UNIVERSITY OF SOUTHAMPTON

FACULTY OF LAW, ARTS & SOCIAL SCIENCES

School of Social Sciences

ESSAYS ON MONETARY POLICY: MACRO AND FIRM-LEVEL EVIDENCE FROM MALAYSIA, A SMALL OPEN ECONOMY

by

Zulkefly Abdul Karim

Thesis for the degree of Doctor of Philosophy

March 2011

University of Southampton

ABSTRACT

FACULTY OF LAW, ARTS & SOCIAL SCIENCES
SCHOOL OF SOCIAL SCIENCES

Doctor of Philosophy

ESSAYS ON MONETARY POLICY: MACRO AND FIRM-LEVEL EVIDENCE FROM MALAYSIA, A SMALL OPEN ECONOMY

By Zulkefly Abdul Karim

This dissertation is comprised of three empirical essays evaluating the effectiveness of monetary policy implementation in a small open economy (i.e. Malaysia) by using macro, and micro-level study. The motivations for these three studies evolve around the issue of the role of monetary policy in transmitting to economic activity at the macroeconomic level, and at the microeconomic level through firm-level equity returns, and firm-level investment spending.

The first essay, which is in Chapter 2, examines the implementation of monetary policy in a small open economy at the macroeconomic level by using an open-economy structural VAR (SVAR) study. Monetary policy variables (interest rate and money supply) have been measured through a non-recursive identification scheme, which allows the monetary authority to set the interest rate and money supply after observing the current value of foreign variables, domestic output and inflation. Specifically, this chapter tests the effect of foreign shocks upon domestic macroeconomic fluctuations and monetary policy, and examines the effectiveness of domestic monetary policy as a stabilization policy. The results show the important role of foreign shocks in influencing Malaysian monetary policy and macroeconomic variables. There is a real effect of monetary policy, which is that a positive shock in money supply increases domestic output. In contrast, a positive interest rates shock has a negative effect on domestic output growth and inflation. The effects of money supply and interest rate shocks on the exchange rate and stock prices are also consistent with standard economic theory. In addition, domestic monetary policy enables to mitigate the negative effect of external shocks upon domestic economy.

The second essay (chapter 3) investigates the effects of domestic monetary policy shocks upon Malaysian firm-level equity returns in a dynamic panel data framework. A domestic monetary policy shock is generated via a recursive SVAR identification scheme, which allows the monetary authority to set the overnight interbank rate after observing the current value of world oil price, foreign income, foreign monetary policy, domestic output and inflation. An augmented Fama and French (1992, 1996) multifactor model has been used in estimating the determinants of firm-level stock returns. The results revealed that firm stock returns have responded negatively to monetary policy shocks. Moreover, the effect of domestic monetary policy shocks on stock returns is significant for small firms' equity, whereas equity of large firms is not significantly affected. The effect of domestic monetary policy also has differential effects according to the sub-sector of the economy in which a firm operates. The equity returns of financially constrained firms are also significantly more affected by domestic monetary policy than the returns of less constrained firms.

The third essay, which is in Chapter 4, examines the effects of monetary policy on firms' balance sheets, with a particular focus on the effects upon firms' fixed-investment spending. The focal point concerns the two main channels of monetary policy transmission mechanism, namely the interest rate and broad credit channels in affecting firms' investment spending. Specifically, the interest rates channel is measured through the firm user cost of capital, whereas the broad credit channel is identified through the firms' liquidity (cash flow to capital stock ratio). By estimating the firms' investment model using a dynamic neoclassical framework in an autoregressive distributed lagged (ARDL) model, the empirical results tend to support the relevance of interest rates, and the broad credit channel in transmitting to the firm-level investment spending. The results also reveal that the effect of monetary policy channels to the firms' investment are heterogeneous, in that the small firms who faced financial constraint responded more to monetary tightening as compared to the large firms (less constrained firms). The effect of monetary policy is also heterogeneous across sub-sectors of the economy, as some sectors (for example, consumer products, industrial products and services) are significantly affected by monetary policy, whereas other sub-sectors (for example, property) are not affected.

List of Contents

List of Tables

Page

List of Figures

List of Abbreviations

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criteria
ARDL	Autoregressive Distributed Lagged
ASEAN	The Association of Southeast Asian Nations
BLR	Base Lending Rate
BNM	Bank Negara Malaysia
CAPM	Capital Asset Pricing Model
CPI	Consumer Price Indices
DSGE	Dynamic Stochastic General Equilibrium
FFR	Federal Fund Rate
FOMC	Federal Open Market Committee
G-7	Group of Seven countries (Canada, France, Germany, Italy, Japan, United Kingdom and Unites States)
GDP	Gross Domestic Product
GMM	Generalized Method of Moment
IBOR	Inter bank Overnight Rate
IFS	International Financial Statistic
IMF	International Monetary Fund
INF	Inflation Rate
IPI	Industrial Production Index
KLCI	Kuala Lumpur Composite Indices
MFD	Mundell-Fleming-Dornbusch
NEER	Nominal Effective Exchange Rate
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Square
OPR	Overnight Policy Rate
SIC	Schwarz Information Criteria
SVAR	Structural Vector Autoregressive
UCC	User Cost of Capital
UK	United Kingdom
US	United States of America

List of Appendices

Page

Declaration of Authorship

I, **Zulkefly Abdul Karim**

Declare that the thesis entitled

ESSAYS ON MONETARY POLICY: MACRO AND FIRM-LEVEL EVIDENCE FROM MALAYSIA, A SMALL OPEN ECONOMY

and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

- this work was done wholly or mainly in candidature for a research degree at this university;
- where any part of this thesis has previously been submitted for a degree or any other qualification at this university or any other institutions, this has been clearly stated;
- where I have consulted the published work of other, this is always clearly attributed;
- where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
- I have acknowledged all main sources of help;
- where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
- none of this work has been published before submission.

Signed: …………………………

Date: ……………………………

Acknowledgement

Throughout completion this thesis, it is a very long and challenging learning process. Therefore, it is a great pleasure to convey my gratitude to the number of people who made this research achievable.

First and foremost, I would like to express my deepest appreciation to my PhD co-supervisors, Dr. Peter Smith, and Dr. John Bluedorn for their support, enthusiasm, encouragement, and their great comments and suggestions have improved this dissertation immensely.

I also would like to express gratitude to the Ministry of Higher Education of Malaysia, and The National University of Malaysia (UKM) who jointly sponsored my study leave. I wish to thank my colleagues at the Economics Division, School of Social Sciences for their support and inspiration, in particular to Dr. Wan Azman Saini Wan Ngah, Dr. Corrado Giulietti, Dr. Nayef Alsadoun, Reza Boostani, Dayang Affizah, Riayati Ahmad, Norimah Rambeli, Juan Correa, Derya Tas, Dimitris, Ronaldo, Mauro, and Luis.

I am indebted to my family members for their support and encouragement. I am deeply grateful to my parents, Abdul Karim Mat Arif and my late mother, Rahmah bt Abdullah, and my late brother Abdul Aziz. For them, this thesis is dedicated. I also would like to thanks my family members; my elder brothers (Kamarzaman and Jamaludin), my elder sisters (Jamilah and Norezea), my younger brothers (Samsul Arifin, Bakri and Megat Ghazali), my late father in law (Yaacop Yeop Ariffin), my mother in law (Masitah Tak), my brothers-in-law (Hanip, Zohdi, Syakir and Syamin), and my sisters in law (Rahmah, Maziah and Som).

Finally, but certainly not least, I am extremely indebted to my wife, Maryani Yaacop, and my beloved children, Sarah Ain Ardini, Izz Idlan, Ain Adlina, and Izz Ihsan, who have accompanied me with love, patience, and giving me a vital encouragement during entire my research training. For them, this thesis is dedicated.

1. INTRODUCTION

1.1 Background of the study

The main question relating to the implementation of monetary policy is that the central bank must either target a monetary aggregate or interest rate as an operating target. In Malaysia's experience, the Bank Negara Malaysia (BNM) as the nation's Central Bank switched the monetary policy strategy from monetary targeting towards interest rate targeting in November 1995. During interest rate targeting, monetary policy has operated through short-term interest rates to attain the ultimate target, that is a sustainable long-run economic growth, accompanied with price and financial stability [1]. The BNM believed that a change in the interest rates policy has a predominant effect on the domestic economy through macro and firm-level activity. This is because a change in the BNM policy rate will have a direct effect on interest rates (lending rate, deposit rate, and money market rate), which will affect the cost of funds and liquidity in the banking system. This, in turn, will affect the private sector, particularly firms' balance sheet conditions in terms of their financial assets (for example, equity returns), investment spending, and liabilities position, which subsequently influences aggregate expenditure and inflation.

