquad (5.49) \qquad (-5.02) \qquad (-17.16) \qquad (12.55)$$
$$R^2 = 0.99 \quad SC = 9.45 \quad FF = 2.27 \quad NO = 43.68 \quad HS = 1.09$$

$$R_t^d = -528.93 + 2.056\, C_{t-1} - 1.063\, NP_t$$
$$\quad\; (-0.43) \qquad (2.88) \qquad (-2.43)$$
$$F = 3.35 \qquad W = 10.08$$

$$\Delta R_t^d = 1.642\, \Delta C_t - 0.872\, \Delta NP_t - 0.067\, \varepsilon_{t-1}$$
$$\quad\; (5.49) \qquad (-17.16) \qquad (-2.84)$$
$$R^2 = 0.83 \qquad \bar{R}^2 = 0.81 \qquad LL = -596.28$$

The estimated function reveals that the coefficients on all of the regressors are statistically significant and have the hypothesised signs. The demand for reserves responds positively to currency in circulation and the response is statistically significant. On the other hand, the estimated coefficient on net position indicates a negative and statistically significant relationship between the net position and the demand for reserves.

The ARDL equation has a high explanatory power and passes all of the diagnostic tests except normality (NO). The null hypothesis of no cointegration between the demand for reserves, currency, and net position is rejected based on the F statistic. However, the W statistic is between the upper bound and lower bound, meaning the test is inconclusive. On the other hand, the error correction test for cointegration indicates that demand for reserves, currency in circulation and net position are cointegrated.

5.3.8 Supply of Total Deposits

$$D_t^s = 295.24 + 1.027\, D_{t-1} + 0.410\, R_t - 0.538\, R_{t-1} + 9.423\, r_t^k$$
(83.86) (3.48) (3.48) (-4.73) (2.23)

$R^2 = 0.99 \quad SC = 8.58 \quad FF = 1.43 \quad NO = 4.94 \quad HS = 2.32$

$$D_t^s = -11098.2 + 4.802\, R_t + 354.23\, r_t^k$$
(-0.77) (3.69) (1.25)

$F = 3.27 \quad W = 9.82$

$$\Delta D_t^s = 0.410\, \Delta R_t + 9.423\, \Delta r_t^k - 0.027\, \varepsilon_{t-1}$$
(3.48) (2.23) (-2.17)

$R^2 = 0.27 \quad \bar{R}^2 = 0.23 \quad LL = -690.78$

The ARDL equation is well determined in the sense of having high explanatory power and passes all of the diagnostic tests. All the coefficients are correctly signed in accordance with economic theory and statistically significant. The results indicate that the supply of total deposits is positively influenced by the domestic interest rate and reserves. The null hypothesis of no cointegration between the supply of total deposits, reserves, and domestic interest rate could not be rejected based on the F and W statistics. On the other hand, the error correction test for cointegration indicates that the supply of total deposits, reserves, and domestic interest rate are cointegrated.

5.3.9 Price Level

$$P_t = 9.593 + 1.108\, P_{t-1} - 0.217\, P_{t-2} + 0.0002\, MS_t + 0.039\, P_t^m - 0.034\, P_{t-1}^m$$
(3.06) (10.25) (-2.15) (2.11) (3.20) (-2.53)

$R^2 = 0.99 \quad SC = 6.58 \quad FF = 0.45 \quad NO = 4.96 \quad HS = 4.58$

$P_t = 87.367 + 0.002\ MS_t + 0.045\ P_t^m$
(37.68) (4.59) (0.92)
$F = 6.15 \quad W = 18.46$

$\Delta P_t = 0.217\ \Delta P_{t-1} + 0.0002\ \Delta MS_t + 0.039\ \Delta P_t^m - 0.109\ \varepsilon_{t-1}$
(2.14) (2.10) (2.20) (-3.14)
$R^2 = 0.44 \quad \bar{R}^2 = 0.41 \quad LL = -102.43$

The estimated coefficients are consistent with theoretical predictions. The autoregressive distributed lag equation is well determined since R^2 is equal to 0.99 and it passes all the diagnostic tests apart from heteroscedasticity (HS). The money supply and import prices have a positive and significant influence on the price level. The results are consistent with those obtained by Moosa (1986a), Salih et al. (1989), Salih et al. (1991), Salih (1993,) Al-Mutairi (1995), Eltony (2001), and Hasan and Alogeel (2008). These findings are not surprising, given that Kuwait is heavily dependent on imported goods and services. The null hypothesis of no cointegration between the price level, money supply, and import price is rejected based on the W and F statistics. Moreover, the error correction test also indicates the presence of cointegration, which is in line with the findings of Murshed and Nakibullah (2015).

5.3.10 Imports

$M_t = -124.42 + 0.400\ M_{t-1} + 0.287\ M_{t-2} + 0.038\ Y_t^n + 0.917\ Q_t$
(-0.53) (3.70) (2.69) (3.17) (2.41)
$R^2 = 0.96 \quad SC = 2.12 \quad FF = 2.21 \quad NO = 19.57 \quad HS = 0.03$

$M_t = -398.645 + 0.122\ Y_t^n + 2.939\ Q_t$
(-0.59) (9.99) (2.43)
$F = 2.88 \quad W = 8.66$

$\Delta M_t = -0.287\ \Delta M_{t-1} + 0.038\ \Delta Y_t^n + 0.917\ \Delta Q_t - 0.312\ \varepsilon_{t-1}$
(-2.69) (3.17) (2.41) (-2.91)
$R^2 = 0.27 \quad \bar{R}^2 = 0.24 \quad LL = -563.38$

The estimation results for the imports function reveal that non-oil GDP and the exchange rate are important determinants of imports. The $R^2$of the ARDL equation is 0.96, which indicates a high explanatory power. Furthermore, the ARDL equation passes all of the diagnostic tests apart from normality (NO), which is attributed to the presence of outliers. The coefficients are correctly signed in accordance with economic theory and they are statistically significant. The null hypothesis of no cointegration between imports, non-oil GDP, and the exchange rate could not be rejected based on the W and F statistics. Nevertheless, the error correction test for cointegration indicates that the variables have a stable long-run relation.

5.3.11 Supply of Credit

$$CR_t^s = \underset{(5.79)}{547.23} + \underset{(44.92)}{1.074}\, CR_{t-1} + \underset{(2.88)}{0.21}\, D_t - \underset{(-4.62)}{0.306}\, D_{t-1} + \underset{(2.28)}{0.188}\, NP_t - \underset{(-4.34)}{0.349}\, NP_{t-1}$$

$R^2 = 0.97 \quad SC = 8.42 \quad FF = 3.34 \quad NO = 10.15 \quad HS = 0.32$

$$CR_t^S = \underset{(-3.90)}{-7358.2} + \underset{(10.82)}{1.254}\, D_t + \underset{(2.95)}{2.169}\, NP_t$$

$F = 4.73 \qquad W = 14.20$

$$\Delta CR_t = \underset{(2.88)}{0.212}\, \Delta D_t + \underset{(2.28)}{0.188}\, \Delta NP_t - \underset{(-3.11)}{0.074}\, \varepsilon_{t-1}$$

$R^2 = 0.53 \quad \bar{R}^2 = 0.49 \quad LL = -627.09$

The results show that the supply of credit is positively influenced by total deposits and the net position. Given that R^2 is 0.97, the ARDL equation has a high explanatory power. Furthermore, the equation passes all of the diagnostic tests except for normality (NO), which is caused by the presence of outliers. All of the coefficients are correctly signed in accordance with economic theory and they are statistically significant.

The null hypothesis of no cointegration between the supply of credit, total deposits and net position could not be rejected based on the F statistic, but the W statistic rejects the null hypothesis. On the other hand, the error correction test for cointegration indicates that the supply of credit, total deposits and net position are cointegrated.

5.3.12 Demand for Credit

$$CR_t^d = -921.21 + 0.864\, CR_{t-1} + 0.277\, Y_t^n + 0.688\, Y_t^o - 2.278\, Y_{t-1}^o + 3.087\, Y_{t-2}^o$$
(-7.57) (63.32) (10.60) (3.48) (-3.31) (3.09)

$$-2.080\, Y_{t-3}^o + 0.609\, Y_{t-4}^o - 140.69\, r_t^f + 162.001\, r_{t-1}^f$$
(-2.91) (2.85) (-2.44) (2.87)

$R^2 = 0.99$ $SC = 2.63$ $FF = 1.04$ $NO = 16.43$ $HS = 2.21$

$$CR_t^d = -6781.7 + 2.037\, Y_t^n + 0.189\, Y_t^o - 158.87\, r_t^f$$
(-7.65) (24.58) (3.92) (-2.14)

$F = 33.69$ $W = 134.79$

$$\Delta CR_t^D = 0.276\, \Delta Y_t^n + 0.688\, \Delta Y_t^o - 1.616\, \Delta Y_{t-1}^o + 1.471\, \Delta Y_{t-2}^o$$
(10.60) (3.48) (-3.24) (2.91)

$$-0.609\, \Delta Y_{t-3}^o - 140.692\, \Delta r_t^f - 0.136\, \varepsilon_{t-1}$$
(-2.85) (-2.44) (-9.95)

$R^2 = 0.69$ $\bar{R}^2 = 0.66$ $LL = -595.72$

The ARDL equation is well determined in the sense of having high explanatory power since R^2 is 0.99 and the equation passes all of the diagnostic tests except for normality (NO). All of the coefficients are correctly signed in accordance with economic theory and they are statistically significant. The null hypothesis of no cointegration between the demand for credit and the explanatory variables is rejected based on the F and W statistics. Likewise, the error correction test indicates the presence of cointegration between the variables.

5.3.13 Stock Prices

$$SP_t = -166.21 + 0.725\, SP_{t-1} + 0.059\, CR_t - 0.083\, CR_{t-1}$$
(-3.17) (13.26) (1.79) (-2.73)
$$+0.058\, Y_t^n + 0.020\, Y_t^o - 0.020\, Y_{t-1}^o$$
(3.73) (2.71). (-2.65)
$R^2 = 0.96 \quad SC = 8.34 \quad FF = 3.67 \quad NO = 17.88 \quad HS = 2.51$

$$SP_t = -604.26 + 0.084\, CR_t + 0.214\, Y_t^n + 0.002\, Y_t^o$$
(-3.88) (4.24) (4.88) (2.26)
$F = 6.99 \quad W = 27.98$

$$\Delta SP_t = 0.059\, \Delta CR_t + 0.058\, \Delta Y_t^n + 0.020\, \Delta Y_t^o - 0.275\, \varepsilon_{t-1}$$
(2.79) (3.73) (2.70) (-5.03)
$R^2 = 0.14 \quad \overline{R}^2 = 0.11 \quad LL = -527.09$

The estimation results reveal that credit, non-oil GDP, and oil GDP are important determinants of stock prices. The ARDL equation has a high explanatory power (goodness of fit) since R^2 is 0.96. Additionally, the equation passes all of the diagnostic tests except for normality (NO), which is attributed to the presence of outliers. All of the coefficients are correctly signed in accordance with economic theory and they are statistically significant except for credit (CR), where the t-ratio is equal to 1.79.

The results show that the non-oil GDP and oil GDP have a positive and significant effect on stock prices. However, credit has an insignificant effect and the lagged credit (by one quarter) has a negative significant effect on the stock prices. The null hypothesis of no cointegration between the stock prices and the explanatory variables is rejected based on the F and W statistics. Likewise, the error correction test for cointegration indicates that the variables are cointegrated.

5.4 Elasticities

After the estimation of the model and ensuring the stability of the estimates in the previous section the next step is reporting the elasticities that emerge from the model estimation. In order to present a meaningful estimate of the elasticity, it is common practice to estimate the elasticity by using mean values of the variables. Therefore, if

$$Y = f(X) \tag{5.18}$$

Then the elasticity, E, can be estimated as

$$E(Y,X) = b.\frac{\bar{X}}{\bar{Y}} \tag{5.19}$$

where $\bar{X}$ and $\bar{Y}$ are the mean values of X and Y, respectively, E denotes the elasticity, and b represents the coefficient of X. The elasticities estimation results are presented in Table 5.1. It is noteworthy that these are total, not partial, elasticities, in the sense that they measure the response of Y to changes in X when all other variables that affect Y change at the same time—that is, without the imposition of the *ceteris paribus* condition.

For example, the results show that a 1% change in exports bring about an almost equal percentage change in oil GDP, which makes a lot of sense, since oil GDP is determined by oil exports. Likewise, a one percentage point rise in the dollar interest rate brings about an almost equal change in the domestic interest rate. Elasticities with respect to policy variables (G and MS) can be used for the purpose of formulating policy. For example, a 10% increase in government expenditure produces a 6% increase in non-oil GDP and 3.2% increase in stock prices. It also produces a 3% increase in the CPI. It also seems that monetary and fiscal changes have close effects on inflation (elasticities of 0.31 for G and 0.37 for MS). Thus, these elasticities can be taken into account with respect to policies pertaining to growth and inflation.

Table 5.1: Elasticities Estimation Results

	G	X	MS	r^f
Y^n	0.59			
Y^o		0.98		
P	0.31	0.24	0.37	-0.22
r^k				1.05
QM				
C	0.81			
DD	0.96	0.76		-0.68
QM	0.72	0.60		-0.52
R	0.67			
D	0.84			
M	0.67			
CR	0.88			-0.64
SP	0.32	0.59		-0.23

Two points are left to be made here. The first is that the elasticities are estimated with standard errors (of the estimated regression coefficients), which can be used to construct confidence intervals to add more precision to policy prescriptions. The second point pertains to the proposition that the estimated elasticities reported in Table 5.1 are inconsistent with the *ceteris paribus* condition because they are estimated from the two-variable relation (5.18). Elasticities that are consistent with the with the *ceteris paribus* condition are estimated from a functional relation of the form $Y = f(X_1, X_2, \dots . X_n)$, because the estimated coeffeicient on one explanatory variable is a measure of the response of the dependent variable to changes in that explanatory variable when all other variables are kept unchanged (hence, *ceteris paribus).*

5.5 Concluding Remarks

This chapter is dedicated to estimating the model specified in chapter four. The data used for model estimation consist of quarterly data series for the period 1995 to 2017. The time series were collected from the Bloomberg Terminal, Thomson Reuters

DataStream and the reports published by the Central Bank of Kuwait. Given that the model is recursive, OLS is deemed an appropriate estimation method, since a characteristic of a recursive model is that the error terms are not correlated with the explanatory variables. The estimation results presented in this chapter indicate that the model is well specified and that it has a high explanatory power. Moreover, cointegration is found in all of the equations, indicating that the presence of stable long-run relations.

CHAPTER 6

THE PREDICTIVE POWER OF THE MODEL

6.1 Introduction

Forecasting is the formal method of generating expectations, and these expectations are used in the decision-making process. The main function of forecasting is to convert uncertainty into risk, the difference being in the availability or otherwise of probability distributions for future outcomes. Forecasting is an essential element in the decision-making process because policy-makers and investors typically use forecasts as they try to come up with policy measures and investment decisions. Forecasting plays a crucial role in the conduct of monetary policy because the monetary authority needs to forecast the direction of the economy before they can determine the policy action they want to pursue. On the other hand, forecasting is crucial for investors because making an investment decision involves expecting the direction of market movements.

This chapter is dedicated to examining the predictive power of the model. In chapter five, the model was estimated and a series of diagnostic tests were presented to demonstrate that the individual behavioural equations are well specified. It is crucial for a macroeconometric model to having well-specified behavioural equations and high explanatory power. From an econometric standpoint, each equation should demonstrate high goodness of fit (R^2) and the coefficients must be signed in accordance with economic theory and are statistically significant. It is also imperative for an econometric model to have a good predictive power, meaning the model must be able to generate forecasts with a reasonable degree of accuracy.

In this chapter, the ability of the model to generate accurate forecasts is examined. After generating the forecasts, measures will be estimated to determine the quality of the predictions. Estimating the forecasting accuracy measures needs to be carried out to determine whether the predicted values trace the actual history of the variables relatively well.

This chapter is divided into five sections, the first of which is an introduction. The second section is concerned with the methodology. The third section discusses the Meese-Rogoff puzzle. The fourth section presents the forecasting results, and the fifth section contains a recapitulation and concluding remarks.

6.2 Methodology

When it comes to generating forecasts, there are generally two main choices for the method of estimation: a rolling approach and recursive approach. In the recursive approach, the estimation sample increases each time a forecast is generated. On the other hand, in the rolling window approach, the sample size is fixed. According to Moosa and Vaz (2015), recursive estimation is preferred to rolling estimation, simply because all the available information is included in recursive estimation. In the rolling approach, on the other hand, information is lost as a result of excluding observation from the sample when forecasts are generated. Clark and McCracken (2009) note that it has historically been more common in the macroeconomics literature for forecasts to be constructed recursively to use all of the available data to estimate parameters. Ben Taieb and Hyndman (2012) argue that because it utilises fewer observations, the rolling approach has higher variance when estimating the model, particularly for longer forecast horizons. Their argument supports the view put forward by Moosa and Vaz (2015).