As a small open economy and highly trade-dependant, the Malaysian economy is vulnerable to the exogenous shocks from external events. Therefore, the BNM has to consider the various effects of the external shocks on the domestic economy in formulating their monetary policy. Specifically, the monetary authority has to consider three aspects relating to the implementation of monetary policy. First, how effective is

[1] During the interest rate targeting, monetary policy in Malaysia can be categorized into three main evolutions. Firstly, from November 1995 up to September 1998, the BNM has introduced a new Base Lending Rate (BLR) framework which takes into account the 3-month inter bank rate in the BLR formula. Secondly, since September 1998, the BNM has employed interest rate targeting with a fixed exchange rate, and modified the BLR framework taking into account the Intervention Rate in the determination of BLR formula. At the same time, due to the currency crisis that occurred in the East Asian region, the BNM implemented capital controls to stabilize the economy. Thirdly, since April 2004, the BNM has introduced a new interest rates framework, the Overnight Policy Rate (OPR) to signal the monetary policy stance. During this period, the BNM has gradually liberalized capital control, and has eliminated the pegging with the US dollar since July 2005.

domestic monetary policy in mitigating the negative effects of external shocks (for example, an adverse supply shocks) on economic activity? This is pivotal to the monetary authority in evaluating what would happen to the domestic economy if they do not react to the external shocks. Second, how effective is monetary policy in affecting the domestic macroeconomic target variables, namely economic growth and inflation? Third, how are the exogenous shocks from external factors (for example, oil price, foreign monetary policy, and foreign income shocks) transmitted to domestic macroeconomic and monetary policy variables? Thus, understanding the macroeconomic links between the foreign shocks, domestic macroeconomic and monetary policy variables are crucial to the policy maker for implementing a prudent monetary policy.

Besides the macroeconomic effects of monetary policy, the response of firm-level activity upon monetary policy changes is also an important issue to investigate. This is because a change in monetary policy variables (for example, interest rate) is generally believed to have a direct effect on firm financial performance in terms of equity returns, and firm balance-sheet conditions in terms of investment spending. The movement in the firm-level equity return, which is influenced by monetary policy, has an important impact on economic activity. This is because macroeconomists believe that the stock market effect of monetary policy could influence economic activity through four mechanisms, namely investment spending (Tobin's q theory), household liquidity effects, household wealth effects, and firm balance-sheet effects[2].

In Malaysia, private fixed-investment spending plays a prominent role as an engine of economic growth. On average, the share of private fixed investment as percentage of current GDP was 12.57 percent between 1997 and 2008[3]. The BNM believed that changes in policy interest rates enable the fine-tuning of firm-level investment spending. Firms borrow some of their funds from the banking sector in financing their investment activity. Thus, a change in interest rates will have a direct effect on the firm user cost of capital (a cost-channel effect of monetary policy), which in turn will have an effect on their investment spending. Besides interest rates, firm

[2] Mishkin (2007) has provided an excellent overview of the role of asset price in monetary policy.
[3]This figure is based on author calculation from the Bank Negara Malaysia, Monthly Statistical Bulletin.

liquidity (cash flow) also plays a vital role in influencing the firm's investment plans. Therefore, examining the role of the interest rate and cash flow on firm-level investment spending can highlight the relevance of interest rate and the broad credit channel in the monetary policy transmission mechanism.

In addition, by analysing disaggregated firm-level data, it is possible to examine the heterogeneity of monetary policy effects according to firm size (small and large firm), and in sub-sectors of the economy. This is essential because the effectiveness of monetary policy is likely to vary between firms due to differences in interest rate sensitivity of the demand for the product, capital intensity, openness of the industry, and firm access to external finance. For example, during monetary contraction, the equity return and investment spending of small firms should be more affected than that of large firms. This is because small firms have limited access to external finance, and therefore will respond by contracting their business activity. Hence, a good understanding of how monetary policy operates at the micro-level (firm-level equity return, and investment spending) is vital to the monetary authority in assessing the overall effect of monetary policy on economic activity.

1.2 Objectives of the study

This dissertation consists of three empirical chapters that examine the role of monetary policy in a small open economy (i.e. Malaysia) by using macro and firm-level study. Specifically, the aims of this dissertation are:

i. To investigate the effects of external shocks on macroeconomic fluctuations and monetary policy implementation in a small open economy.
ii. To examine how effective is domestic monetary policy in mitigating the negative effects of external shocks on domestic macroeconomic variables, and how effective is monetary policy in affecting domestic economic growth and inflation.
iii. To test the role of monetary policy upon the stock market, in particular on firm-level equity returns.

iv. To study the role of the traditional interest rate channel and broad credit channel in influencing firm-level investment spending.

v. To explore the heterogeneous nature of monetary policy effects by firm size (small and large firm), sub-sectors of economic activity, and in financially constrained and less-constrained firms.

1.3 Contributions of the study

This dissertation contributes to the empirical debate on the effectiveness of monetary policy in a small open economy (i.e. Malaysia) by using macroeconomic and firm-level study. A central issue in any assessment of monetary policy's effects is the appropriate measurement of the monetary policy. This dissertation provides two approaches in measuring monetary policy variables by investigating monetary policy effects on macroeconomic and firm-level activity. Specifically, in the first essay (chapter 2) and second essay (chapter 3), a monetary policy change has been measured by using an open economy SVAR identification scheme. In contrast, in the third essay (chapter 4), monetary policy is measured through the firms' user cost of capital growth (the interest rate channel), and the cash flow capital stock ratio (the broad credit channel).

In the first essay (chapter 2), regarding the issue of the role of monetary policy as a stabilization policy, this study complements the existing literature by analyzing the effectiveness of monetary policy in a small open economy (i.e. Malaysia) at the macroeconomic level. Previous findings on the effectiveness of monetary policy in a small open economy using an open economy SVAR approach have been limited. In the Malaysian context, the previous studies by Azali and Matthews (1999), Ibrahim (2005), and Tang (2006) were inadequate in explaining the effectiveness of monetary policy as a stabilization policy. This study makes a significant contribution by improving the previous study in four dimensions. First, Azali and Matthews (1999) and Ibrahim (2005) have studied the monetary policy effects in a small-scale VAR in a closed-economy, which does not take into account the role of foreign variables. It is necessary to control for the foreign variables in the SVAR study because the Malaysian economy is relatively small and highly trade-dependent. Thus, it is expected that the Malaysian macroeconomic fluctuations and monetary policy will be vulnerable to the exogenous shocks from the external environment.

Second, although Tang (2006) has considered recursive VAR in open-economy analysis, and Ibrahim (2005) has used recursive VAR in a closed-economy context, their identification of structural shocks is inappropriate. This is because the recursive VAR identification makes strong assumptions about the underlying structural errors. Unless there is a theoretical foundation to support this assumption, the underlying shocks are improperly identified (Cooley and LeRoy, 1985). Therefore, this study gives a novel contribution to the monetary policy analysis in a small open economy (i.e. Malaysia) by using the SVAR approach, which allows the identification of structural shocks according to economic theory. Third, there is no empirical study in a small open economy that has examined how effective is monetary policy as a stabilization policy, in particular to mitigate the negative effect of foreign shocks upon domestic macroeconomic variables. This study departs from the previous literature by using the shutdown methodology in investigating the related questions. Fourth, this study also contributes to the existing literature by investigating the effectiveness of monetary policy during monetary targeting, and interest rate targeting regimes. By splitting the study into two monetary policy regimes, it can evaluate the different role of monetary policy as a stabilization policy, and give some ideas to the monetary authority in designing a prudent monetary policy.

The second essay (chapter 3) attempts to contribute to the existing literature by extending the analysis of the role of domestic monetary policy shocks upon firm-level equity returns in an emerging market economy (i.e. Malaysia). Specifically, there are four aspects of the significant contributions of this study. First, in the Malaysian context, there have been a few studies [for example, Habibullah and Baharumshah (1996); Ibrahim (1999) and Ibrahim and Aziz (2003)] that have examined the link between a monetary policy measure and aggregate stock returns, but none of these studies used identified monetary policy changes. Therefore, this study improves upon the previous studies by measuring monetary policy shocks using an identified VAR (SVAR) approach. This is because an identified VAR approach offers a solution to the problems caused by the endogeneity of monetary policy, which arises when the monetary authority sets interest rates after observing other macroeconomic variables and business cycle conditions. Second, although Allen and Cleary (1998); Clare and Priestley (1998); Lau et al. (2002) and Shaharudin and Fung (2009) have examined the determinants of firm-level stock returns in Malaysia, they have ignored the role of monetary policy variables. Third, the determinants of the firm-level equity return have been estimated in this study by using an augmented Fama and French (1992, 1996) multifactor model in a dynamic panel data framework. Using the Fama and French (1992, 1996) multifactor model allows us to control for other determinants of firm-level equity returns, in particular the role of international factors (for example, international market returns and international monetary policy), and firm financial characteristics (for example, the ratio of book value to market value, firm liquidity, leverage, and sales growth). Fourth, the findings on the heterogeneity of monetary policy effects upon firm-level equity return have been limited in the previous literature. Therefore, this study provides a significant contribution by examining the heterogeneous nature of monetary policy effects according to firm size, sub-sectors of economic activity, and financially constrained and less-constrained firms. A good understanding of why an individual stock return reacts so differently to monetary policy is crucial for the monetary authority and financial market participants. For example, the monetary authority needs to know which categories of firm are more severely affected during monetary policy tightening. Thus, the most affected firm/sector may require financial assistance during a period of tight monetary policy. In contrast, for financial market participants, the heterogeneous effects of monetary policy on equity return is crucial for their business plan, in particular for formulating an effective investment, and risk management decisions.

Numerous studies have examined the role of monetary policy at a macro level. However, there is a limited number of studies that examine the effect of monetary policy on firm-level balance sheets, in particular on firm-level investment spending. In the Malaysian context, there is no previous study that has examined the effect of monetary policy on firm-level investment spending. Therefore, this dissertation (in the third essay that is in chapter 4) provides three significant contributions relating to the role of monetary policy upon firm-level investment spending behaviour in a small open economy (i.e. Malaysia). First, it examines the role of the interest rate and the broad credit channels in transmitting to the firm-level investment spending. It is very important for the monetary authority in assessing how relevant is the traditional interest rate and broad credit channel in the monetary transmission mechanism. Second, the firm-level investment spending has been estimated by using an augmented dynamic neoclassical model in an autoregressive distributed lagged (ARDL) model. Using the neoclassical model allows us to link the firm-level investment spending to the growth of user cost of capital (interest rate channel), cash flow to capital stock ratio (broad credit channel), and sales growth. Third, this study also contributes to the existing literature by examining the differential monetary policy effects on firm investment according to the firm size (small and large firm), and by sub-sector of economy activity. By understanding the differential monetary policy effects, the monetary authority can make an accurate assessment about the overall economic effects of the policy transmission process. Thus, a good understanding of the factors that determine the differential effects of monetary policy is crucial to the monetary authority for implementing an appropriate monetary policy, selecting the ideal monetary policy indicators, and more importantly to suggest the structural reform in goods, labour and financial markets.

1.4 Outline of the dissertation

The organization of the dissertation is as follows:

Chapter 2 investigates the implementation of monetary policy in a highly-trade dependent and small open economy by using macroeconomic level study. Specifically, it examines how domestic monetary policy, and macroeconomic variables in a small open economy are vulnerable to exogenous shocks from external environment, namely oil prices, foreign income, and foreign monetary policy shocks. This chapter also examines how effective is monetary policy as a stabilization policy in mitigating the negative effect of foreign shock on the domestic economy. In addition, this chapter also examines the different role of monetary policy variables during monetary targeting and interest rates targeting regimes.

Chapter 3 deals with the empirical investigation of the effect of the domestic monetary policy shocks on Malaysian firm-level equity returns. The determinants of firm-level stock returns have been estimated by using an augmented version of the Fama and French (1992, 1996) multifactor model in a dynamic panel GMM estimation. In order to investigate the heterogeneous effects of monetary policy upon firm-level equity return, the sample of firms has been divided into three categories, which are by firm size (small and large firm), by sub-sector economy activity, and by financially constrained and less-constrained firms.

Chapter 4 attempts to examine the monetary policy effects on firms' balance sheets, with a particular focus on the effects upon non-financial firms' fixed-investment spending. The firm-level investment spending has been estimated by using the neoclassical model in ARDL framework. The focal point is given to the two main channels of monetary policy transmission mechanism, namely the interest rate and broad credit channels in transmitting to firm investment spending. In addition, the differential of monetary policy effects has also been examined by splitting the sample according to the firm size, and by sub-sectors of economy activity.

The last chapter, which is in Chapter 5, is the conclusions. It provides a summary and discussion of overall findings, and policy implications as well as suggesting directions of future study.

2. SHOCKS, MONETARY POLICY, AND MACROECONOMIC FLUCTUATIONS IN A SMALL OPEN ECONOMY: A STRUCTURAL VAR STUDY OF MALAYSIA

2.1 Introduction

It is generally accepted that a small and highly trade-dependent economy like Malaysia is not insulated from shocks to a variety of external variables, including world oil prices, foreign income, foreign monetary policy, world commodity, and world financial market shocks[4]. Therefore, the monetary authority, especially the Bank Negara Malaysia (BNM) has to consider the various resulting external environments in their formulation of monetary policy. This is vital to minimize any negative effect of external shocks to the domestic economy.

Changes in the world oil price and US monetary policy have been generally accepted to have an important effect on macroeconomic fluctuations and policy. For instance, Hamilton (1983, 1996) stated that most US recessions are preceded by increases in the oil price. In addition, an increase in the world oil price can also trigger a tight monetary policy in response to the higher inflation induced by the oil price shocks. In the US, output and employment have declined due to monetary tightening (increase in FFR) caused by the endogenous response by the Fed to the higher inflation induced by the positive oil price shocks (Bernanke et al., 1997). On the other hand, the monetary authority may respond with a reduction in interest rates to offset the losses in real economic growth due to an increase in oil prices.

Foreign monetary policy, especially shocks in the US federal fund rate (FFR), is also an important factor in influencing monetary policy implementation and macroeconomic fluctuations in a small open economy. For example, Kim (2001) found

[4] In Malaysia, the degree of economic interdependence or economic openness as measured by the share of exports and imports as a percentage of GDP has increased significantly from 86.88 percent in 1970 to 112.59 percent in 1980 and 146.89 percent in 1990. In fact, since 1999 it has been greater than 200 percent. These statistics indicate that the Malaysian economy is highly dependent, and thus vulnerable to external shocks, for example foreign income shocks from large countries.

that a US monetary policy expansion has a positive spillover effect on the G-6 countries' output, which affects the world capital market. Canova (2005) finds that US monetary policy shocks significantly affect the interest rates in Latin America. Moreover, such external shocks are an important source of macroeconomic fluctuations in Latin America. Mackowiak (2007) also found that external shocks are an important source of macroeconomic fluctuations in emerging market countries. In fact, US monetary policy shocks have strong and immediate effects upon emerging market interest rates and exchange rates. Based on this analysis, as a small and trade-dependent economy, the Malaysian monetary policy and domestic macroeconomic variables are expected to be affected by US monetary policy.

Most economists have agreed that monetary policy has a real effect at least in the short run (Taylor, 1997). Choosing the proper operating target of monetary policy (interest rates or monetary aggregates) is pivotal for the monetary authority to stimulate effectively the real sector's activity, and to maintain price stability. Poole (1970) used a Hicksian IS-LM model to show that interest rate targeting is superior to money stock targeting if the money market shocks (influencing the LM curve) are relatively smaller than the shocks arising in the commodity market (influencing the IS curve). Since the 1990s, most central banks around the world have shifted their monetary policy stance from targeting monetary aggregates towards targeting interest rates. The main reason is the instability in the relationship between monetary aggregates and aggregate expenditures due to financial innovations, and changes in the payments technology occurring in the 1990s (Handa, 2009). Therefore, whether the money stock or interest rates have a larger effect on the macroeconomic variables is an interesting issue to investigate in this study.

The aim of this study is to examine empirically the implementation of monetary policy in a small and highly open economy with special reference to Malaysia. Particular focus has been given to three main issues. First, how are external shocks such as world oil price, foreign income and foreign monetary policy shocks transmitted to the Malaysian economy and monetary policy? Second, how effective is Malaysian monetary policy in influencing domestic macroeconomic variables? Third, how effective is domestic monetary policy in mitigating the negative effects of external shocks to the domestic economy? This study uses a non-recursive structural vector autoregressive (SVAR) modeling framework in nine variables, which include three foreign variables, two domestic monetary policy variables, and four macroeconomic variables. In the SVAR model, monetary policy variables (money supply and interest rates) are assumed to respond contemporaneously with all foreign variables (world oil price, foreign income, and foreign monetary policy) and domestic variables (domestic output and inflation), but not the current value of other variables (exchange rate and asset price). However, the exchange rate and asset prices are allowed to affect monetary policy variables with a lag. All foreign variables have been assumed to be completely exogenous to the domestic variables, which do not respond contemporaneously or with lags to the movement in the domestic variables. In addition, a shutdown methodology has also been used to isolate how monetary policy helps to absorb foreign shock effects upon domestic macroeconomic variables (economic growth and inflation).