In this chapter, the forecasting process involves recursive regressions which is consistent with what is suggested by Marcellino (2002) and Marcellino et al. (2003) who clearly state that their forecasts are generated by using a recursive methodology. Using a recursive methodology is preferred over the rolling window method by many economists. Stock and Watson (1996) argue that recursive forecasting is a more robust estimation method for macroeconomic variables. Furthermore, Macdonald and Marsh (1993), Stock and Watson (2003), and Pesaran et al. (2006) indicate that including all of the available information when estimating the forecasts improves predictive performance.

To test the predictive power of the model, measure the model's stability over time and evaluate the importance of the explanatory variables, out-of-sample forecasts are generated for all of the endogenous variables by estimating recursive regressions. Moreover, forecasts will be generated from the structural equations, reduced-form equations, and equilibrium conditions. Following the generation of forecasts, the next step is measuring forecasting accuracy relative to the random walk as a benchmark.

Chen and Yang (2004) classify measures of forecasting accuracy into two types: (i) stand-alone measures and (ii) relative measures. The stand-alone accuracy measures are calculated without the need to compare the forecasts to a given reference or a benchmark such as mean absolute error, mean square error, and root mean square error. On the other hand, the relative measures, such as Thiel's inequality coefficient, are used to compare the forecasts to a baseline or benchmark such as a weighted average of forecasts or the random walk. Therefore, to quantify the accuracy of the forecasts, the following measures of predictive accuracy are calculated relative to the random walk as a benchmark: (i) mean absolute error, (ii) mean square error, (iii) root mean square error, (iv) random walk mean square error, (v) random walk root mean square error, (vi) Theil's inequality coefficient, and (vii) direction accuracy.

The mean absolute error (MAE) is the most straightforward measure of forecasting accuracy. As the name suggests, it is the average absolute value of the difference between the predicted value and the actual value (error). The main advantage of MAE is that it is less sensitive to large deviations compared to other accuracy measures. The MAE is calculated as

$$MAE = \frac{\sum_{t=1}^{n} \left| \frac{F_t - A_t}{A_t} \right|}{n} \tag{6.1}$$

where F denotes the forecasts, A represents the actual observations, n is the number of data points. It is obvious from equation (6.1) that the MAE is calculated on the basis of percentage errors (relative to actual values) to remove the scale factor and make the forecasts comparable. The only exception is the interest rate r^k, simply because it is measured in a percentage term.

The mean square error (MSE) is the average of the squared errors. Squaring the difference between the predicted value and the actual value provides two advantages: (i) the positive and negative errors will not cancel out each other, and (ii) the measure is more sensitive to larger errors. The MSE is calculated as

$$MSE = \frac{\sum_{t=1}^{n}\left(\frac{F_t - A_t}{A_t}\right)^2}{n} \tag{6.2}$$

The root mean square error ($RMSE$) is one of the most commonly used measures of forecasting accuracy in the forecasting literature. As the name suggests, it is the square root of the sum of the squared errors, consequently, which means that it has the same advantages as the mean square error (MSE). If the model predicted perfect forecasts, it would result in having a value of zero for the mean absolute error, mean square error, and root mean square error. The $RMSE$ is calculated as

$$RMSE = \sqrt{MSE} = \sqrt{\frac{\sum_{t=1}^{n}\left(\frac{F_t - A_t}{A_t}\right)^2}{n}} \tag{6.3}$$

$$MSE\ RW = \frac{\sum_{t=1}^{n}\left(\frac{A_t - A_{t+1}}{A_{t+1}}\right)^2}{n} \tag{6.4}$$

$$RMSE\ RW = \sqrt{\frac{\sum_{t=1}^{n}\left(\frac{A_t - A_{t+1}}{A_{t+1}}\right)^2}{n}} \tag{6.5}$$

Hyndman and Koehler (2006) argue that the root mean square error and mean square error are popular because of their theoretical relevance in statistical modelling. Nevertheless, they are more sensitive to outliers than mean absolute error.[6]

The most commonly used relative measure of forecasting accuracy is Theil's inequality coefficient (U), which measures the forecasting accuracy of the model

[6] Equations (6.1)-(6.5) look different from the equations used to estimate the same metrics in Chapter 3. The difference lies in the use of absolute or percentage forecasting errors (relative to the actual values). Equations (6.1)-(6.5) are based on the percentage errors whereas the equations used in Chapter 3 are based on the absolute errors. One advantage of using percentage errors is to facilitate comparison by eliminating the scale factor.

relative to the random walk as a benchmark. Theil's inequality coefficient (U) is calculated as follows:

$$U = \frac{\sqrt{\frac{\sum_{t=1}^{n}\left(\frac{F_t - A_t}{A_t}\right)^2}{n}}}{\sqrt{\frac{\sum_{t=1}^{n}\left(\frac{A_t - A_{t+1}}{A_{t+1}}\right)^2}{n}}} \tag{6.6}$$

which means that it is the ratio of the RMSE of the model to the RMSE of the random walk—hence it assumes a range of values, each of which has an interpretation. Table 6.1 summarises the possible values and what they mean.

Direction accuracy is a binary measure whereby if the direction of the forecast matches the direction of the actual change it gives a value of one, conversely, if the direction of the forecast does not match the direction of the actual change it assumes a value of zero. Therefore, if direction accuracy is equal to one, it means that the model predicts all the directional changes correctly. Direction accuracy will be calculated as specified in Equation (3.29). As explained in Chapter 3, the direction accuracy of the random walk is by definition zero because it is a no-change model. This is why the assertion of Cheung et al. (2005), that a direction accuracy of 50% is needed to outperform the random walk, is wrong.

Table 6.1: Possible Values of Theil's Inequality Coefficient

Coefficient Value	Meaning
$U = 1$	The model is as good as the random walk.
$U = 0$	The model predicted perfect forecasts.
$0 < U < 1$	The model predicted less than perfect forecasts but still outperformed the random walk.
$U > 1$	The model is worse than the random walk.

In addition to the quantitative measures of forecasting accuracy, a visual (graphical) approach is used to illustrate the forecasting accuracy of the model. The first method is a line chart showing the actual observation and the forecasts, which provides a general view on how well the forecasts perform compared to the actual series. The second method is the prediction-realisation diagram, which was presented by Theil (1961). It is a scatter diagram relating predictions to realisations for the purpose of evaluating how well the model predicts the direction and magnitude of change in the actual observation in the series. The forecast changes are shown on the vertical axis while the actual changes are measured on the horizontal axis. A line of perfect forecasts is plotted in the scatter diagram, which is simply a 45-degree line passing through the first and third quadrants. The first quadrant indicates a correctly predicted positive change, and the third quadrant indicates a correctly predicted negative change. On the other hand, the second and fourth quadrants indicate a wrong prediction of change. Therefore, the smaller the scattering around the line of perfect forecasts, the more accurate are the forecasts.

6.3 The Meese-Rogoff Puzzle

Meese and Rogoff (1983) examined the out-of-sample forecasts of several structural models of exchange rate determination (the flexible-price monetary model, sticky-price monetary mode, and the portfolio balance model) in addition to univariate time series models and compared them to the random walk. The accuracy of the out-of-sample forecasts was measured by root mean square error ($RMSE$), mean error (ME) and mean absolute error (MAE), with the $RMSE$ being the main criterion for comparing forecasts. They attribute the poor performance to simultaneous equation bias, misspecification, sampling error, and stochastic movements in the true underlying parameters. Meese and Rogoff conclude that the structural monetary models cannot outperform the random walk model even though their forecasts are based on actual realised values of the explanatory variables. The findings of Meese and Rogoff created a challenge, as economists started to test their models relative to the random walk as a benchmark.

The publication of the Meese and Rogoff (1983) famous paper has changed the perception of forecasting models. Many economists accepted the results and suggested that this represents a puzzle. Evans and Lyons (2004) refer to the findings of Meese and Rogoff as the most researched puzzle in international macroeconomics. Abhyankar et al. (2005) argue that the failure of models based on monetary fundamentals to generate better out-of-sample forecasts than a naive random walk is a major puzzle in international finance. Evans and Lyons (2005) claim that the findings of Meese and Rogoff that structural macroeconometric models cannot beat a naive random walk have "proved robust over the decades". The main reason why the results of Meese and Rogoff cannot be invalidated is that the forecasting models are being evaluated based on the root mean square error and similar statistics that depend on the magnitude of the error. Engel et al. (2007) claim that outperforming the random walk is too strong a criterion for accepting a model.

On the other hand, some economists argue that it is not appropriate to evaluate the accuracy of the forecasts by using measures based on the magnitude of the error, such as the root mean square error. Furthermore, they claim that the random walk can be easily outperformed if the forecasting models are evaluated based on measures of direction accuracy and profitability. They also argue that evaluating forecasts by measuring the direction accuracy and the ability to generate profit by using a forecasting-based trading strategy is more significant than measuring the magnitude of the error. For example, Cheung et al. (2005) indicate that using measures other than the mean square error does not amount to “changing the rules of the game” and that reducing the mean square error may not be important from an economic standpoint, indicating that using the mean square error could lead to missing out on other significant aspects of forecasting such as direction accuracy and profitability at long-run. They also indicate that the direction of change is “perhaps more important from a market timing perspective”. Leitch and Tanner (1991) contend that direction accuracy might be more important for profitability and economic concerns. Engel (1994) supports the use of direction accuracy, which he describes as ‘‘not a bad proxy for a utility-based measure of forecasting performance’’. Della Corte et al. (2009) conclude that the failure to beat the random walk is caused by the use of inappropriate measures of forecasting accuracy.

According to Leitch and Tanner (1991) and Moosa and Burns (2013), economists are baffled by the observation that profit-maximising firms waste millions of dollars buying and generating professional forecasts while the measures based on the magnitude of the error such as the root mean square error show that the random walk forecasts are almost always better. Leitch and Tanner contend that the root mean square error and similar metrics have a weak connection to profitability and that direction accuracy is more related to profitability than measures that depend on the absolute forecasting error. They also suggest using direction accuracy to evaluate forecasts if the profitability is not measurable.

Moosa and Burns (2014) argue that ‘‘conventional macroeconomic and time series models cannot outperform the random walk in out-of-sample forecasting if forecasting accuracy is measured in terms of the root mean square error or similar metrics that depend on the magnitude of the forecasting error’’. Moreover, they suggest that the results of Meese and Rogoff do not indicate a failure of monetary economics nor represent a puzzle. They also argue that it is possible to beat the random walk if the forecasting models are evaluated by profitability and direction accuracy instead of the RMSE and similar metrics. They conclude that the unbeatable random walk is a myth and that the failure of models to outperform the random walk in terms of the root mean square error is a reality.

6.4 Forecasting Results

Following the generation of forecasts, the model is validated by examining its out-of-sample forecasting power using measures of forecasting accuracy that depend on the magnitude of the error and those that measure direction accuracy. The quality of the forecasts is evaluated based on the divergence between the generated predictions and the actual data, which is referred to as the forecasting error. A perfect model produces a value of zero for the mean absolute error, mean square error and root mean square error.

Table 6.2 presents the measures of forecasting accuracy generated by structural equations. The results indicate that the price level (P), Demand for Credit (CR^d), and imports (M) have the lowest errors, whereas quasi money (QM), domestic interest rate (r^k), reserves (R), and stock prices (SP) have the highest errors. Furthermore, the mean square error and the root mean square error of the forecasts are greater than that of the random walk for all the variables. Hence Theil's inequality coefficient for all the variables is higher than one, meaning the predictions are worse than those of the random walk. The results are in line with the findings the Meese and Rogoff (1983) meaning the random walk is unbeatable in terms of root mean square error and other measures based on the magnitude of the error. However, it can be seen that the directional accuracy is more than 50% for most of the variables. In all cases, it is significantly different from 0, meaning the model's predictive power for directional changes is by far better than the random walk.

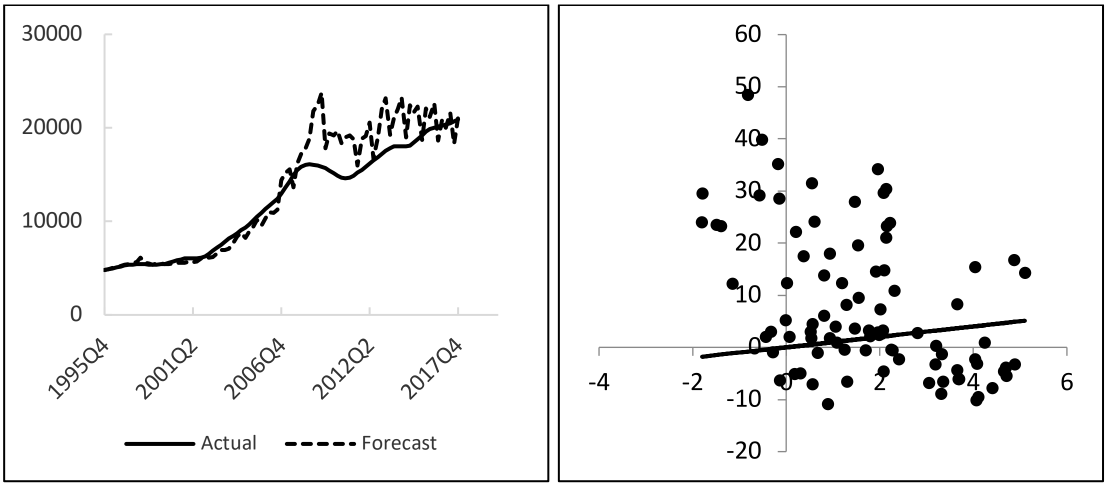
Table 6.2: Measures of Forecasting Accuracy (Structural Equations)

	MAE	*MSE*	*RMSE*	*MSE RW*	*RMSE RW*	*U*	*D*
Y^n	11.202	235.450	15.344	5.437	2.332	6.581	0.523
Y^o	11.951	246.108	15.688	70.957	8.424	1.862	0.761
C	11.280	241.035	15.525	58.709	7.662	2.026	0.580
r^k	0.482	0.583	0.764	0.349	0.591	1.293	0.431
DD	14.496	487.691	22.084	53.991	7.348	3.005	0.540
QM	85.999	85.999	9.274	13.337	3.652	2.539	0.621
R	25.541	950.774	30.835	210.569	14.511	2.125	0.391
D	14.390	462.543	21.507	12.418	3.524	6.103	0.299
P	1.787	5.442	2.333	1.120	1.058	2.204	0.547
M	9.083	123.106	11.095	117.294	10.830	1.024	0.506
CR^s	11.696	237.883	15.423	14.868	3.856	4.000	0.690
CR^d	7.153	84.181	9.175	14.606	3.822	2.401	0.605
SP	24.892	1179.932	34.350	154.148	12.416	2.767	0.500

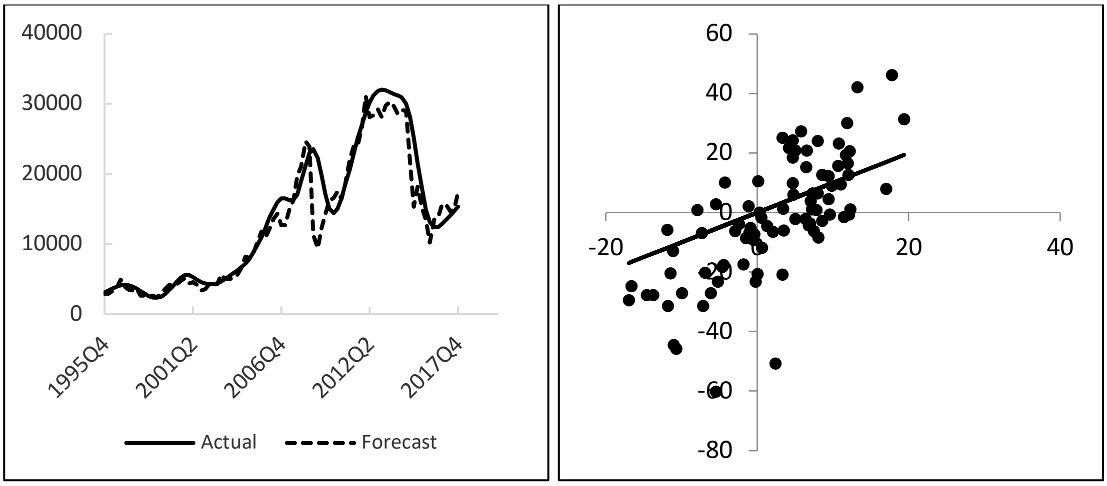
Figure 6.1 illustrates the prediction-realisation diagrams and the trajectories of the actual and forecast estimations generated by the structural equations. It can be seen that the forecasts track the actual time paths of the variables reasonably well and that most of the observations fall in the first and third quadrants, implying a good degree of forecasting accuracy.