This study attempts to contribute to the existing literature by analyzing the effectiveness of monetary policy in a small open economy (i.e. Malaysia) by using macroeconomic data. Specifically, this study makes a significant contribution by improving the previous study in four dimensions. First, this study considers the role of foreign factor in modeling an open-economy SVAR. Previous studies of monetary policy effects in Malaysia, for example Azali and Matthews (1999) and Ibrahim (2005) have used a small-scale VAR in a closed-economy, but they do not consider the role of foreign variables in their analysis. Therefore, it is essential to examine the foreign shocks effects on macroeconomic fluctuations and monetary policy because the Malaysian economy is relatively small and highly trade-dependent. Second, this study employs an open economy structural VAR model, which permits an identification strategy based on economic theory rather than the sometimes questionable assumptions which underlie a traditional recursive VAR. In the Malaysian context, although Tang (2006) has considered recursive VAR in open-economy, and Ibrahim (2005) has used recursive VAR in closed-economy, however their identification of structural shocks is inappropriate. Thus, this study provides a novel contribution to the monetary policy analysis in a small open economy (i.e. Malaysia) by identifying the structural shocks according to the economic theory. Third, this study uses a shutdown methodology in examining what would happen to the domestic economy if the monetary authority (for example, BNM) did not response to the external shocks. This is very important to the monetary authority in evaluating the effectiveness of monetary policy as a stabilization policy, in particular to minimize the negative effect of foreign shocks upon domestic macroeconomic variables. Fourth, this study departs from the existing literature by investigating the effectiveness of monetary policy during monetary targeting and interest rates targeting regimes. By splitting the study into two monetary policy regimes, it can evaluate the difference role of monetary policy as a stabilization policy, and give some idea to the monetary authority in designing a prudent monetary policy.

The results of the study indicate the existence of a real effect of monetary policy on macroeconomic variables. Foreign shocks appeared to play a prominent role in influencing domestic macroeconomic and monetary policy variables. In general, monetary policy plays a pivotal role in minimizing the negative effect of external shocks to the domestic economy. Therefore, the monetary authority has to consider the external environment in formulating monetary policy, and can employ monetary policy as a stabilization policy.

The rest of the chapter is organized as follows. Section 2.2 presents a literature review relating to monetary policy identification scheme in the SVAR literature. Section 2.3 briefly discusses the research methodology, and Section 2.4 presents the empirical results by focusing on structural impulse-response function (SIRF). Section 2.5 discusses some robustness checking, and Section 2.6 summarizes and concludes.

2.2 Literature Review

Many studies have used identified VAR or structural VAR (SVAR) in investigating the effects of monetary policy shocks on real economic activity. Most of the issues relating to SVAR methodology are concerned with the appropriate identification of monetary policy shocks, and exploring whether the VAR model should be in level form, first difference form or a combination.

Most of the SVAR literature has focused on a closed economy, in particular the US economy, in investigating the effects of monetary policy shocks on economic activity[5]. These studies are justified given that the US is a large country and not much affected by its international surroundings. For example, Gali (1992) by using SVAR in the IS-LM model has stated that favourable supply shocks are the major contributors in influencing economic activity compared with other shocks (money supply, money demand and IS shocks). Bernanke and Blinder (1992) have used a small scale VAR with four endogenous variables namely FFR, unemployment rate, log of CPI, and the log levels of each of three bank balance-sheet variables (deposit, securities and loans) in monthly data. In their SVAR model, monetary policy is assumed a predetermined variable, which is does not defend on other contemporaneous shocks. The findings of the study showed that the FFR is a better indicator in predicting economic activity than other interest rates or other monetary aggregates. For example, a positive shock in FFR increases the unemployment rate after a year, whereas bank deposits fall in response to the monetary tightening. In fact, short-run fluctuations in real variables are dominated by the shift of policy variables and not by non-policy variables. In addition, the monetary transmission mechanism works through credit or bank loans as well as through money.

Kim and Roubini (2000) have studied the SVAR in a large open-economy by using the sample of non-US G-7 countries. They used seven variables which is 3 foreign variables (the world price of oil, FFR, and exchange rate), and 4 domestic variables namely short-term interest rates, monetary aggregate, the consumer price index, and industrial production with data of monthly frequency. The money supply equation is assumed to be the monetary policy reaction function, which is the monetary authority sets the interest rate after observing the current value of money, the world oil price, and the exchange rate but not the current value of other variables. The findings indicated that the effects of the monetary policy shocks on exchange rates and other macroeconomic variables are consistent with the predictions of traditional economic theory. The real effect of the monetary policy is temporary and all empirical puzzles

[5] For example, there are studies on the US economy by Sims (1986), Blanchard and Quah (1989), Gali (1992) , Gordon and Leeper (1994), Christiano et al. (1996), Bernanke and Blinder (1992), Bernanke and Mihov (1998), and Sims and Zha (2006).

such as the liquidity puzzle[6], price puzzle[7] and exchange rate puzzle[8] are addressed. In addition, monetary policy is not the major contributor to output fluctuations in the G-7 countries and in the most countries, foreign shocks (oil price shocks and the US monetary policy) have contributed more to output fluctuations.

However, there is a limited number of study in small open economies which examined the effect of the monetary policy shocks by using an open SVAR approach. For example, the recent SVAR studies of a small open economy were conducted by Cushman and Zha (1997), Brischetto and Voss (1999), Dungey and Pagan (2000), Parrado (2001), and Buckle et al. (2007). Most of the studies have used block exogeneity restrictions in modeling the international economic linkages to the small open economy.

Cushman and Zha (1997) and Dungey and Pagan (2000) have imposed two blocks in their structural equation model, which is a block representing the international economy, and a block representing the domestic economy. In modeling SVAR for the Canadian economy, Cushman and Zha (1997) included four international variables, namely the US industrial production, the US consumer prices, the US federal fund rate, and world total commodity export prices. The main identification scheme in their study has three folds. First, domestic interest rate is assumed to react contemporaneously to foreign interest rate and commodity market, but not on contemporaneous output. Second, the exchange rate is assumed to response contemporaneously to all shocks. Third, foreign variables have treated as a separate block, which is block (exogenous) for the domestic (small open) economy. This means that, domestic variables are not allowed to affect foreign variables either contemporaneously or with a lags. The empirical findings stated that Canadian monetary policy responds significantly and contemporaneously with home interest rates, exchange rate, foreign interest rates and

[6] The liquidity puzzle is emerged when a positive innovation in monetary aggregate (money supply) appear to be associated with an increases instead of decreases in nominal interest rates.
[7] The price puzzle is an increase in interest rates (monetary tightening) is associated with an increase in the price level rather than a decrease.
[8] The exchange rate puzzle is a monetary contraction (for example, a positive innovation in interest rates) is associated with an impact depreciation of the domestic currency rather than appreciate.

foreign price levels. In addition, there is no evidence of interest rates puzzles[9], exchange rates puzzles and prices puzzles, and the external shocks become the dominant source of domestic output fluctuations. Monetary policy shocks (an increase in interest rates) has a small but negative effect on output.

In contrast, Dungey and Pagan (2000) included five international variables, namely real US GDP, real US interest rates, the Australian term of trade, the Dow Jones Index deflated with the US consumer price index, and real exports. The Australian monetary policy (cash rate) is assumed to follow a standard Taylor-rule, which is the cash rate is assumed to response contemporaneously to the Australian gross national expenditure and inflation. The domestic variables are assumed cannot influence foreign variables either contemporaneously or with a lag. The main findings indicated that overseas factors are generally a substantial contributor to domestic activity, and domestic monetary policy contributes to stabilize economic activity, but the effect is not large.

In the Malaysian context, there have been few studies relating to the effect of monetary policy shocks on economic activities in the existing literature. For example, Azali and Matthews (1999) have employed Bernanke's (1986) contemporaneous structural VAR approach (six variables in a closed-economy) in investigating the relationship between money-income and credit-income during the pre- and the post-liberalization eras. They found that, during the pre-liberalization period, the bank credit shock had more impact compared with the money shock in explaining output variability. In contrast, after the post-liberalization period, money as well as credit innovations were significant in explaining output shocks. In short, aggregate demand was significantly influenced by credit innovation during pre-liberalization, while money innovation played an important role during post-liberalization in explaining output variability.

Another study by Ibrahim (2005) used recursive VAR identification in a closed economy in examining the sectoral effect of a monetary policy shock. His results supported the real effect of monetary policy shocks. For example, it was seen that real

[9] The interest rates puzzle or output puzzle is where a monetary contraction by an increase in interest rates is associated with an increase in output level rather than decrease.

output declined during monetary tightening (positive shocks of interest rates). In fact, some sectors such as manufacturing, construction, finance, insurance, real estate, and business services seem to decline more than aggregate production in responding to the interest rates shocks. In short, those sectors that are very heavily dependent on bank loans are more sensitive to monetary policy shocks. In comparison, a recent study by Tang (2006) has examined the relative importance of the monetary policy transmission mechanism channel (interest rates, credit, asset price, and exchange rate channel) by using 12 variables in an open-economy VAR model. The variables are four foreign variables (foreign block), and eight domestic variables (domestic block), which is estimated by using a recursive VAR identification scheme. The foreign block is assumed not completely exogenous to the domestic block, which are the domestic variables are allowed to affect the foreign variables in lags but not contemporaneously. His finding concludes that the interest rates channel plays a pivotal role in influencing output and inflation. In addition, the asset price channel is also relevant for explaining output variability, but for inflation, the exchange rate channel is more relevant than the asset price channel.

To the author's best knowledge, there is no empirical study in Malaysia so far that has examined the link between foreign shocks, monetary policy, and domestic macroeconomic fluctuations by using an open economy SVAR framework. In fact, there is also no empirical study has examined the effectiveness of monetary policy in stabilizing the macroeconomic variables (domestic output and inflation) from external shocks. Although Tang (2006) has considered recursive VAR in open-economy and Ibrahim (2005) has used recursive VAR in closed-economy, their identification of structural shocks is inappropriate. As noted by Cooley and LeRoy (1985) the recursive VAR identification makes strong assumptions about the underlying structural errors. Unless there is a theoretical foundation to support this assumption, the underlying shocks are improperly identified[10]. The inclusion of foreign variables in the SVAR model is reasonable given that Malaysian is a small and highly trade-dependent economy, so it is expected that Malaysian macroeconomic fluctuations and monetary

[10] Another criticism is that the Choleski decomposition in the recursive VAR is subject to variable ordering. For example, with the 8 variables model there are 40 320 possible orderings (i.e. 8! =1 x 2 x 3 x 4 x 5 x 6 x 7 x 8), and therefore it is not practical to try all alternative orderings.

policy will be vulnerable to external shocks. Therefore, based on this backdrop, this study provides a novel contribution to the monetary policy analysis in a small open economy (i.e. Malaysia) by using an open-economy SVAR study.

2.3 Research Methodology

This study will use an open economy structural VAR (non-recursive identification). Specifically, the SVAR-A model will be employed to identify the contemporaneous relationship. As a robustness check, the model is also estimated under a variety of alternative identification schemes, re-ordering the foreign variables, exchange rate and asset price, and modeling without money. In addition, the sample has also been divided during the monetary targeting and interest rates targeting regime periods. In this section, the methodology and data employed are briefly explained.

2.3.1 Data and Variables Description

All data are at a monthly frequency spanning from January 1980 until May 2009 and collected from the IMF's International Financial Statistic (IFS), except for asset price, where the data are collected from Thompson Datastream. All variables are transformed into logs except for FFR, INF and IBOR, which are stated in percentage points. Specifically, the endogenous variables included in the VAR are;

i)Oil Price $(LOIL)$

It refers to the log of world oil prices (US $ per barrel). The world oil price is an indicator of adverse supply shocks (inflationary and contractionary) to the Malaysian economy. Although the Malaysian government subsidized the oil price by selling it below world market price, it is expected that any increase in the world oil price will be transmitted to domestic inflation and output. There are two possible reasons. First, an increase in world oil price will increase the cost of imported intermediate goods and services. Second, an increase in world oil price will increase cost of the government's fuel subsidy. Consequently, the Malaysian government has responded by cutting fuel subsidy through an increase in domestic oil price in order to safeguard their budget. Therefore, it is expected that positive shocks in the world oil prices will increase the cost of production, and subsequently will trigger cost-push inflation and reduced investment spending, subsequently leading to a contraction in economic activity.

ii)Foreign Income ($IPIUS$)

This study uses the US Industrial Production Index as a proxy for foreign income. The selection of US income as a proxy for foreign income is reasonable since the US is the major trading partner of Malaysia. For instance, on average, from 1997 to 2008, exports to the US have constituted 20 percent of the total Malaysian exports, most of which have concentrated on manufacturing products such as electrical and electronic goods and textiles, clothing and footwear[11].

iii)Foreign Monetary Policy (FFR)

The FFR of the US is used as a proxy for foreign monetary policy. FFR is also an appropriate indicator in analyzing the effect of foreign monetary policy on a small open economy given that the US is a large economy and has a powerful impact in the international arena. As noted by Grilli and Roubini (1995), it is very important to control for US monetary policy in an empirical model of a small open economy. Any changes in the FFR will signal the condition of the US economy, and subsequently is expected to transmit to the monetary policy stance and macroeconomic fluctuations in a small open country. For instance, monetary tightening in the US by increasing the FFR will contract the US output and attract capital inflow into the US. As a result, the US dollar appreciates and domestic currency depreciates. The depreciation in domestic currency will improve the trade balance and subsequently increase economic growth. However, if the domestic country is concerned about the capital outflows, they may respond by increasing domestic interest rates.

[11] This figure is based on the author's calculation from the Bank Negara Malaysia, Monthly Statistical Bulletin. Besides the US, the other Malaysian major trading partners are ASEAN countries (particularly Singapore), Japan and European Union. For instance, in 2008 the US, Singapore, Japan and European Union have contributed 52.23 percent of the total Malaysian exports.

iv)Domestic Income $(IPIM)$

Domestic income is a target variable, which is proxied by the Malaysian Industrial Production Index (IPI). In Malaysia, IPI is a good proxy for output because it comprises the three main indices in the economy; the manufacturing index (weighted 70.7 %), mining index (weighted 23.4 %), and electricity index (weighted 6.0%). The manufacturing sector includes 86 industries out of 197 industries, which accounted for 87.8% of the value of gross manufacturing output and 83.7% of the value-added in the 2000 census. The mining sector covers the production of crude oil, natural gas and tin-in-concentrates, which amounted to 99.5% of the value of gross mining output and 99.8% of the value-added in 2000 census. The electricity sector covers the generation of electricity by plants licensed to generate as well as to sell electricity, which amounted to 97.8% of the total electricity generated in 2000. In fact, the correlation between IPI and real Gross Domestic Product using quarterly data is 0.98, which indicates that the IPI is a good proxy for domestic output. Therefore, based on this argument it is reasonable to use IPI as a proxy for Malaysian output.

v)Inflation (INF)

Another target variable is the inflation rate (INF) which is calculated from the changes in the Consumer Price Indices (CPI)[12]. The inclusion of INF in the model is reasonable given that the BNM has been targeting the inflation rate as an objective since 1990.

vi)Monetary aggregate (LM)

The narrow monetary aggregate M1 is also considered as a monetary policy variable because M1 is more liquid, and thus demanded for transactions purposes. Although BNM focused on broad money, that is M3, from early 1987 until 1995, it is believed that M1 is more favoured as a monetary instrument target. For example, Tang (2006) suggests that M1 is the best candidate for a monetary aggregate because it is relatively stable and more liquid than the broad monetary aggregate. The broad money (M3) is relatively more unstable than narrow money (M1) because of the subsequent

[12] The standard formula to compute the inflation rate is $\frac{CPI_t - CPI_{t-1}}{CPI_{t-1}} \times 100$.

developments in the economy, and the financial system (BNM)[13]. However, there are some limitations in using M1 as a monetary instrument target. Generally, the monetary authority cannot directly control M1 because it is also influenced by market participants. For example, the public, which determines its currency holdings relative to its demand deposits, and the commercial banks, which for a given required reserve ratio, determine their actual demand for reserves as against their demand deposit liabilities[14].

vii)Interest Rates ($IBOR$)

The inter bank overnight rate (IBOR) is also a good candidate for a monetary policy variable because the BNM has directly influenced the inter bank rate through its intervention in the money market (Domac, 1999). In fact, since April 2004, the BNM has introduced a new monetary policy framework, namely the Overnight Policy Rate (OPR) to signal the monetary policy stance. Furthermore, the monthly transactions in inter bank money market in terms of overnight deposit is huge comparing with other inter bank deposits. For instance, in April 2008 the volume of transaction in overnight deposits was Malaysian Ringgit (RM) 93.92 billon in inter bank money market comparing with other kinds of inter bank deposits which are recorded as relatively low.

viii)Kuala Lumpur Composite Index ($KLCI$)