Figure 6.1: The Predictive Power of the Structural Equations

Non-Oil GDP



Oil GDP



Demand for Currency

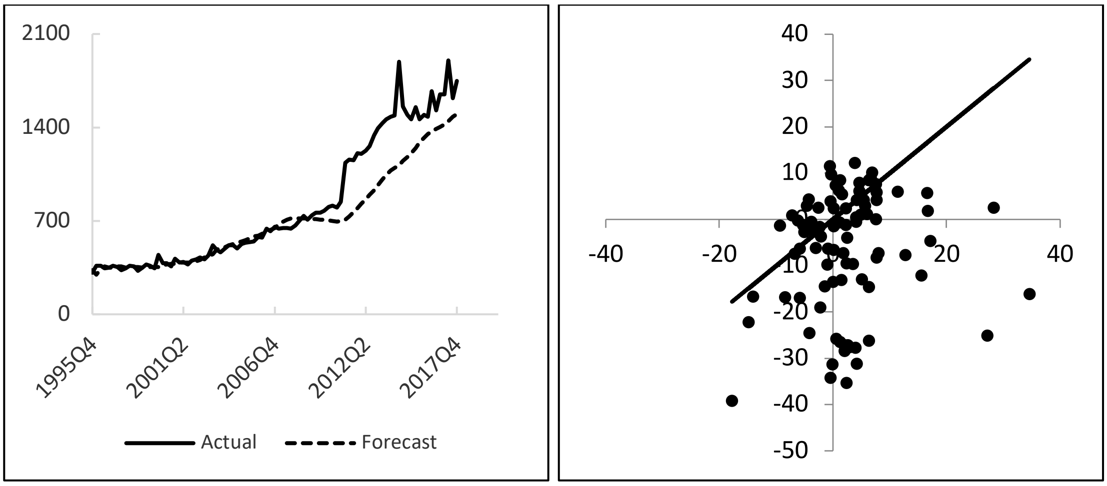
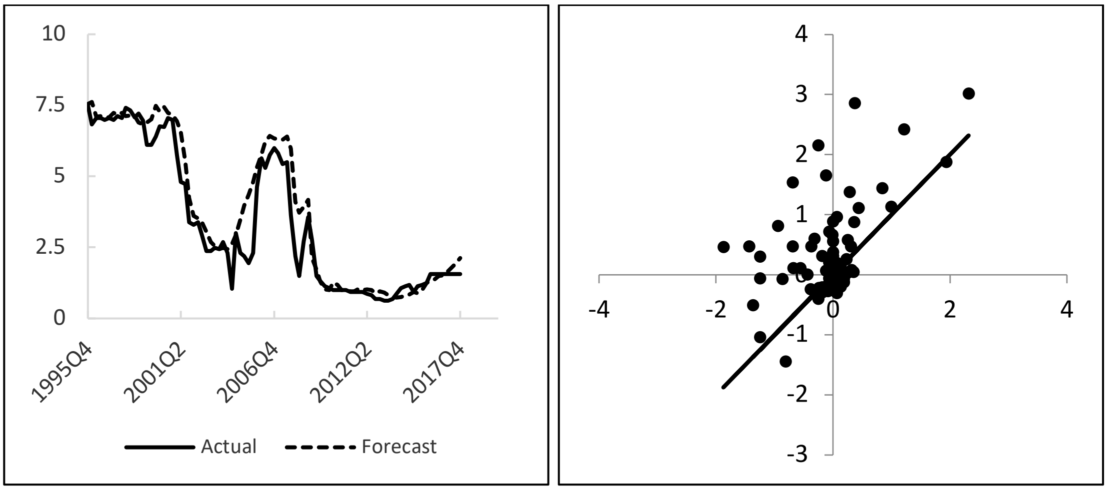
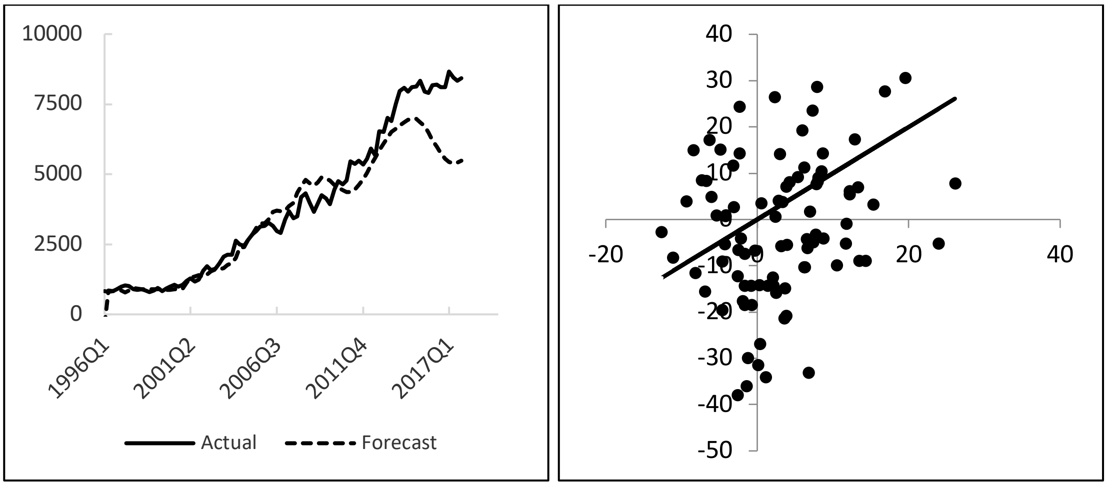


Figure 6.1: (Continued)

Three Months Interbank Rate



Demand for Demand Deposits



Demand for Quasi-Money

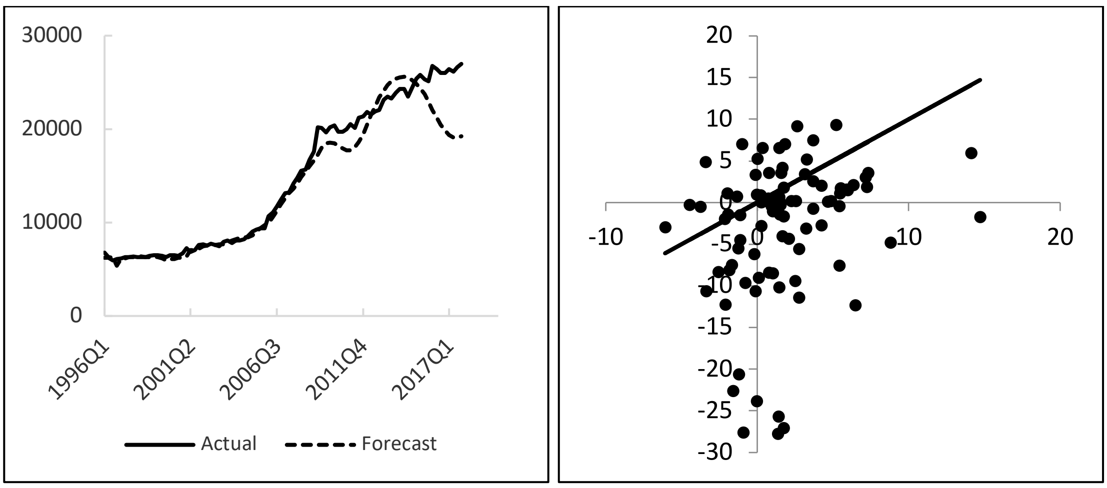
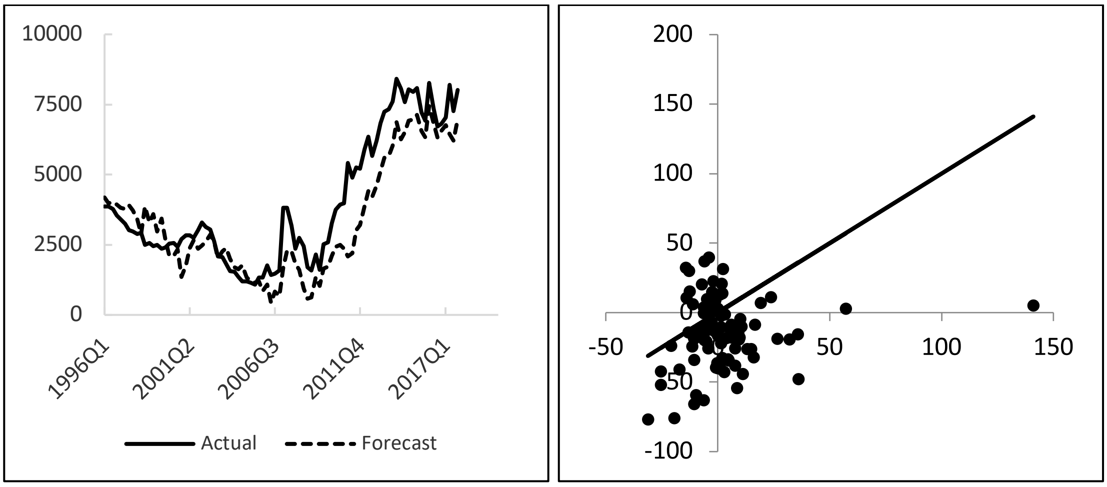
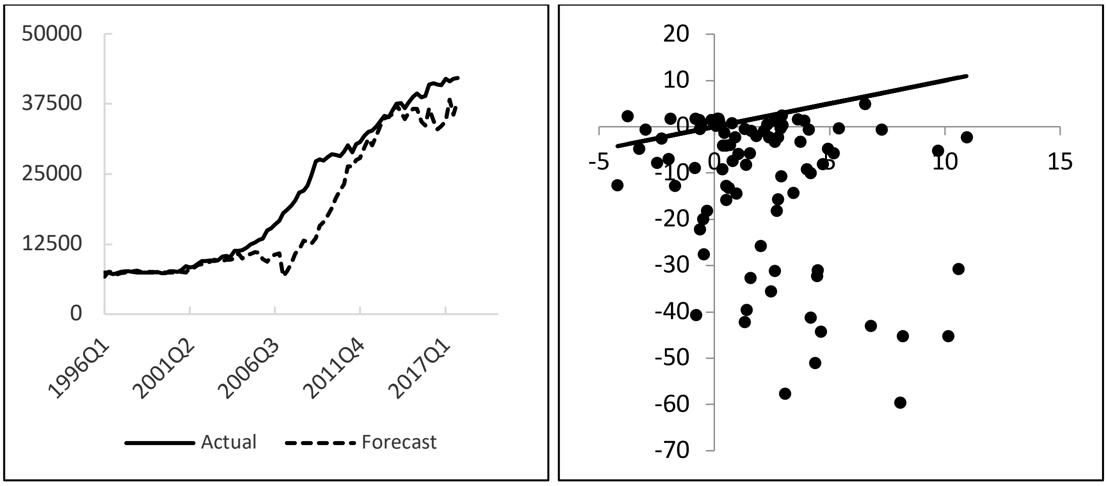


Figure 6.1: (Continued)

Demand for Reserves of Local Banks



Supply of Total Deposits



Price Level

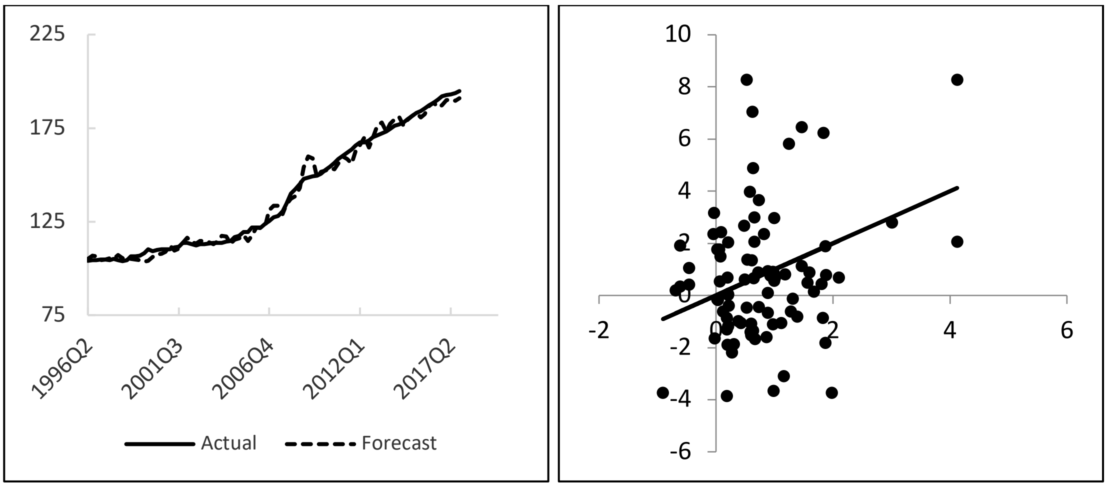
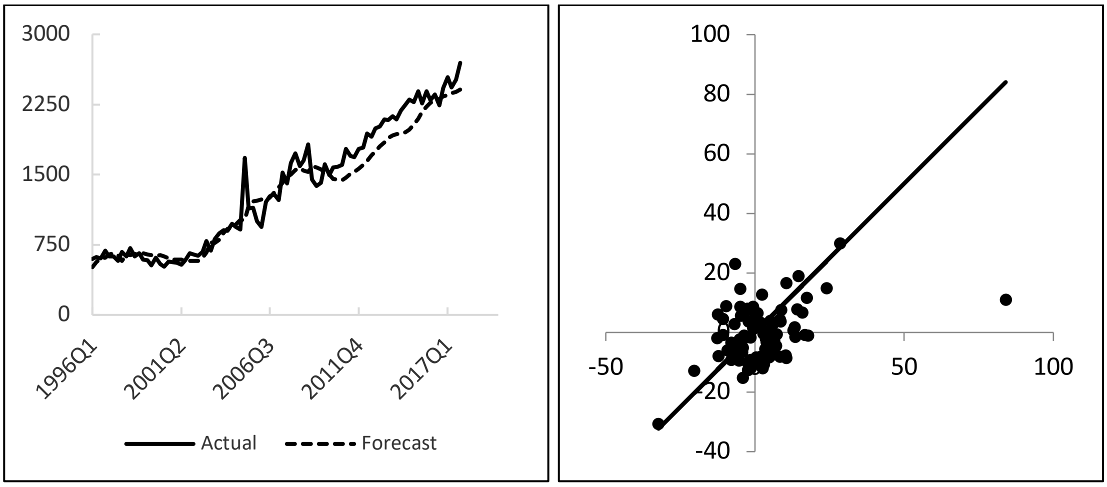
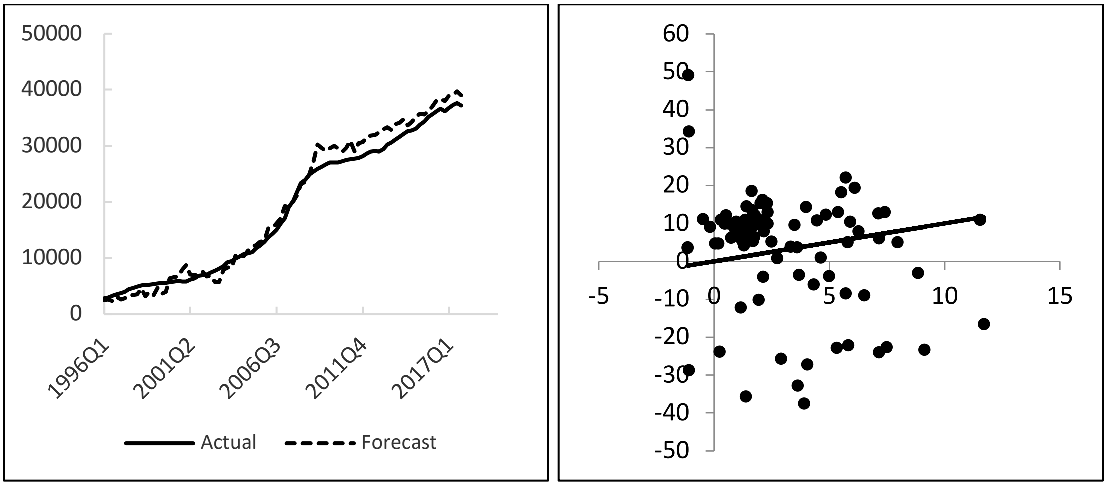


Figure 6.1: (Continued)