Kuala Lumpur Composite Indices (KLCI) is also important for analyzing the effect of the monetary policy on the asset prices, and can examine how the economic activity responds to the stock market development.[15] For instance, an easing of monetary policy through increasing the amount of the money supply (or reduction in interest rates) leads to an increase in the stock market (asset price), and subsequently will stimulate the economic activity via two channels - a wealth effect and a Tobin's-q effect. An increase in asset prices through monetary easing will increase the investor's financial wealth, and subsequently will stimulate consumer spending. For the firm, an increase in the asset

[13] Malaysian experienced a large capital inflow in 1990s, therefore, the annual growth of M3 was extremely volatile, and reduces the viability of M3 as a monetary target.
[14] In open economies, the balance of payment surpluses (deficits) of a country can increase (decrease) its money supply (Handa, 2009). Therefore, it creates difficulties for the monetary authority in controlling the monetary aggregate.
[15] An excellent literature survey about the effect of monetary policy on stock prices can be found in Sellin (2001).

price will also encourage new investment spending because it is profitable for the firm to create a new investment project due to the increase in the share prices.

x) Nominal Effective Exchange Rate ($NEER$)

Besides asset prices, the role of exchange rate is also important given that Malaysian is a highly trade-dependent economy, and any changes in exchange rate will significantly affect the external sectors, particularly export and import. According to the Mundell-Fleming-Dornbusch (MFD) model, monetary policy expansion via an increase in money supply will reduce the interest rates, and consequently will attract capital outflow from the domestic country to the foreign country because investment in foreign financial assets is more profitable than in domestic financial assets. Thus, domestic currency will be depreciated against foreign currency, and will stimulate a positive trade balance for the domestic country, which in turn will increase the domestic output.

In addition to the endogenous variables, the model also includes three dummy variables for breaks in the intercept, which coincide with major economic events. Specifically, the events are: the regime shift from monetary targeting to the interest rates targeting, the period in which the Ringgit was pegged to the US dollar, and the Asian financial crisis. It is assumed these three events only influence variables in the domestic block rather than the foreign block. In addition, the seasonal dummy has also considered for all endogenous variables. During the period in which the Ringgit was pegged to the US dollar (September 1998 until April 2005), the BNM also imposed controls on capital outflows, and restrictions on exchange rate transactions. By controlling the capital outflow, it immediately eliminated the offshore market for the Ringgit, protected the remaining foreign exchange reserves, and more importantly, restored independent monetary control. The selective capital control is necessary to contain speculation against the Ringgit, and to stabilize short-term capital flows. Therefore, in order to take into account the stability of the monetary policy shock during capital control period, a dummy variable has been used in the baseline model (it takes the value of one from September 1998 until April 2005, and zero otherwise).

2.3.2 Time Series Properties

Much of the SVAR literature in monetary policy has ignored possible non-stationarity of the variables in the VAR model[16]. However, ignoring non-stationarity in the VAR system is inappropriate because only stationary variables return to the long-run mean after a shock. In this study, the Augmented Dickey-Fuller (ADF) test was employed to investigate the presence of unit roots in the data. After testing for unit roots, the optimum lag in the VAR model is chosen by using the Akaike information criteria (AIC) and Schwarz information criterion (SIC). In addition, this study also tests the existence of serial correlation among the residuals for each variable in the VAR model by using the auto-correlation function.

2.3.3 Malaysian Structural VAR Modeling

In this study, the endogenous variables are divided into two blocks; namely foreign and domestic. The foreign block includes the world oil price, foreign income, and a foreign monetary policy measure. The domestic block includes target variables (domestic output and inflation), policy variables (monetary aggregate and interest rates), and two other variables namely asset prices and the exchange rate. The set of the included variables allows us to estimate the effect of external shocks to domestic macroeconomic and monetary policy variables, and examine the effectiveness of the domestic monetary policy on macroeconomic variables.

It is assumed that a small open economy like Malaysia is described by a structural form representation. The dynamic relationship of the system of equation in the structural model can be written as follows;

$$A_0 Y_t = \Gamma_0 D_0 + A(L) Y_t + \varepsilon_t \tag{2.1}$$

[16] Ramaswamy and Sloek (1997) have discussed extensively whether the VAR model should be estimated in level, difference or in vector error correction model (VECM).

Where, A_0 is an invertible square matrix of coefficients relating to the structural contemporaneous interaction between the variables in the system, Y_t is a (9×1) matrix that is the vector of system variables or $[\Delta LOIL \quad \Delta LIPIUS \quad FFR \quad \Delta LIPIM \quad INF \quad \Delta LM \quad IBOR \quad \Delta LNEER \quad \Delta LKLCI]'$, D_0 is a vector of deterministic variables (constant, trend and dummy variables), $A(L)$ is a k^{th} order matrix polynomial in the lag operator L $\left[A(L) = A_1 L - A_2 L^2 - ..... - A_k L^k\right]$, $\varepsilon_t = \left[\varepsilon_t^{\Delta LOIL} \quad \varepsilon_t^{\Delta LIPIUS} \quad \varepsilon_t^{FFR} \quad \varepsilon_t^{\Delta LIPIM} \quad \varepsilon_t^{INF} \quad \varepsilon_t^{\Delta LM} \quad \varepsilon_t^{IBOR} \quad \varepsilon_t^{\Delta LNEER} \quad \varepsilon_t^{\Delta LKLCI}\right]'$ is the vector of structural shocks which satisfies the conditions that $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_s^{'}) = \Omega_\varepsilon = I$ (identity matrix] for all $t = s$.

Equation (2.1) cannot be directly estimated to derive the true value of A_0, $A(L)$ and ε_t. However, equation (2.1) can be estimated by transforming to the reduced form representation as follows;

$$Y_t = A_0^{-1}\Gamma_0 D_0 + A_0^{-1}A(L)Y_t + A_0^{-1}\varepsilon_t \tag{2.2}$$

or

$$Y_t = \Pi_0 D_0 + \Pi_1(L)Y_t + \mu_t \tag{2.3}$$

Where, $\Pi_0 = A_0^{-1}\Gamma_0$, $\Pi_1 = A_0^{-1}A(L)$, $\mu_t = A_0^{-1}\varepsilon_t$ and $E(\mu_t \mu_t^{'}) = A_0^{-1}\Omega A_0^{-1'} = \Sigma$.

2.3.4 Identification Scheme

In identifying the structural VAR model, this study employed the SVAR-A model proposed by Amisano and Giannini (1996). Enough restrictions have to be imposed on matrix A_0. According to the order condition, for the system to be just identified or exactly identified, it requires $K(K-1)/2 = 9(8)/2 = 36$ zero restrictions on the contemporaneous matrix A_0. However, since the contemporaneous matrix A_0 in equation (2.4) has 40 zero restrictions, the SVAR model is over-identified.

The solution to the SVAR system can be generated by recovering the relationship between the reduced-form disturbances (μ_t), and the underlying structural shocks (ε_t). This relationship can be estimated by using the equation (2.3), which $\mu_t = A_0^{-1}\varepsilon_t$ or $A_0\mu_t = \varepsilon_t$ by using the maximum likelihood estimates. In matrix form, this relationship can be represented as follows;

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21}^0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{31}^0 & a_{32}^0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{41}^0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{51}^0 & 0 & 0 & a_{54}^0 & 1 & 0 & 0 & 0 & 0 \\ a_{61}^0 & a_{62}^0 & a_{63}^0 & a_{64}^0 & a_{65}^0 & 1 & 0 & 0 & 0 \\ a_{71}^0 & a_{72}^0 & a_{73}^0 & a_{74}^0 & a_{75}^0 & a_{76}^0 & 1 & 0 & 0 \\ a_{81}^0 & a_{82}^0 & a_{83}^0 & a_{84}^0 & a_{85}^0 & a_{86}^0 & a_{87}^0 & 1 & 0 \\ a_{91}^0 & a_{92}^0 & a_{93}^0 & a_{94}^0 & a_{95}^0 & a_{96}^0 & a_{97}^0 & a_{98}^0 & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{\Delta LOIL} \\ \mu_t^{\Delta LIPIUS} \\ \mu_t^{FFR} \\ \mu_t^{\Delta LIPIM} \\ \mu_t^{INF} \\ \mu_t^{\Delta LM} \\ u_t^{IBOR} \\ \mu_t^{\Delta LNEER} \\ \mu_t^{\Delta LKLCI} \end{bmatrix} = \begin{bmatrix} \varepsilon_t^{\Delta LOIL} \\ \varepsilon_t^{\Delta LIPIUS} \\ \varepsilon_t^{FFR} \\ \varepsilon_t^{\Delta LIPIM} \\ \varepsilon_t^{INF} \\ \varepsilon_t^{\Delta LM} \\ \varepsilon_t^{IBOR} \\ \varepsilon_t^{\Delta LNEER} \\ \varepsilon_t^{\Delta LKLCI} \end{bmatrix} \qquad (2.4)$$

2.3.4.1 Identification of Foreign Blocks

The variables in foreign blocks have been assumed to be completely exogenous to the domestic blocks. It is common to identify that the foreign variables do not respond contemporaneously or with lags to the movement in the domestic variables in a small open country. This assumption is reasonable given that Malaysia is a small open economy and has no powerful impact on an international level. Specifically, the world oil price is a structural disturbance or exogenous variable that is uncorrelated with other contemporaneous shocks. Meanwhile, the US income and FFR can influence world oil price in lags. The US income is assumed to respond contemporaneously with the world oil price and all foreign variables lag. This means that the US income has a negative response to the world oil price because the US is a major net oil importer country in the world. The FFR is assumed to respond contemporaneously to the innovations in world oil price and the US income and all foreign variables lag. The FFR reacts positively to the world oil price in minimizing the inflationary pressure due to the positive shocks of world oil price. This assumption is also consistent with prior studies, for example, Hamilton (1996) and Bernanke et al. (1997) who found that oil price movements have a significant forecast power for the stance of monetary policy in the US economy. In contrast, FFR responds negatively with the US income in minimizing the output gap.

2.3.4.2 Identification of Domestic Blocks

Variables in the domestic blocks are assumed to respond mainly contemporaneously with foreign variables. In addition, all domestic variables responded to foreign variables in the lags.

Identification of Target Variables

Domestic output growth has been assumed to respond contemporaneously only to the world oil price shocks, and respond in the lags to all endogenous variables. Domestic output growth reacts positively to the current growth of world oil price. This assumption is reasonable given that Malaysia is net exporter of oil. However, in the long run, the relationship between oil price and output is expected to be negative because an increase in world oil price will increase the cost of production, whereas the firms will respond by cutting the level of production or investment. In addition, it is assumed that Malaysian output does not respond contemporaneously with other variables in the system. For instance, the monetary policy variable, that is, monetary aggregate and interest rates, cannot influence output contemporaneously. The main plausible justification for this assumption is that firms do not change their output and prices instantaneously in responding to the monetary policy signal within a month, due to the inertia, adjustment costs and planning delay, but they will respond immediately to the current oil prices following their mark-up rule (Kim and Roubini, 2000). This type of restriction is also imposed by Bernanke and Blinder (1992), and Bernanke and Mihov (1998).

Domestic inflation has been assumed to respond contemporaneously to the innovations in oil prices and domestic output. The positive innovation in oil prices and domestic output will spontaneously accelerate the domestic price level. However, other variables in the system cannot influence domestic inflation spontaneously because inflation is a slow-moving variable. However, all endogenous variables are assumed to affect the inflation rate in the lags.

Identification of Monetary Policy Shocks

The main issue relating to monetary policy analysis in the SVAR study is an appropriate identification of monetary policy shocks. In market economies, the use of the interest rates as a major instrument of monetary policy does not imply that it can ignore the role of money supply. This is because the interest rates are determined in financial markets. For example, if the monetary authority wants to lower the interest rates but not supporting with a required increase in the money supply, it would find that the market interest rates would deviate from its desired level. As a result, the intended effects on expenditures will not be achieved. Therefore, an interest rate policy must be accompanied by an appropriate money supply (Handa, 2009). For that reason, this study will consider two types of monetary policy shocks, namely, money supply and interest rates.

It is assumed that the monetary authority (the BNM) sets the money supply after observing the current level of all foreign variables, domestic output growth and inflation. This is reasonable given that monetary authority can observe the data on a monthly basis and chooses the amount of money supply to offset any negative effect resulting from foreign shocks, domestic aggregate demand and inflation shocks to the domestic economy. Besides money supply, the monetary authority can also use interest rates as a policy target. Thus, it is assumed that the monetary authority sets the interest rates after observing the current value of domestic variables that are domestic output, inflation and money supply, and all foreign variables, but not the current value of other variables. The inclusion of output, inflation and money in the monetary policy reaction function is reasonable given that the central bank can observe these data on a monthly basis. For instance, if the amount of money supply has grown rapidly, interest rates will decline, which in turn increases the inflation rate due to the aggregate demand pressure. As a result, the central bank will respond immediately by increasing the policy interest rates (interest rates smoothing) to minimize the inflationary pressure. The inclusion of foreign monetary policy in the domestic monetary policy reaction function is reasonable given that the Malaysian economy is highly dependent on the US economy. Therefore, it is reasonable to assume that the BNM will response positively to the US monetary policy in minimizing the capital outflow as well as stabilizing the domestic currency. The justification of the monetary policy reaction function is also consistent with previous studies, for example, Kim and Roubini (2000), Cushman and Zha (1997), and Sims and Zha (2006).

Identification of exchange rate and asset price shocks

The exchange rate is assumed to be respond contemporaneously with all foreign and all domestic variables (except stock price. In contrast, the asset price is assumed to respond contemporaneously to all foreign and all domestic variables. This assumption is reasonable given that exchange rate and stock market are the fast-moving variables in the system. The asset price is assumed to respond contemporaneously to the exchange rate because any changes in the exchange rate will influence international capital mobility, which in turn affects the stock market. For instance, an appreciation in domestic currency makes domestic assets more expensive to the international investors, and therefore decreases the demand for domestic asset, subsequently leading to a decline in the asset price.

2.3.4 Shutdown Methodology

A few studies have used shutdown methodology to examine the relative strength of the monetary policy transmission channel by comparing the baseline impulse response with the constrained model [for example, Ramey (1993) and Ludvigson et al. (2002) in the US economy, Levy and Halikias (1997) in France, and Tang (2006) in Malaysian context]. However, so far no study has examined how effective is monetary policy as a stabilization tool in minimizing the negative effect of external shocks on the domestic economy, in particular for a small open economy. In order to examine the effectiveness of monetary policy in mitigating the effect of foreign shocks on domestic macroeconomic variables (output and inflation), the baseline impulse response function must be compared with the constrained model. In the constrained model, both monetary policy variables (money supply and interest rates) are shut down by setting the monetary policy coefficient equal to zero in the domestic output and inflation equations.

To shutdown the effect of monetary policy variable on domestic output, the estimated contemporaneous coefficient and all lagged coefficients of monetary policy variable in the domestic output equation are setting to zero. Similarly, to shut down the effect of monetary policy on inflation, the estimated contemporaneous coefficient and lagged coefficients of monetary policy in the inflation rate equation are set equal to zero. By shutting down the estimated coefficients of monetary policy, the effects of foreign shocks on domestic macroeconomics variables can be examined without allowing endogenous responses of the monetary policy variables. Therefore, the deviation or difference of the constrained impulse response from the baseline impulse response represents the relative importance of monetary policy in stabilizing the macroeconomics variable in response to foreign shocks.

However, monetary policy (money supply and interest rates) is allowed to influence other variables (for example, asset prices, and exchange rate). This assumption indicates that there is a partial shutdown in the constrained model. However, there is a limitation by using the partial shutdown methodology; in particular, it cannot deal with the indirect effect of other exogenous shocks in the estimation model. This would imply that the constrained model is mis-specified.

2.4. Empirical Results

This section discusses the main empirical findings that consist of the results of preliminary analysis and the structural impulse response function (SIRF). The results of shutdown methodology are also discussed in examining the relative important of monetary policy in mitigating the negative effect of external shocks to domestic economy.

2.4.1 Preliminary Analysis

Table 2.1 reports the result of the unit root test by using the Augmented Dickey-Fuller test. As can be seen, only three variables, which are the FFR, inflation (INF), and inter bank overnight rate (IBOR) are stationary at level form at least at 10 percent significance level; meanwhile other variables are stationary in first difference form[17]. The optimum lag in the VAR system is determined by Akaike information criterion (AIC) and Schwarz information criterion (SIC). The optimum lag based on AIC criterion is twelve and it is one for the Schwarz information criterion (SIC). However, the appropriate selection of the lag-length criteria in VAR model is determined once the existence of serial correlation is rejected in the VAR individual residuals. Therefore, Table 2.2 gives detailed information about the serial correlation test among the individual residual series for different lag-lengths. For example, by testing one lag, there is a serial correlation for all residual series except for μ_{LM1}. The serial correlations decrease once the numbers of lags are increased. By using nine lags, there is serial correlation for three residual series such as μ_{LIPIUS}, μ_{FFR} and μ_{INF}. In comparison, by using 12 lags serial correlation exists for two variables which are μ_{FFR} and μ_{INF}. Therefore, twelve lags as recommended by AIC are used in the VAR model because this can minimize the existence of serial correlation where only two out of nine variables have a serial correlation, that is, the residual of FFR and INF.