Imports



Supply of Credit



Demand for Credit

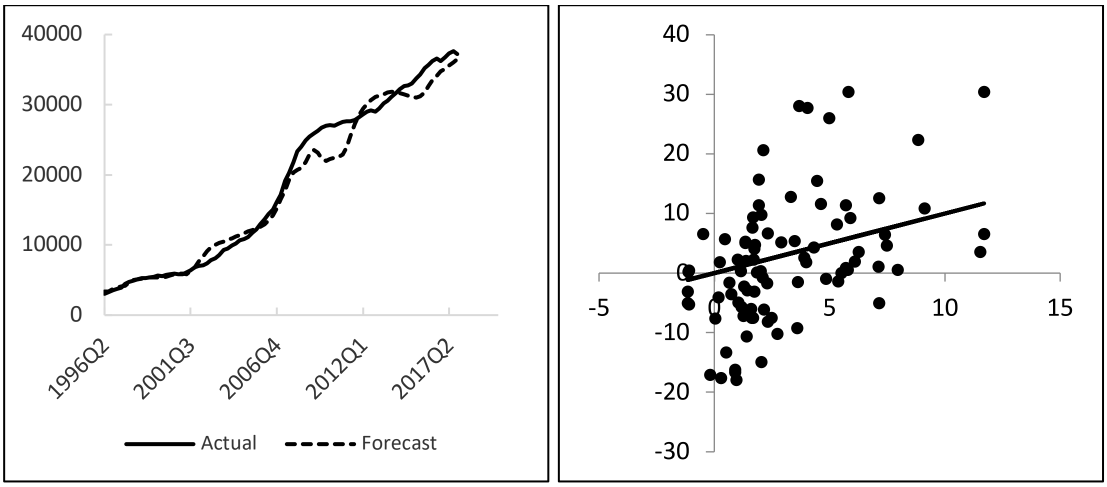
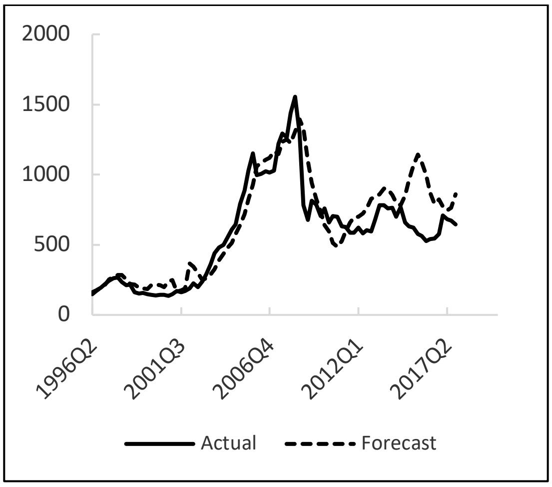
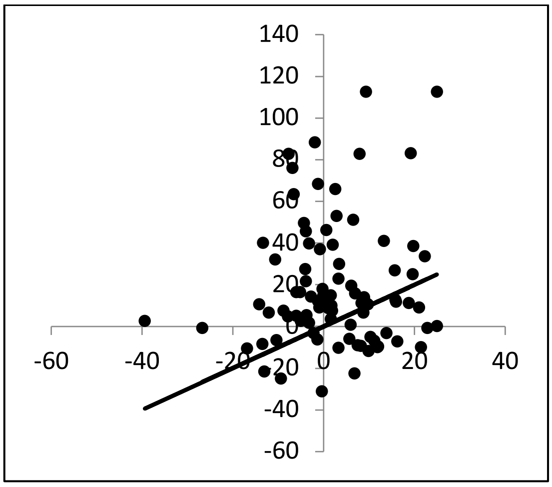


Figure 6.1: (Continued)

Stock Prices





An inspection of Table 6.3, which illustrates measures of forecasting accuracy for the predictions generated by reduced-form equations, reveals that the price level (P), demand for credit (CR^d), and imports (M) have the lowest errors—the results are similar to those generated by the structural equations. Moreover, quasi-money (QM), reserves (R), and stock prices (SP) have the highest errors. The MSE and RMSE are greater than those of the random walk for all the variables, which is why Theil's inequality coefficient for all the variables is higher than one and indicating the forecasts are worse than those generated by the random walk. This also supports the Meese-Rogoff puzzle because the forecasts failed to outperform the random walk in terms of RMSE and MSE. The predictive power for directional changes is better than that of the structural equations' forecasts, since it can be seen that the directional accuracy is more than 50% for all variables. The results support the findings of Moosa and Burns (2014) since the forecasts easily outperformed the random walk in terms of directional accuracy.

Table 6.3: Measures of Forecasting Accuracy (Reduced-Form Equations)

	MAE	*MSE*	*RMSE*	*MSE RW*	*RMSE RW*	*U*	*D*
Y^n	11.202	235.450	15.344	5.437	2.332	6.581	0.523
Y^o	11.951	246.108	15.688	70.957	8.424	1.862	0.761
C	8.303	113.900	10.672	58.709	7.662	1.393	0.716
r^k	0.483	0.584	0.764	0.349	0.591	1.293	0.432
DD	9.556	151.752	12.319	54.500	7.382	1.669	0.540
QM	70.516	70.516	8.397	13.492	3.673	2.286	0.552
R	26.938	1364.546	36.940	210.569	14.511	2.546	0.552
D	7.337	90.328	9.504	12.418	3.524	2.697	0.586
P	2.742	14.386	3.793	1.133	1.064	3.563	0.635
M	11.355	246.466	15.699	117.294	10.830	1.450	0.621
CR^s	11.066	228.662	15.122	14.606	3.822	3.957	0.698
CR^d	9.741	162.556	12.750	14.606	3.822	3.336	0.698
SP	33.190	2347.979	48.456	155.196	12.458	3.890	0.494

Table 6.4 presents measures of forecasting accuracy for the predictions generated by the equilibrium conditions equations. The money supply (MS) has a lower MSE and RMSE than credit (CR), and Theil's inequality coefficient is higher than one, indicating failure to beat the random walk. The direction accuracy is more than 50% for both of the variables, indicating that predictive power for directional changes is good and by far better than that of the random walk.

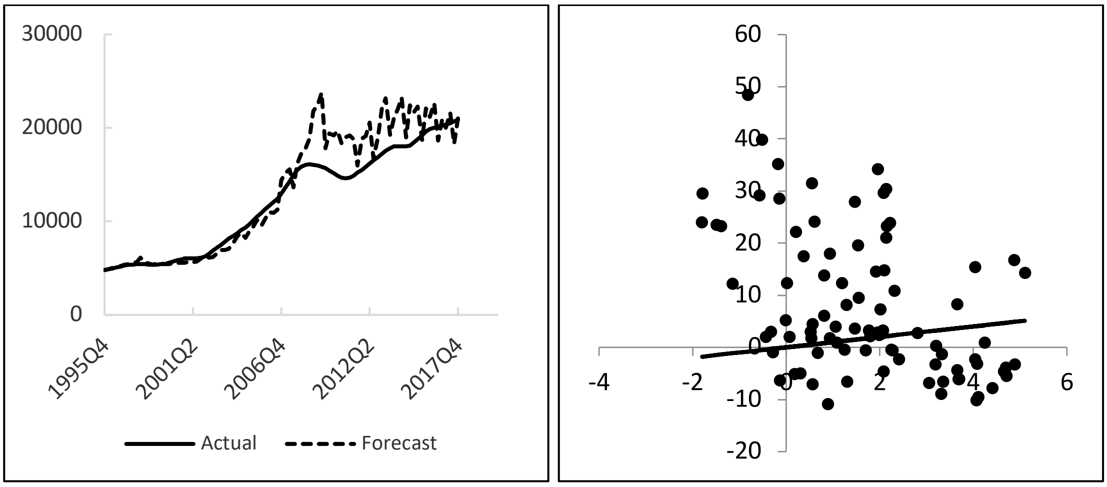
Table 6.4: Measures of Forecasting Accuracy (Equilibrium Conditions Equations)

	MAE	*MSE*	*RMSE*	*MSE RW*	*RMSE RW*	*U*	*D*
MS	5.650	55.166	7.427	12.025	3.468	2.142	0.575
CR	9.737	163.059	12.769	13.955	3.736	3.418	0.682

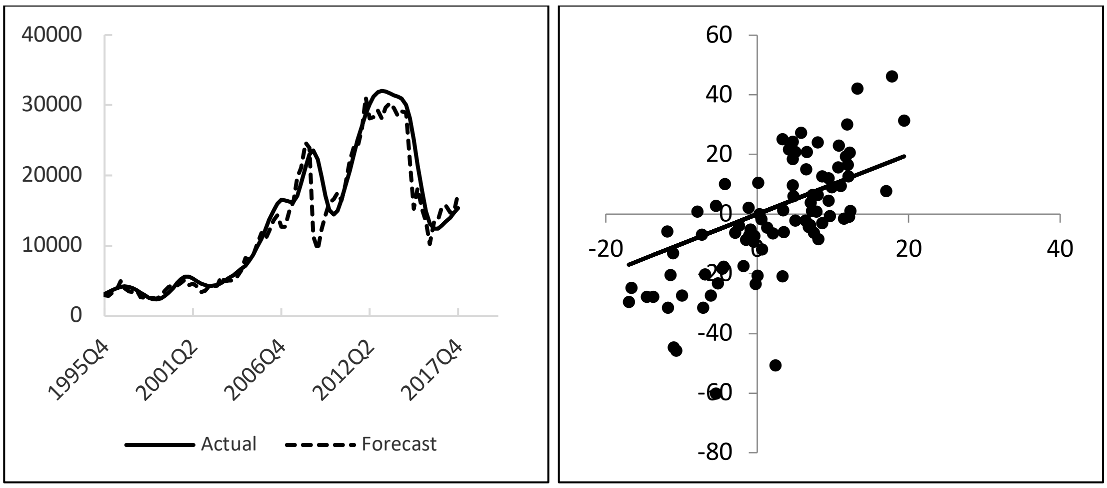
Figure 6.2 and 6.3 show the prediction-realisation diagrams in addition to the actual values and forecasts generated by the reduced-form equations and equilibrium conditions, respectively. It can be seen from the figures that the forecasts estimations track the actual time paths of the variables quite well.

Figure 6.2: The Predictive Power of the Reduced-Form Equations

Non-Oil GDP



Oil GDP



Demand for Currency

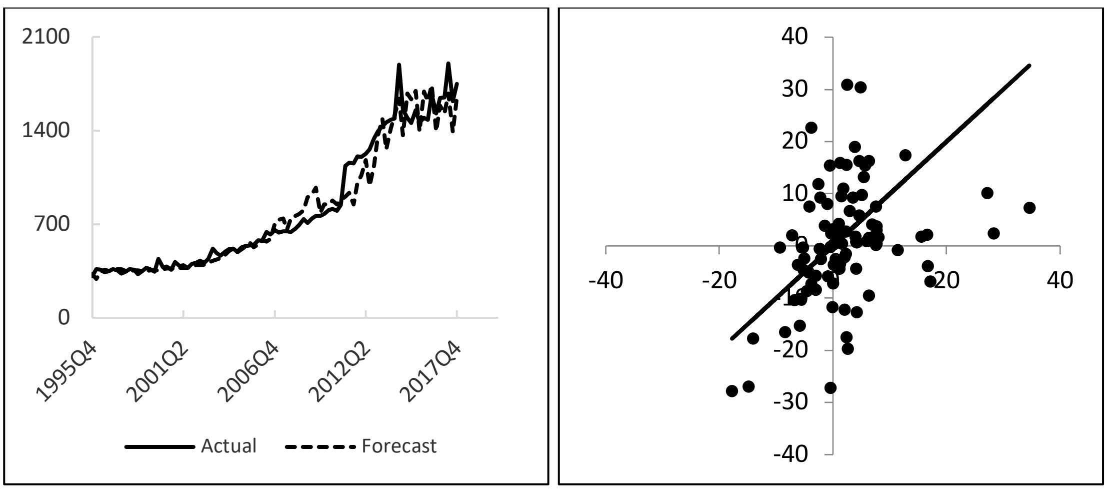
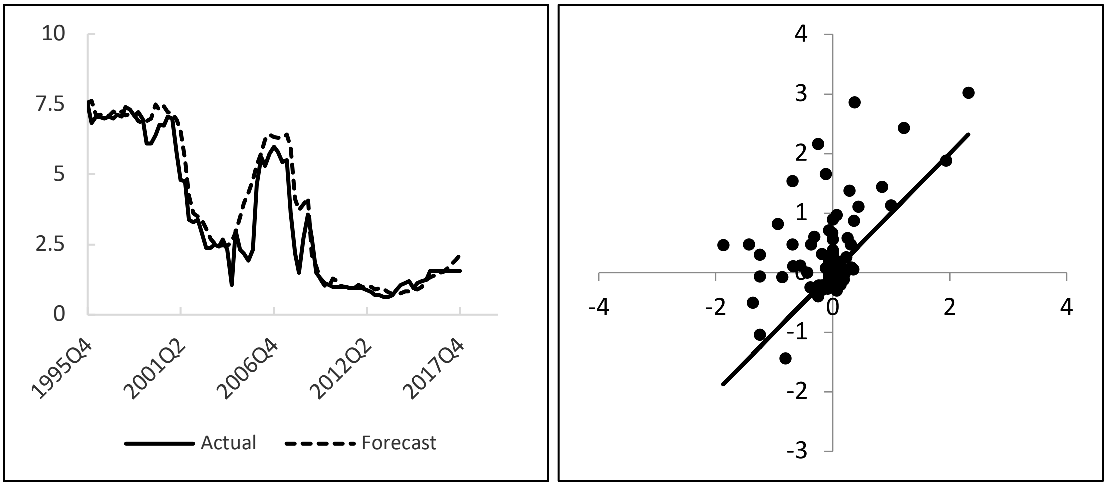
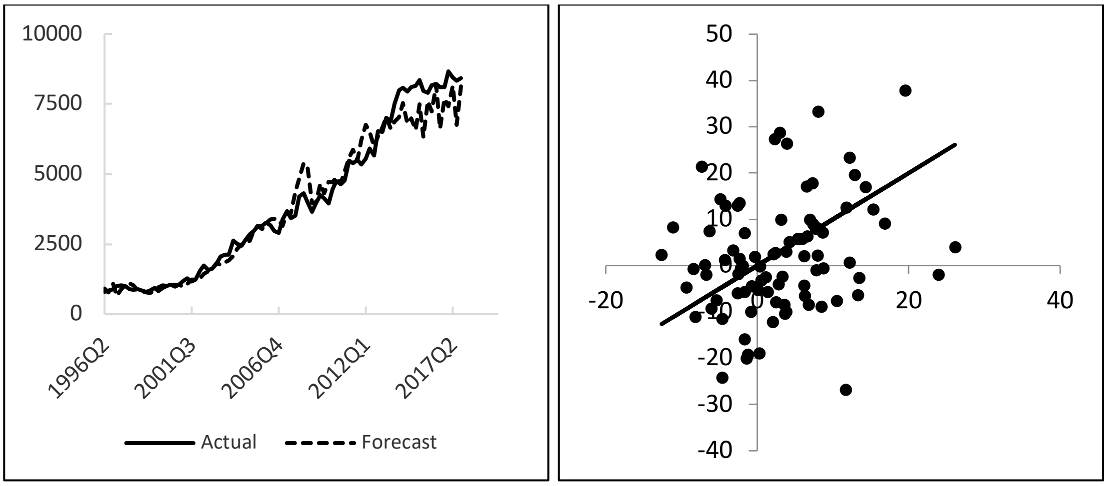


Figure 6.2: (Continued)

Three Months Interbank Rate



Demand for Demand Deposits



Demand for Quasi-Money

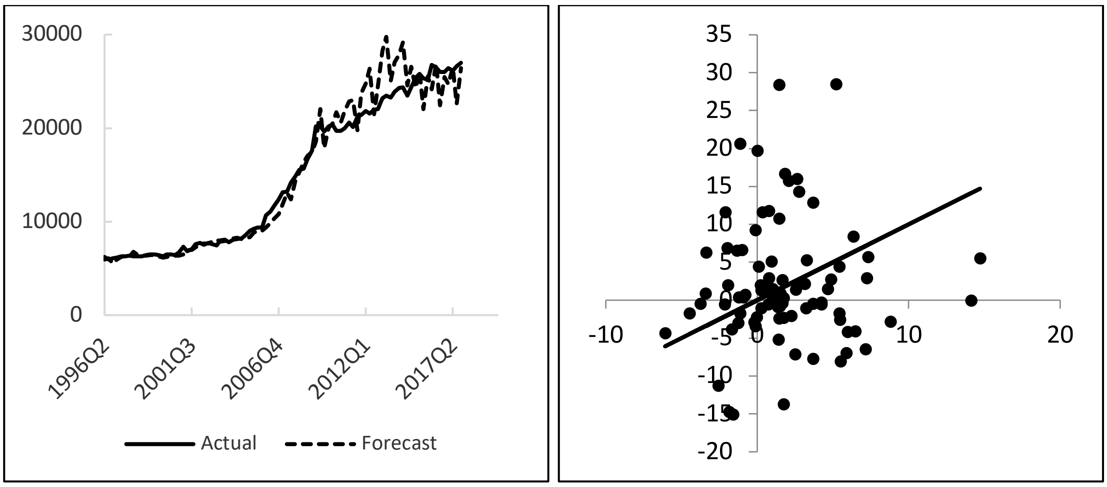
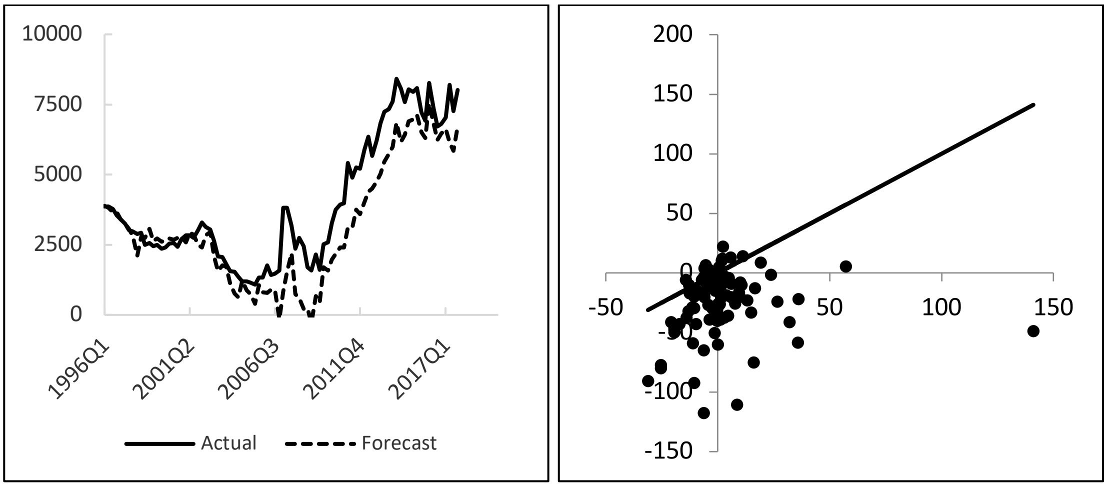
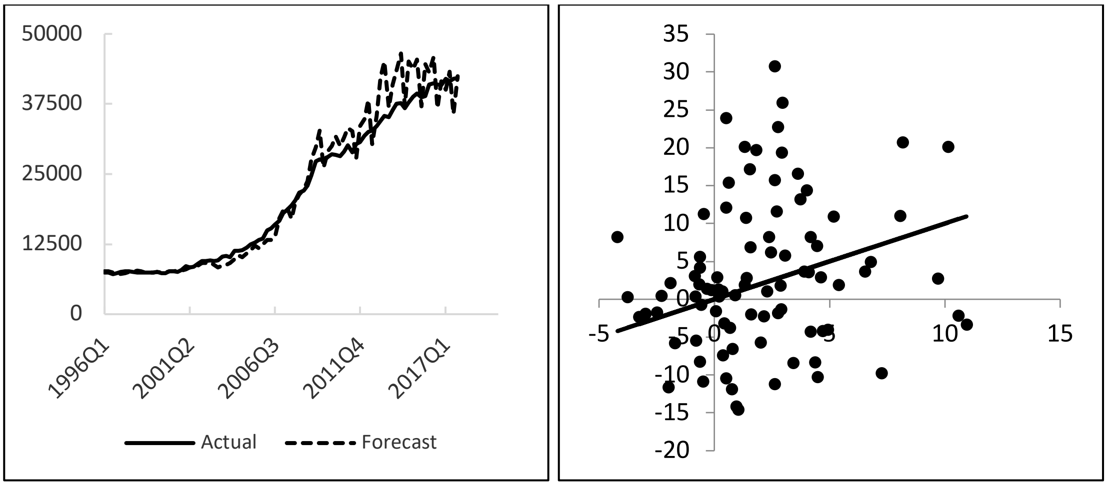


Figure 6.2: (Continued)

Demand for Reserves of Local Banks



Supply of Total Deposits



Price Level

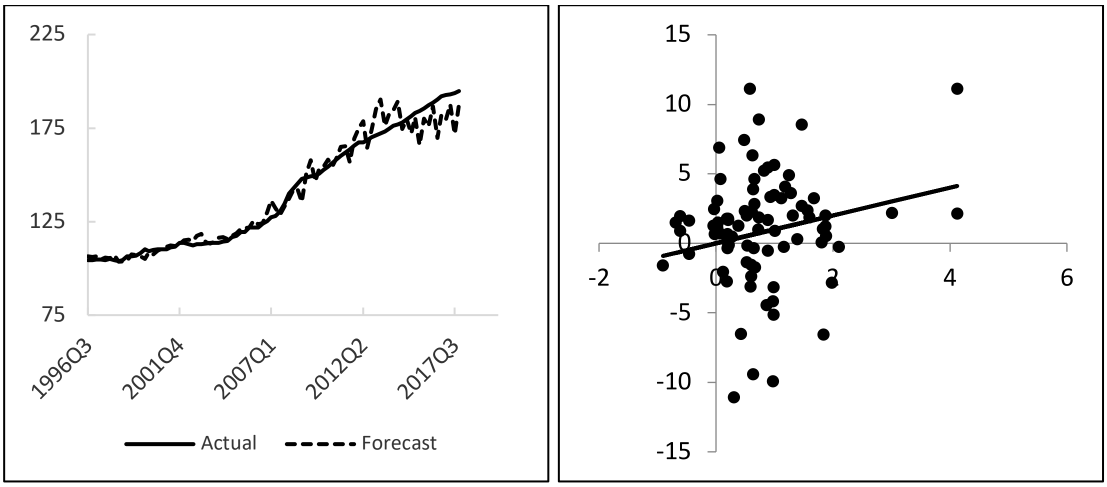
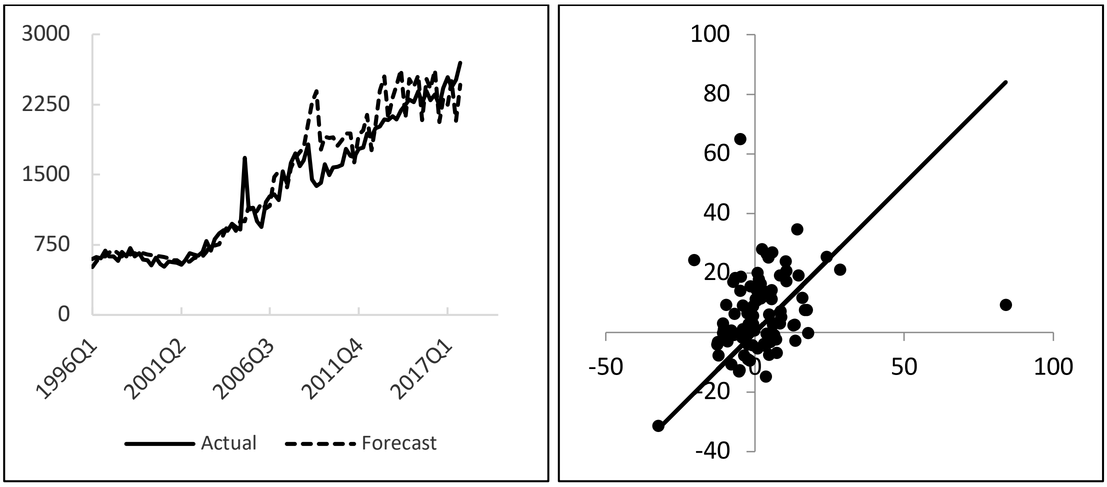
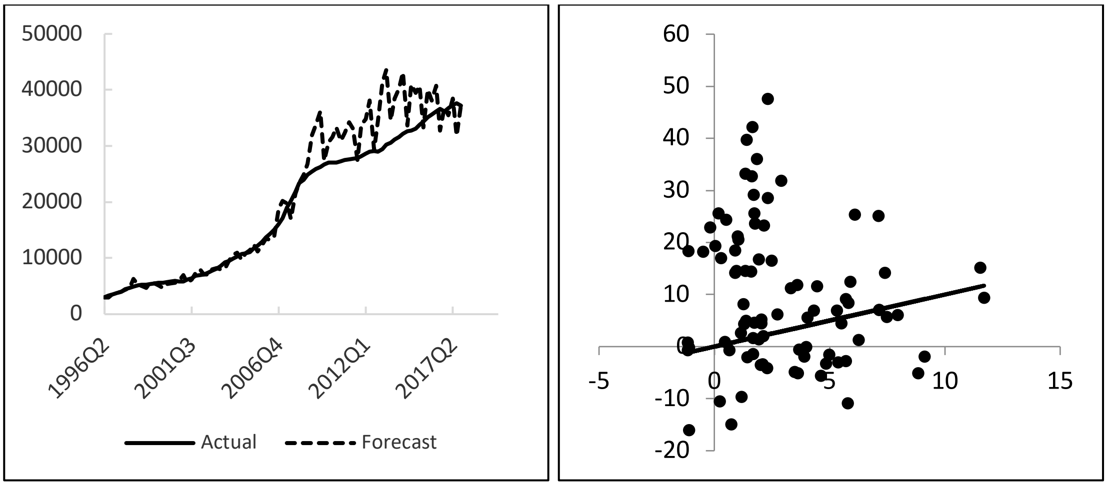


Figure 6.2: (Continued)

Imports



Supply of Credit



Demand for Credit

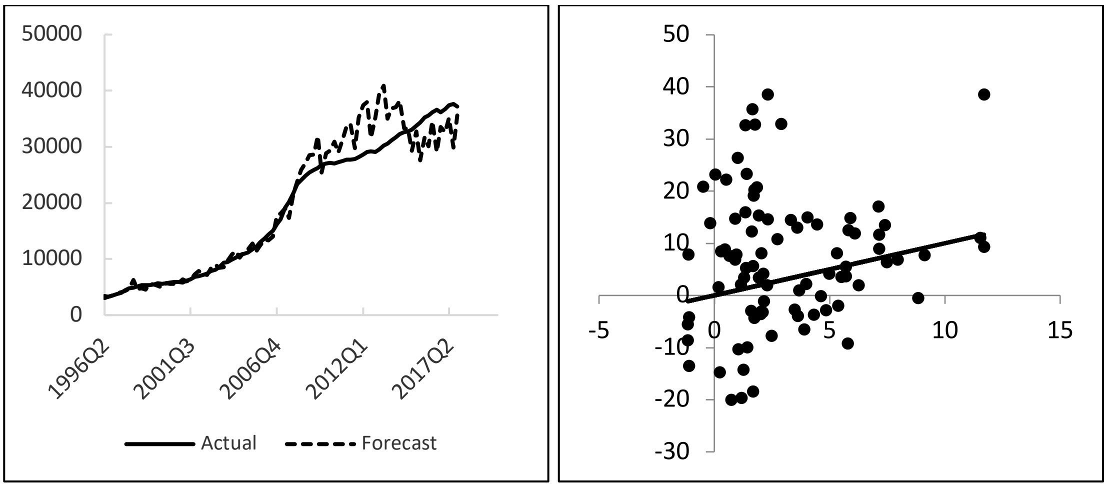


Figure 6.2: (Continued)

Stock Prices

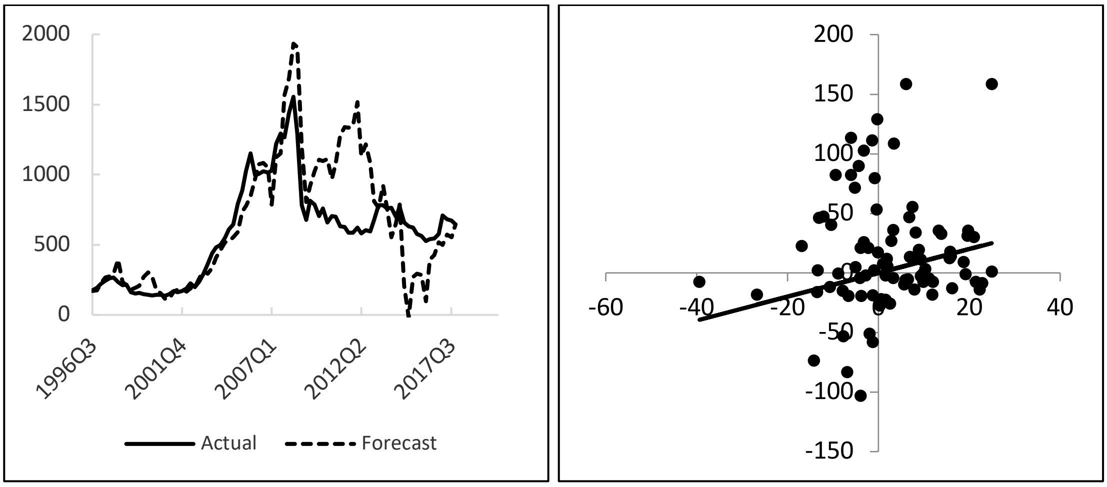
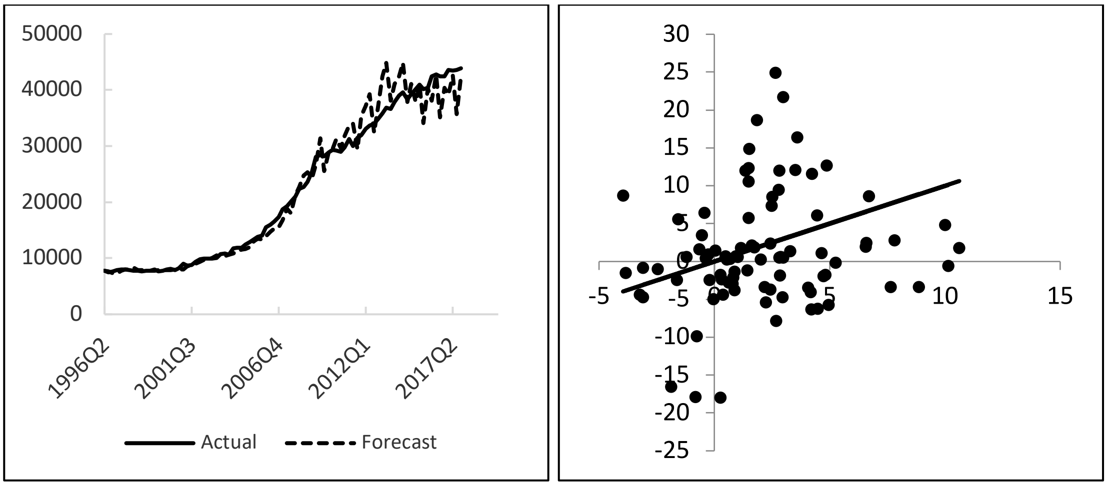
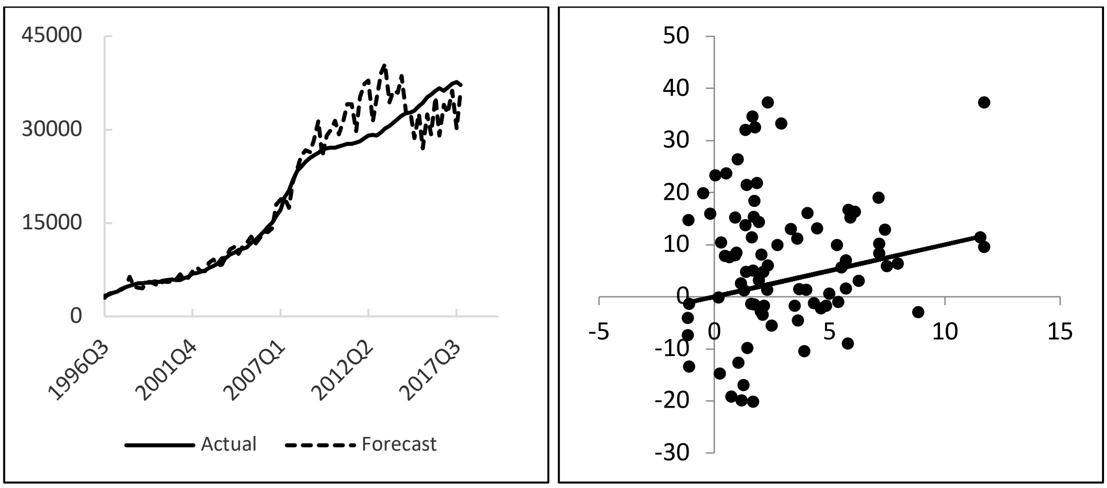


Figure 6.3: The Predictive Power of the Equilibrium Conditions

Money Stock



Credit



6.5 Concluding Remarks

This chapter examines the predictive accuracy of the model by generating forecasts and measuring their accuracy. The forecasts are generated recursively by including all of the available information because—according to Macdonald and Marsh (1993), Stock and Watson (2003), and Pesaran et al. (2006)—including all of the available information when estimating the forecasts improves predictive performance. The results demonstrate that the random walk could not be outperformed in terms of mean square error, root mean square error and other measures based on the magnitude of the error, which is in line with the findings of Meese and Rogoff (1983).

On the other hand, the model's predictive power for directional changes is quite good and, which makes any of the equations better than the no-change random walk. The findings indicate that most of the equations have a direction accuracy of more than 50%. The results presented in this chapter are in line with those of Moosa and Burns (2014) since the forecasts fail to outperform the random walk in terms of the root mean square error and easily beat the random walk in terms of the direction accuracy.

CHAPTER 7

FORECASTING-BASED TRADING

7.1 Introduction

According to Leitch and Tanner (1991), economists are baffled by the observation that profit-maximising firms waste millions of dollars buying and generating professional forecasts when the random walk model forecasts are almost always better. Normally, the quality of the forecasts is measured by the $RMSE$ and similar measures that are based on the magnitude of the forecasting error. Nevertheless, many economists claim that it is not appropriate to evaluate the accuracy of the forecasts by using measures based on the magnitude of the error such as the $RMSE$. Additionally, they claim that the ultimate test of forecasting power is the capability to generate profits by utilising a forecasting-based trading strategy.

The objective of this chapter is to examine the ability to make profit by trading based on the forecasts, using several trading strategies. The chapter is divided into five sections, the first of which is an introduction. The second section contains a description of trading strategies. The third section presents the results of stock trading. The fourth section presents the results of trading based on forecast changes in interest. The fifth section contains a recapitulation and concluding remarks.

7.2 Trading Strategies

Five trading strategies are utilised in this chapter: (i) buy and hold strategy, (ii) buy or short sell strategy, (iii) buy or short sell without borrowing strategy, (iv) buy or stand strategy, and (v) buy or stand without borrowing. In the buy and hold strategy the deviation between the actual stock and the forecasted stock price is estimated in percentage term as

$$D = 100\left(\frac{SP}{\widehat{SP}} - 1\right) \tag{7.1}$$

where D represents the deviation, SP is the stock price, and $\widehat{SP}$ denotes the stock price forecast. In this case the forecast is taken to be some sort of an equilibrium or fundamental value.

When the stock is undervalued by a predetermined percentage, meaning that the deviation (D) is negative, it is considered a buy signal; conversely, when the stock is overvalued by a predetermined percentage, meaning the deviation (D) is positive, it is regarded as a sell signal. After selling the stock, the current value of the portfolio is invested at the domestic interest rate (r^k) until the next buy signal is detected. When $D < 0$, the stock is undervalued, indicating a buying opportunity because the stock price is expected to rise in the future. When $D > 0$, the stock is overvalued, indicating a selling opportunity because the stock price is expected to decline. The rate of return (RoR) is the percentage net gain or loss of an investment over a specified period. Therefore, the rate of return on each trade can be calculated as

$$RoR = 100\left(\frac{P_S}{P_B} - 1\right) \tag{7.2}$$

where P_S is the selling price and P_B is the buying price. The portfolio value (PV) after each trade is calculated as

$$PV_t = PV_{t-1}\left(1 + \frac{RoR}{100}\right) \tag{7.3}$$

In the buy or short sell strategy, a buy signal or a short sell signal is generated by evaluating whether the stock price is expected to rise or fall in the following quarter, based on the forecasts of the stock price generated by the model. If the stock price is expected to rise in, this is considered as a buy signal; conversely, if the stock price is expected to fall, it is regarded as a short sell signal. The rate of return on short selling is calculated as

$$RoR = 100\left(\frac{P_B}{P_S} - 1\right) \quad (7.4)$$

It is worth noting that the trades are closed at the end of the period, regardless of the outcome of the trade, and the value of the portfolio is calculated by assuming that the principal amount is borrowed at the domestic interest rate (r^k). The cost of borrowing is deducted from the returns at the end of each quarter. Hence:

$$PV_t = PV_{t-1}\left(1 + \frac{RoR - \frac{r_{t-1}^k}{4}}{100}\right) \quad (7.5)$$

In the buy or short sell without borrowing strategy, we assume that the principal amount is not borrowed, which means that all the returns from the trades are kept without having to deduct the cost of borrowing.

In buy or stand strategy, the decision to a buy the stock or stand is made according to whether the stock price is expected to rise or fall in the following period. If the price is expected to rise in the next quarter, the stock is bought; conversely, a standing signal is indicated if the stock price is expected to fall. When no trades take place, the portfolio is invested at the domestic interest rate (r^k). Similar to the buy or short sell strategy, all the trades are closed at the end of the period, and the value of the portfolio is calculated by assuming that the principal amount is borrowed at the domestic interest rate.

In the buy or stand without borrowing strategy, it is assumed that the principal amount is not borrowed. Therefore, the cost of borrowing is not deducted at the end of each period. It is worth noting that the last two trading strategies are designed to imitate the stock market in Kuwait, since short selling is not allowed.

7.3 Results of the Stock Prices Forecasting-Based Trading

In this section, the five trading strategies are utilised in trading stocks. In the buy and hold strategy, the deviation between the actual stock price (proxied by Kuwait stock exchange index) and the forecast is estimated in percentage terms. Deviations of 5% and 10% are used as signals for buying and selling. After selling the stock, the current value of the portfolio is invested at the domestic interest rate (r^k) until the next buy opportunity emerges. The values of the portfolios of the structural forecasts from 1996 to 2017 are presented in Figure 7.1 and Figure 7.2. Likewise, the values of the portfolios of the reduced-form forecasts are illustrated in Figure 7.3 and Figure 7.4.

The structural forecasts are better than the reduced-form forecasts in this trading strategy. Moreover, the buy and hold strategy with a deviation of 10% for the structural forecasts is by far the best out of the four if the performance of the trading strategies is judged strictly on the basis of the terminal value of the portfolio. However, it is worth noting that the performance of the structural forecasts might have been distorted by the performance of the Kuwait stock market. During the global financial crisis, the market plummeted and never regained what was lost until today.

Figure 7.1: Buy and Hold - 5% Deviation (Structural Forecasts)

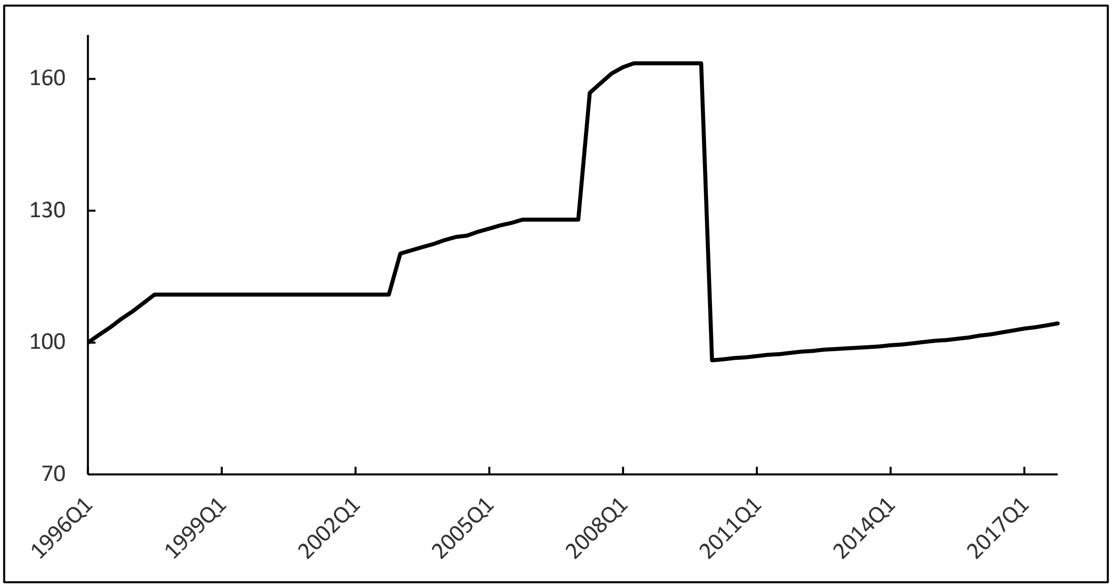


Figure 7.2: Buy and Hold - 10% Deviation (Structural Forecasts)

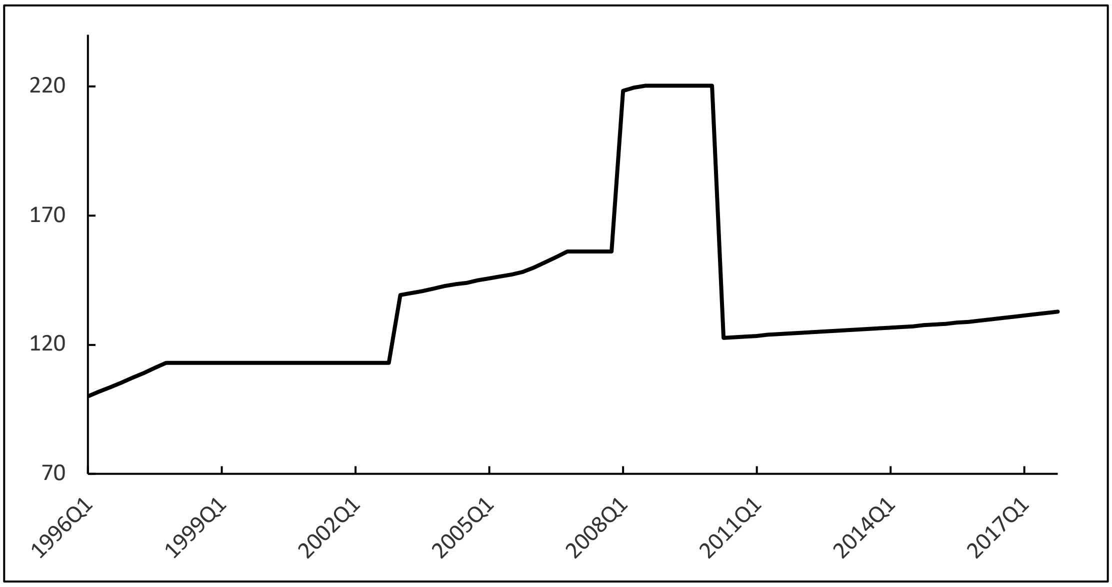


Figure 7.3: Buy and Hold - 5% Deviation (Reduced-Form Forecasts)

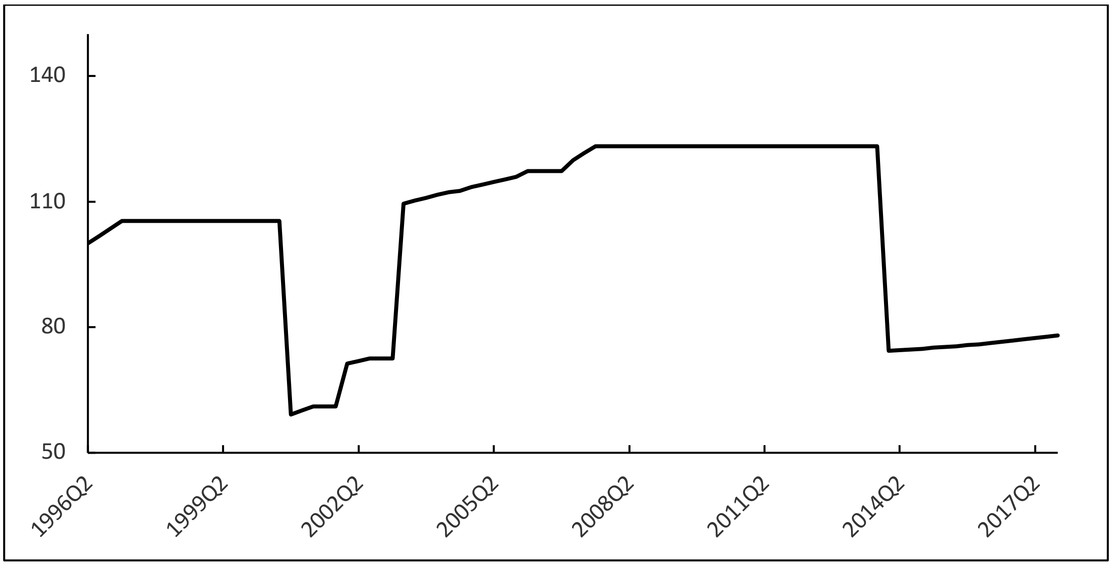
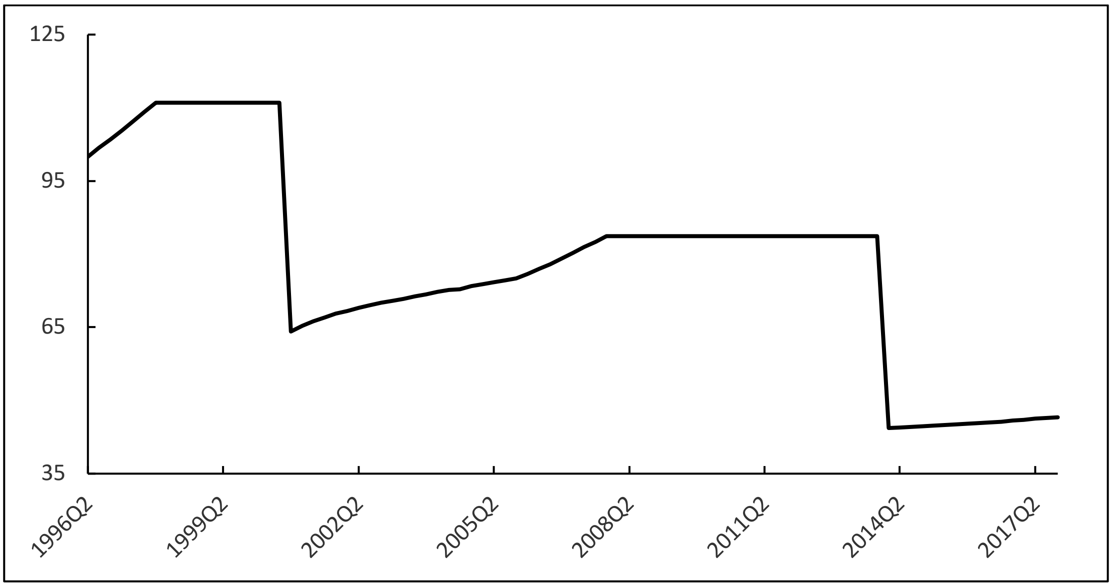


Figure 7.4: Buy and Hold - 10% Deviation (Reduced-Form Forecasts)



In the buy or short sell trading strategy, we either buy or short sell based on the prediction of the direction of change in the following quarter. If we expect an increase in the price of the stock, we buy; conversely if the price of the stock is expected to fall, we short sell. The value of the portfolios over time for the structural forecasts and reduced-form forecasts are presented in Figure 7.5 and Figure 7.6, respectively.

Figure 7.5: Buy or Short Sell (Structural Forecasts)

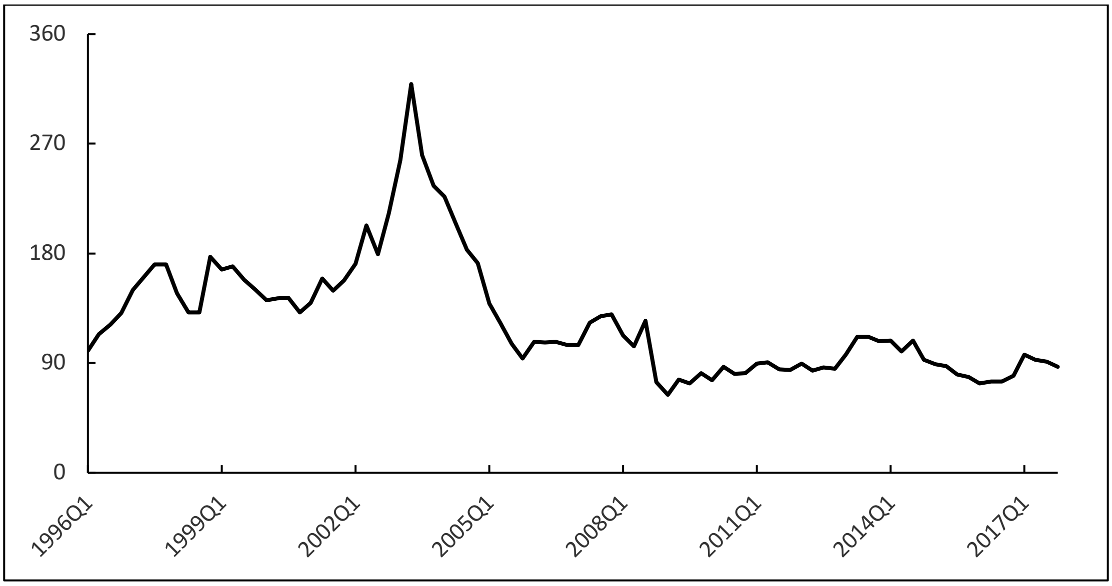
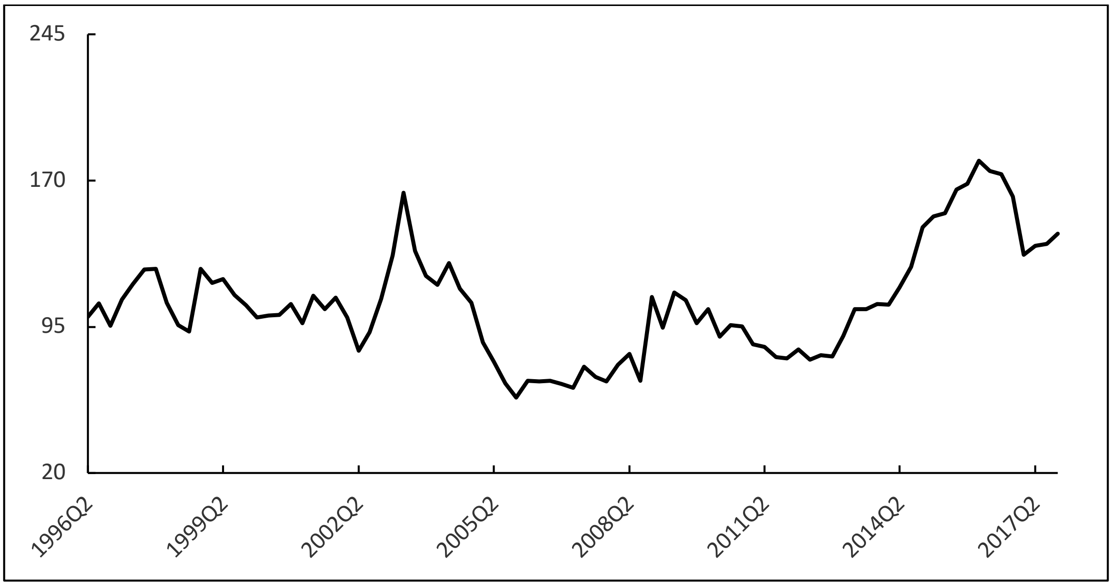


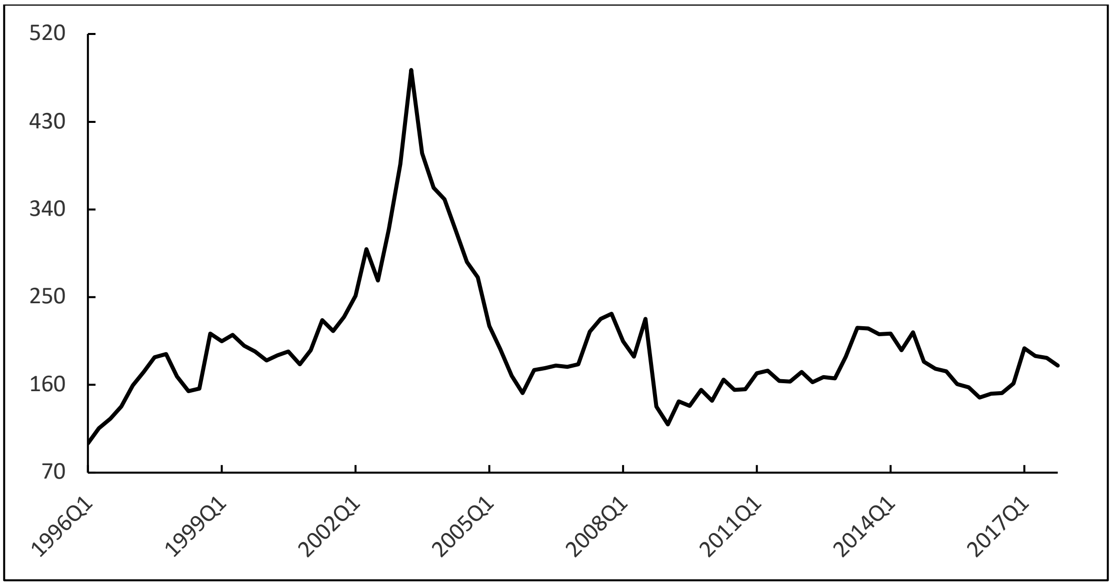
Figure 7.6: Buy or Short Sell (Reduced-Form Forecasts)



The results indicate that the reduced-form forecasts performed better than the structural forecasts. The cumulative return for the reduced-form forecasts is 42.89%, whereas the structural forecasts portfolio has a -21.96% cumulative returns. The value of both of the portfolios dropped after the third quarter of 2003, which is around the time of the invasion of Iraq. Political instability in the region at that time may have caused a decline in the values of the portfolios.

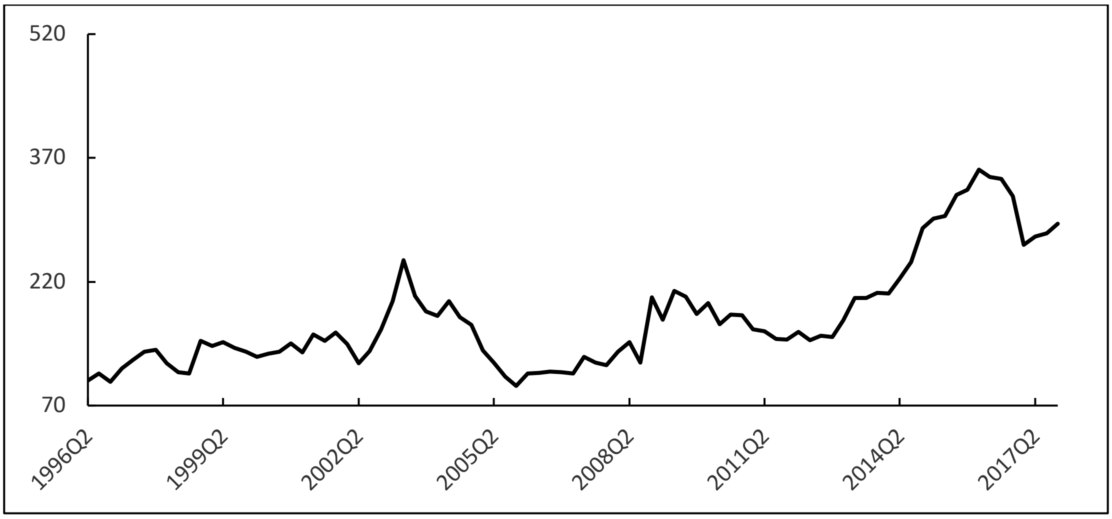
In the buy or short sell without borrowing strategy, we do not assume that the principal amount is borrowed. Trading without borrowing the principal amount means that we do not have to subtract the borrowing cost for every trade. The value of the portfolios over time for the structural and reduced-form forecasts are illustrated in Figure 7.7 and Figure 7.8, respectively.

Figure 7.7: Buy or Short Sell Without Borrowing (Structural Forecasts)



The reduced-form forecasts performed better than the structural forecasts in the buy or short sell without borrowing strategy. The cumulative return for the reduced-form and structural forecasts are 190.35% and 79.89% respectively. Similar to the buy or short sell strategy, the values of portfolios dropped after the third quarter of 2003, which could be attributed to the political instability in the region caused by the invasion of Iraq.

Figure 7.8: Buy or Short Sell Without Borrowing (Reduced-Form Forecasts)



The buy or stand strategy is relatively similar to the buy or short sell strategy. The only difference is that in this strategy we do not short sell when we expect a decline in the stock price—instead we stand. When the stock price is expected to fall, no trades take place and the portfolio amount is invested at the domestic interest rate (r^k). The value of the structural and reduced-form forecasts portfolios are presented in Figure 7.9 and Figure 7.10.

Figure 7.9: Buy or Stand (Structural Forecasts)

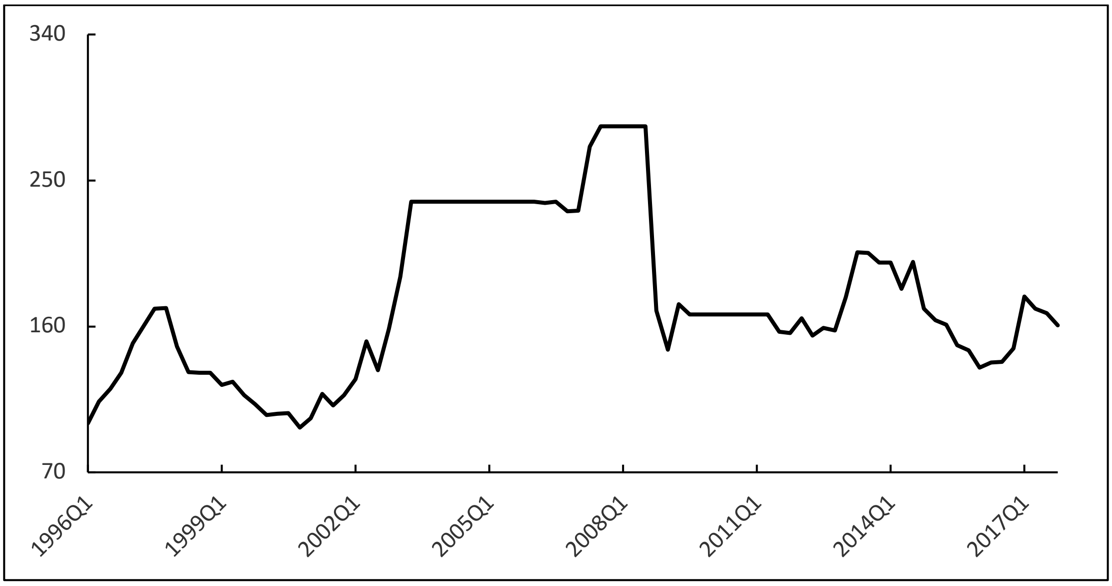
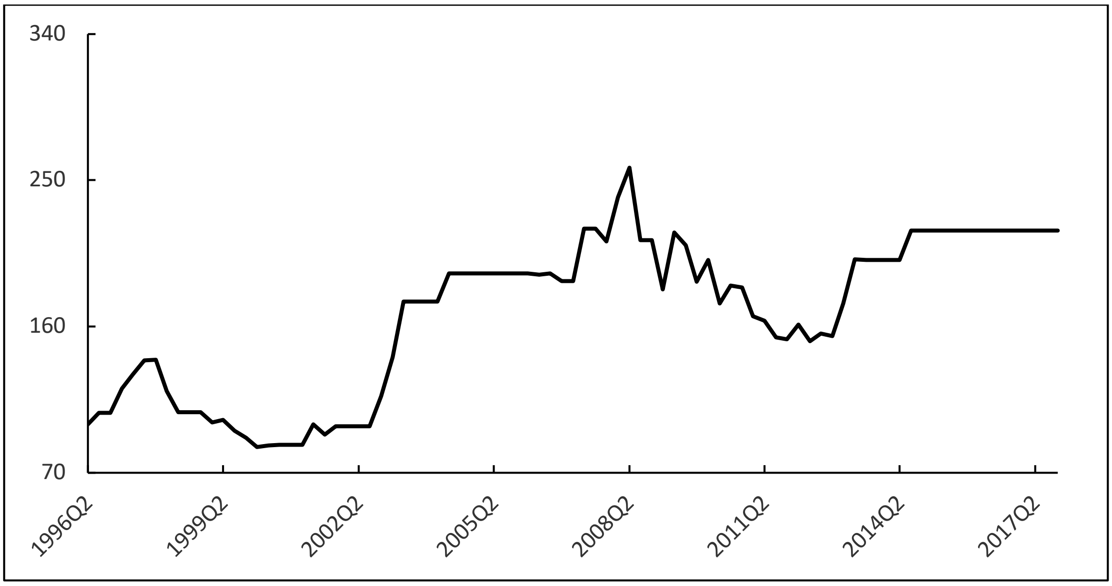


Figure 7.10: Buy or Stand (Reduced-Form Forecasts)



In the buy or stand without borrowing strategy, we do not assume the principal amount is borrowed. Similar to the buy or short sell without borrowing strategy, we do not have to deduct the cost of borrowing for every trade. The results of this trading strategy are presented, for the structural forecasts and reduced-form forecasts, Figure 7.11 and Figure 7.12, respectively.

Figure 7.11: Buy or Stand Without Borrowing (Structural Forecasts)

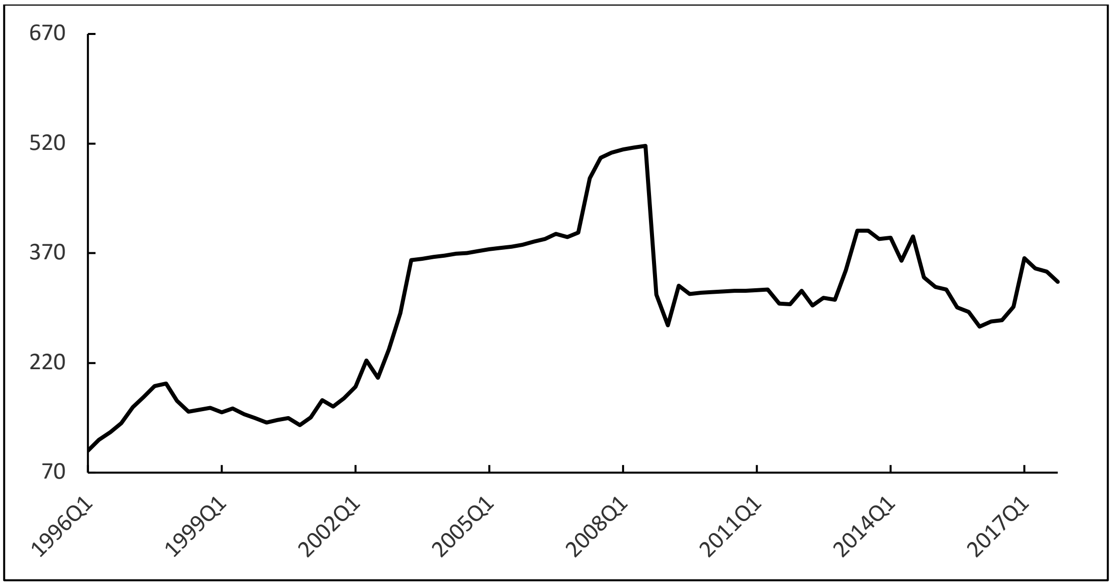
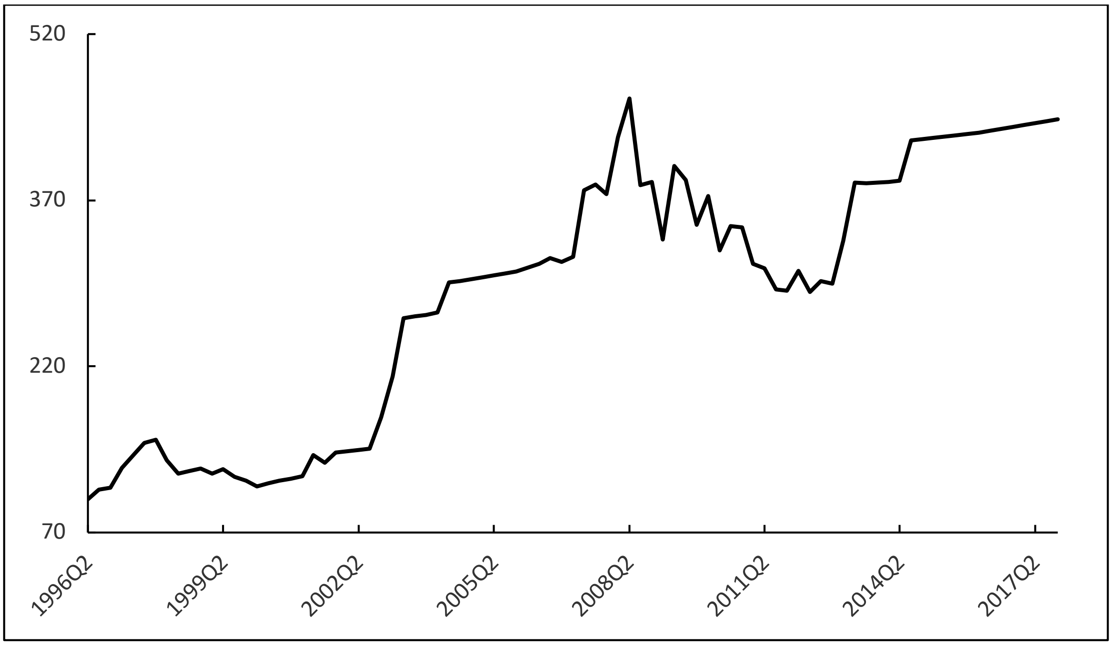


Figure 7.12: Buy or Stand Without Borrowing (Reduced-Form Forecasts)



The result indicates that the reduced-form forecasts performed better than the structural forecasts in this trading strategy. Moreover, the performance of the structural forecasts portfolio is affected by the performance of the Kuwait stock market during the global financial crisis.

In terms of profitability, Table 7.1 reveals that buy or stand without borrowing trading strategy outperforms all the other strategies since the average annual compound rate of return (AACRR) is 7.08% for the reduced-form forecasts and 5.52% for the structural forecasts.[7] On the other hand, the buy and hold strategy has the worst performance. The buy and hold strategy with 10% deviation signal for the reduced-form forecasts has a -53.41% cumulative return and a -3.41% average annual compound rate of return. The buy or short sell without borrowing strategy produces

[7] The average annual compound rate of return is calculated from the initial and terminal values of the invested capital. It is calculated on a quarterly basis, then annualised. It is the average compound rate of return that takes the invested capital from the initial to the terminal value, such that if the initial value is compounded at this rate, the terminal value will be obtained.

relatively good returns, particularly for the reduced-form forecasts where the cumulative return is 190.35%, and the average annual compound rate of return is 5.02%.

Table 7.1: Measures of Profitability for the Trading Strategies (Stock Prices)

Forecasts	Trading Strategy	Cumulative Return %	AACRR %
Structural	Buy and Hold 5%	4.34%	0.19%
Reduced-Form	Buy and Hold 5%	-21.96%	-1.12%
Structural	Buy and Hold 10%	32.87%	1.30%
Reduced-Form	Buy and Hold 10%	-53.41%	-3.41%
Structural	Buy or Short Sell	-12.78%	-0.61%
Reduced-Form	Buy or Short Sell	42.89%	1.65%
Structural	Buy or Short Sell Without Borrowing	79.98%	2.68%
Reduced-Form	Buy or Short Sell Without Borrowing	190.35%	5.02%
Structural	Buy or Stand	60.63%	2.15%
Reduced-Form	Buy or Stand	118.99%	3.67%
Structural	Buy or Stand Without Borrowing	230.83%	5.52%
Reduced-Form	Buy or Stand Without Borrowing	342.95%	7.08%

7.4 Results of the Interest Rate Forecasting-Based Trading

To trade based on the interest rate forecasts, we created a hypothetical irredeemable bond where the price of the bond is inversely related to the interest rate. Based on the nature of the traded bond, we only utilise two trading strategies: (i) buy or short sell without borrowing strategy, and (ii) buy or stand without borrowing. The strategies with the assumption of borrowing are not useful in this case because the cost of borrowing is the domestic interest rate (r^k) and the value of the bond is derived from the domestic interest rate as well. Therefore, it is better to employ the strategies that do not assume that the principal amount is borrowed.

The buy or short sell without borrowing strategy is similar to the one used in trading the stock market in the previous section. In this strategy, a buy or short sell signal is generated by evaluating whether the bond price is expected to rise or fall in the following quarter, based on the forecasts of the interest rate generated by the model. If the bond price is expected to rise, this is considered a buy signal; conversely, if the bond price is expected to fall, this is considered as a short sell signal. Since the value of the bond is inversely related to the interest rate, an expected increase in the interest rate indicates that the value of the bond is expected to decrease which leads to short selling the bond, and vice versa. The value of the portfolio over time is illustrated in Figure 7.13.

Given that the bond price is inversely related to the interest rate in the buy or stand without borrowing strategy, the bond is bought when the interest rate is expected to decline because it means that the price will rise. On the other hand, when we expect the interest rate to rise no trades will take place, and the portfolio amount will be invested at the domestic interest rate (r^k) because we expect the price of the bond to decline. The value of the portfolio from 1995 to 2017 is illustrated in Figure 7.14.

The buy or stand outperforms the buy or short sell strategy in bond trading. As indicated by Table 7.2, the cumulative return for the buy or stand strategy is 1058.21% and the average annual compound rate of return is 11.5%. The buy or short sell also performs relatively well in terms of cumulative return as it produces 789.42% and the average annual compound rate of return is 10.20%. Both of the trading strategies produce better results in trading based on the interest rate forecasts than the stock price forecasts.

Figure 7.13: Buy or Short Sell Without Borrowing (Interest Rate)

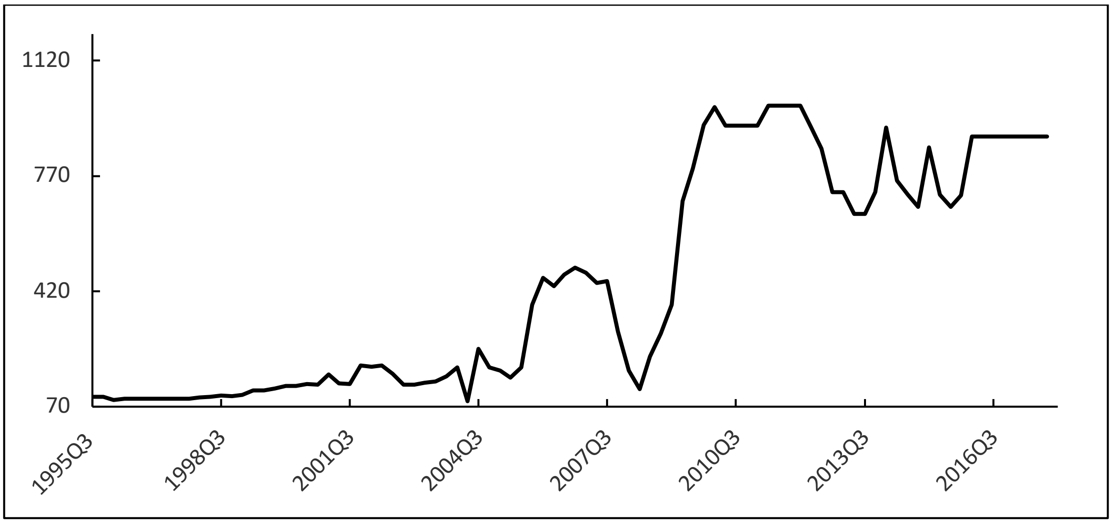


Figure 7.14: Buy or Stand Without Borrowing (Interest Rate)

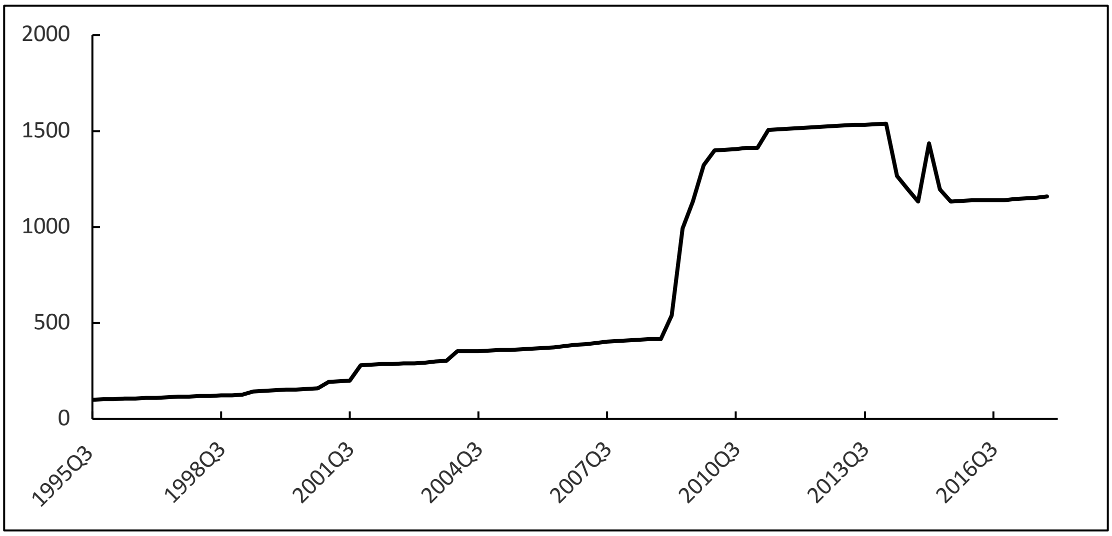


Table 7.2: Measures of Profitability for the Trading Strategies (Interest Rate)

Trading Strategy	Cumulative Return %	AACRR %
Buy or Short Sell Without Borrowing	789.42%	10.20%
Buy or Stand Without Borrowing	1058.21%	11.50%

7.5 Concluding Remarks

According to Leitch and Tanner (1991), the ultimate test of forecasting power is to test the ability of the model to generate profits by utilising forecasting-based trading strategies. The results presented in this chapter indicate that the model can be used to generate profits when the appropriate trading strategy is utilised. In terms of profitability, trading on the interest rate produces better cumulative returns than trading on stock prices. However, the performance of the stock trading was affected by political instability in the region and the global financial crisis as the Kuwait stock exchange index plummeted and never regained what was lost in the crisis until today.

CHAPTER 8

CONCLUDING REMARKS

8.1 Recapitulation

This thesis consists of eight chapters starting with chapter one, which introduces the topic and objectives of the research. The main objective of this research is to develop and estimate a macroeconometric model describing interactions between real and financial variables in the economy of Kuwait. Chapter one presents the outline of the thesis and emphasises the importance and contributions of this research, particularly because it is on a developing country. While the number of studies in this research area is going up, there is still a modest number of studies that cover the developing countries and emerging economies, particularly in the middle east and GCC region.

Chapter two presents a detailed overview of the history and structure of the economy of Kuwait. The main objective of the chapter is to review the main characteristics and sectors of the economy. Furthermore, the chapter discusses several important economic issues, such as the dependence on oil revues, imbalance in the labour force, reliance on international trade and the lavish welfare system. Chapter two also presents the most recent long-term economic plan introduced by the general secretariat of the Supreme Council for Planning and Development, also known as the State Vision Kuwait 2035 or “New Kuwait”.

Chapter three discusses the money-income relation in the economy of Kuwait. The main objectives of the chapter are to find the best definition of money and to understand the relationship between monetary aggregates and economic activity. The monetary aggregates are derived by following Friedman and Meiselman (1963) approach that involves adding sequentially one asset at a time. The presence of a stable long-run relation between the monetary aggregates and economic activity is examined by conducting multiple cointegration tests. Furthermore, the Granger (1969) causality test is used to investigate the causal relation and to determine the direction of causality between monetary aggregates and economic activity. The predictive power is examined by utilising recursive regressions to generate out-of-sample forecasts. Moreover, measures of forecasting accuracy (such as mean absolute error, mean square error and root mean square error) are calculated to determine the quality of the forecasts.

Chapter four is concerned with the specification of the model. The objective of the chapter is to specify a model that describes interactions between the monetary sector and the real sector of the economy. The model provides an analytical framework for examining the behaviour of several economic variables by tracing how real and financial variables affect each other. The model consists of thirteen behavioural equations that cover the role of government expenditure in economic activity, oil GDP, demand for money, the effect of foreign interest rates on domestic interest rates, demand for reserves, supply of deposits, effect of imports and money supply on the price level, imports, credit, and stock prices. The chapter discusses the recursiveness of the model and presents the derivation of the reduced-form equations and equilibrium conditions.

Chapter five is concerned with model estimation by OLS because of its recursive nature. OLS is considered an appropriate estimation method for recursive systems because the error terms are not correlated with the explanatory variables. The estimation results reveal that the model is well specified and that it has a high explanatory power. While several equations pass all of the diagnostic tests, some equations do not pass the normality test, which is attributed to the presence of outliers. Moreover, the cointegration tests reveal the presence of cointegration between the variables in all the equations, indicating that there is a stable long-run relation between the variables.

Chapter six investigates the predictive power of the model by examining its ability to generate accurate predictions. The forecasts are generated by utilising the recursive approach, which is preferred over the rolling approach, particularly when dealing with macroeconomic variables. The main conclusion to be drawn from the forecasting accuracy measures is that the random walk cannot be outperformed in terms of the measures based on the magnitude of the error, which is in line with the findings of Meese and Rogoff (1983). Furthermore, the findings indicate that most of the equations have a direction accuracy of more than 50%, which means the model's predictive power for directional changes is by far better than that of the random walk, which always predicts no change. The results presented in the chapter are in line with previous literature since the forecasts fail to outperform the random walk in terms of measures based on the magnitude of the error and easily outperform the random walk in terms of direction accuracy.

Chapter seven builds upon the findings of chapter six by examining the ability to make a profit by trading based on the forecasts. In chapter seven, five trading strategies are utilised for trading on the basis of the structural and reduced-form forecasts of stock prices and interest rate. The trading results indicate that, when the appropriate trading strategy is applied, the model is capable of generating profits. In terms of profitability, trading based on the interest rate forecasts yields better cumulative returns than trading based on stock price forecasts. Nevertheless, political instability in the region and the global financial crisis negatively affected the results of trading based on the forecasts of the stock prices.

8.2 Key Findings

This study contains several findings, reached either via a detailed theoretical discussion or through empirical analysis. To find the most appropriate theoretical and empirical definition of money in the economy of Kuwait, several empirical tests are carried out to examine the relation between money and economic activity. Six monetary aggregates are derived based on the Friedman and Meiselman (1963) approach for defining monetary aggregates by adding sequentially one asset at a time. Utilising this approach helps to understand the effect of changes in income on each asset included in the monetary aggregates.

The empirical analysis reveals that, based on the Friedman and Meiselman dual criteria, $M1B$ is the best definition of money in Kuwait. Moreover, the time series properties of the variables reveal that all variables are non-stationary in level and stationary in first difference—that is, they are I (1). Cointegration analysis includes four different tests: (i) the Engle-Granger two-step method, (ii) ARDL, (iii) ECM, and (iv) the Johansen procedure. The Engle-Granger two-step method reveals that none of the monetary aggregates is cointegrated with economic activity. On the other hand, the ARDL cointegration test reveals the presence of a stable long-run relation between

$M1B$, $M2$, $M2A$, $M3$ and economic activity. Moreover, the ECM and Johansen procedure (eigenvalue) results indicate the presence of cointegration between all the monetary aggregates and economic activity.

The Granger causality test reveals a unidirectional causal relation that runs from economic activity to the broad monetary aggregates $M2$, $M2A$, $M3$ along with $M1B$, which is in line with the Keynesian view. Furthermore, the direction accuracy of the forecasts is good for all of the monetary aggregates. The empirical results do not provide a clear-cut conclusion in favour of a single monetary aggregate for conducting monetary policy in the economy of Kuwait.

Estimating the structural model reveals that government expenditure is the main determinant of economic activity in the economy of Kuwait. This result is expected, given that the government of Kuwait plays a dominant role in the economy as the largest and main employer in the economy, the leading investor in infrastructure, and the wealth distributor. Moreover, exports have a significant positive influence on oil GDP. The effect of exports on oil GDP is mostly due to the size of the oil sector in the economy. Through the study period, the massive increase in exports is instigated by the increase in the global demand for oil. Kuwait is a major oil-exporting country with a large oil sector that exports around 4.5% of the crude oil in the world. Kuwait relies on oil exports as a major source of revenue, to the extent that oil accounts for more than 90% of total exports in the country.

In the model, the demand for money is disaggregated into three equations. The estimation reveals that the demand for currency is determined by permanent income, and that the demand for demand deposits is influenced by permanent income and the domestic interest rate, which has a larger and more significant effect. Furthermore, the demand for quasi-money is determined by permanent income and the foreign interest rate, which has a larger and more significant effect. It is worth noting that since the demand deposits and quasi-money comprise interest-bearing assets, they are more influenced by movements in the interest rates than permanent income.

Kuwait has a small open economy without any restrictions on capital flows, and the currency is pegged to an undisclosed basket of the currencies of the major financial and trade partners. Under these circumstances, the domestic interest rate should be affected by the foreign interest rate because arbitrage opportunities will arise otherwise. This is confirmed by estimating the domestic interest rate function, where the estimation results show that a 1% increase in the foreign interest rate leads to a 0.773% rise in the domestic interest rate. Moreover, all of the cointegration tests indicate the presence of a stable long-run relation between the domestic and foreign interest rates.

Banks tend to reduce the excess reserves held at the central bank to make use of the funds in banking activities where they can receive interest, such as giving loans and mortgages. However, this is not the case in Kuwait because the central bank bills held by the local banks are interest-bearing, which encourages them to retain excess reserves at the central bank. In Kuwait, the main determinants of the demand for reserve are the currency in circulation and the liquidity position of the local banks, which are cointegrated with the demand for reserves. On the other hand, total reserves and the domestic interest rate are the main determinants of the supply of deposits.

Estimating the price level function reveals that the money supply and trading partners' inflation (import prices) are the main determinates of the inflationary process. The results are not surprising, given that Kuwait is heavily dependent on imports and foreign labour forces, which is why domestic and foreign factors are included in the price level equation. Dependence on imports is caused by the small productive capacity of the economy, which is caused by the lack of resources such as labour and natural resources. Moreover, imports are a function of the exchange rate and economic activity.

The demand for and supply of credit constitute one of the most crucial parts of the economy because of the effect it has on economic activity, spending, and income. The supply of credit is positively influenced by changes in total deposits and the net position of local banks. On the other hand, the demand for credit has three main determinants which are the foreign interest rate, oil GDP, and economic activity. It is worth noting that the foreign interest rate has the largest effect on the demand for credit. In turn, credit affects stocks prices in addition to economic activity and oil GDP. Including credit in the stock price equation is attributed to a common practice in Kuwait where the investors borrow money from local banks to invest in the stock market. The estimation results indicate that economic activity and oil GDP have a positive and significant effect on stock prices.

The predictive power of the model is examined by generating out-of-sample forecasts recursively by including all of the available information as suggested by MacDonald and Marsh (1993), Stock and Watson (2003), and Pesaran et al. (2006). Measuring the accuracy of the forecasts reveals that the random walk could not be outperformed in terms of MSE, $RMSE$ and other measures based on the magnitude of the error. These findings are in line with the results of Meese and Rogoff (1983). Furthermore, the model's forecasting power for changes in direction is by far superior to that of the random walk. The direction accuracy results show that most of the variables have a direction accuracy of more than 50%. The forecasts fail to outperform the random walk in terms of measures based on the magnitude of the error and outperform the random walk in terms of direction accuracy, which is in line with previous empirical literature, such as those of Moosa and Burns (2014).

The last empirical part in this thesis is about the profitability of trading based on the forecasts. Several trading strategies are formulated to trade on the basis of stock prices and the interest rate. In trading based on stock prices, the buy or stand without borrowing trading strategy outperforms all the other strategies, given that the average annual compound rate of return is 7.08% for the reduced-form forecasts and 5.52% for the structural forecasts. On the other hand, the buy or stand strategy produces the best results for trading based on changes in the interest rate. The main conclusion is that the model is capable of generating profits by predicting movements in stock prices and interest rate, particularly when an appropriate trading strategy is utilised.

8.3 Limitations and Potential Extensions

In this thesis, we examine the interactions between the real sector and the monetary sector in the economy of Kuwait. However, we encountered some limitations throughout the preparation of this study which are: (i) the availability of data, and (ii) the limited number of previous studies on Kuwait.

First, problems related to the lack of reliable data and data availability are a common hurdle for researchers dealing with data for developing countries and emerging economies. For instance, in the case of Kuwait, the GDP is only reported on an annual basis. Therefore, we had to use interpolation to derive quarterly figures in this study.

Second, since the previous literature focuses more on developed economies, there is a limited number of studies that cover the economies of developing countries, including Kuwait. While reviewing the literature, we found that most of the studies of the economy of Kuwait are relatively outdated and do not reflect the current state of the economy. Thus, we propose that in the future researchers pay more attention to developing economies.

In view of the results presented in this study further avenues for future research could be based on the following objectives: (i) including more variables in the model, particularly on the real side of the economy; (ii) exploring different methods for estimating the model such as the use a time-varying parametric (TVP) framework, which allows for the effects of the explanatory variables to change over time; and (iii) using different data samples to estimate the model such as including a more extended period or using a different data frequency.

At this stage, it must said once more that this is a finance rather than economics thesis, in which case emphasis is placed on the use of predictions generated by the model to trade on the basis of variations in stock prices and interest rates. Yet, the model can be used to derive some policy implications, particularly the estimated elasticities with respect to policy variables such as government expenditure and the money supply and how they affect growth and inflation. Perhaps another avenue for further research is to re-design the model in such a way as to place more emphasis on policy variables for the purpose of using the results for the purpose of policy formulation.

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