Since the baseline SVAR model is over-identified, we need to test the validity of the over-identification restrictions. The value of χ^2 (with four degrees of freedom) is 7.97 and the probability is 0.11, which indicates that the over-identification restrictions are valid[18].

[17] According to Blanchard and Quah (1989), Gali (1992) and Bjørnland and Leitemo (2009) the level and difference form variables can be combined in the VAR system as long as the system is stationary. An excellent survey about the issue of stationary systems, non-stationary I(1) systems, and a mixture of I(1) and I(0) variables in the SVAR model can be found in Levtchenkova et al. (1998).

[18] The full result of SVAR contemporaneous coefficient estimation is available upon request.

Table 2.1 : Unit root test : Augmented Dickey Fuller (ADF)

Variables	Level Form		First Difference	
	Constant and no trend	Constant and trend	Constant and no trend	Constant and trend
LOIL	-2.009 (2)	-2.477 (2)	-11.578*** (1)	-11.606*** (1)
LIPIUS	-1.842 (12)	-1.870 (12)	-6.531*** (10)	-6.593*** (10)
FFR	-3.336*** (12)	-3.896*** (12)	-4.791** (12)	-4.822*** (12)
LIPIM	-1.571 (12)	-1.694 (12)	-4.153*** (12)	-4.323*** (12)
INF	-3.446*** (10)	-3.365*** (10)	-6.816*** (12)	-6.935*** (12)
LM1	0.433 (10)	-1.802 (9)	-3.054*** (12)	-3.077*** (12)
IBOR	-2.846* (6)	-3.214* (7)	-7.972*** (7)	-7.961*** (7)
LNEER	-1.373 (3)	-2.817 (3)	-8.144*** (7)	-8.592*** (2)
LKLCI	-2.008 (3)	-2.913 (3)	-10.719*** (2)	-10.711*** (2)

Note: *** Denotes significant at the 1% level, ** significant at 5% level and * significant at 10 % level which reject of the null hypothesis on non-stationary. Critical value obtain from Fuller (1976) for constant but no time trend is -3.45, -2.87 and -2.57 for 1%, 5% and 10% significant level respectively, and the critical value for constant and time trend is -3.98, -3.42 and -3.13 for 1%, 5% and 10% significant level respectively.

Number in bracket is the optimum lagged based on Akaike Information Criterion (AIC).

Table 2.2 : Serial correlation test

Residual Series	**Lagged in Baseline VAR**									
	1		3		6		9		12	
	Port.	p-value	Port.	p-value	Port.	p-value	Port.	p-value	Port	p-value
μ_{LOIL}	20.65	0.06	17.23	0.14	6.02	0.91	6.66	0.88	0.67	1.00
μ_{LIPIUS}	52.11	0.00	37.22	0.00	30.56	0.00	27.54	0.01	2.47	1.00
μ_{FFR}	152.71	0.00	56.94	0.00	21.34	0.05	40.09	0.00	36.64	0.00
μ_{LIPIM}	20.81	0.05	16.80	0.16	12.96	0.37	9.17	0.69	0.85	1.00
μ_{INF}	62.20	0.00	60.64	0.00	27.80	0.01	25.01	0.01	20.55	0.06
μ_{LM1}	11.52	0.49	5.14	0.95	8.93	0.71	9.32	0.68	4.09	0.98
μ_{IBOR}	35.45	0.00	19.54	0.08	5.14	0.95	3.82	0.99	3.95	0.98
μ_{LNEER}	33.13	0.00	14.83	0.25	13.96	0.30	3.53	0.99	5.11	0.95
μ_{LKLCI}	24.00	0.02	13.64	0.32	14.15	0.29	5.39	0.94	8.55	0.74

Note : Port. is the Portmanteau statistics.

2.4.2 Whole Sample Analysis

Figures 2.1-2.3 illustrate the structural impulse response functions of the endogenous variables in this study. The main focused is to analyze the foreign shock effects on domestic variables (monetary policy and macroeconomic variables), and the effect of domestic monetary policy shocks (monetary aggregate and interest rates) on domestic macroeconomics variables. The solid line represents the estimated responses; meanwhile the two dashed lines represent the confident bands or error bands. The error bands of the SIRF are derived from Hall's bootstrapping methodology, which has a 68 percent confidence interval with 300 being the number of bootstrap replications[19]. The selection of 300 as the number of bootstrap replications is reasonable because the number of replications offers sufficient to produce valid results, and the 68 percent confidence interval is chosen because it is equivalent to one standard error in the Gaussian case[20]. A one-standard-error interval is likely to be closer to the relevant range of uncertainty (Sims and Zha, 1999).

In order to bootstrap the confidence interval, it proceeds as follows: First, the model of interest is estimated. Denoting the residuals by $\hat{\mu}_t$, the centered residuals $\hat{\mu}_1 - \bar{\hat{\mu}},...., \hat{\mu}_T - \bar{\hat{\mu}}$ are obtained. Then, the bootstrap residuals $\mu_1^*,..., \mu_T^*$ are generated by randomly drawing with replacement from the centered residual. These quantities are used to compute bootstrap time series recursively starting from a given presample value $y_{-p+1},..., y_0$ and fixing the exogenous and deterministic terms. The model of interest is then reestimated and bootstrap versions of the quantities of interest are computed. By repeating these steps a large number of times, bootstrap distributions of the quantities of interest are obtained.

Accumulated impulse-response functions will be discussed for the first difference variables responses, while the usual IRF will be used for the level form variable responses. By accumulating the responses of the first-difference variable on its

[19] The SVAR model has been estimated by using J-Multi statistical software developed by Lutkepohl and Kratzig (2004).
[20] The detailed discussion about the selection of error bands for impulse responses can be found in Sims and Zha (1999).

structural shocks, we can interpret the impact of structural shocks on the level form of endogenous (Y) variables[21].

2.4.2.1 Foreign Shocks Effects on Domestic Variables

Response of domestic monetary policy

Panel A in Figure 2.1 shows the accumulated response of money supply to the innovation in foreign shocks, meanwhile Panel B describes the response of interest rates to the innovation in foreign shocks. As can be seen in Figure 2.1 (Panel A), there is no significant response of money supply to the positive innovation in oil price growth in the first six months. However, after 6 months and up to 30 months, the accumulated response of money supply is significant and negatively responds to the innovation in world oil price growth. For example, within 17 months the accumulated responses of money supply is -0.4 percent in response to the one percent increase in world oil price growth. The negative response of money supply has showed that the policy maker is concerned with stabilizing the domestic price level to offset an inflationary pressure due to the adverse supply shock from an increase in the world oil price. However, after 30 months, the accumulated response of money supply has a positive effect to the innovation in world oil price growth. The positive response is because the policy maker has acted to stimulate aggregate demand to offset the adverse supply shocks. The response of the interest rates to the innovation in world oil price growth is negative within 3 months, that is, the interest rate has declined by 0.15 percentage points in responding to the one percent increase in world oil price growth. However, after 3 months and up to 10 months, the interest rate responds positively to the world oil price growth, and reached the maximum point at 0.20 percentage points in 10 months. After 10 months, the response of interest rates gradually decreases, decaying after 40 months.

Money supply responds negatively to foreign income shocks. For instance, an accumulated response of money supply in response to one percent increase in foreign income growth is appropriately of -1 percent after a 15 month period. One possible explanation is that the monetary authority has been concerned with stabilizing the

[21] See Appendix 2.1 for the derivation of impulse-response function with combinations of I(1), and I(0) data.

domestic price level, since the expansion of foreign income has triggered an increase in domestic inflation due to an increase in external demand. In contrast, the interest rate responds significantly positively to foreign income shocks with the highest response being 0.22 percentage points within 10 months. However, after 10 months the positive response of the interest rate begins to reduce and decays after 50 months.

Money supply has positively responded to the positive innovation in FFR. For instance, the highest accumulated response has been recorded within a 10 month period, which is that a one percentage point increase in FFR leads to an increase in money supply of 0.6 percent. However, after 10 months, the accumulated response of money supply has gradually declined and reached zero after 50 months. The positive response of money supply implies that the monetary authority was concerned to off-set the negative effect of monetary tightening in the foreign country (US). The domestic interest rate has responded positively to the FFR shocks, recording a 0.05 percentage point change in three months. However, after three months up to 5 months, the domestic interest rates has responded negatively, having fallen by 0.10 percentage point in response to a one percentage point increase in FFR. In contrast, after 15 months the domestic interest rate responds positively to the positive innovation in FFR. The positive response of domestic interest rates implies that the monetary authority is concerned about the capital inflow from domestic country to the US due to the monetary tightening in the US. Therefore, to ensure that portfolio investment in Malaysia is competitive, the BNM has to respond by increasing the domestic interest rates.

Response of domestic macroeconomic variables

Figure 2.2 in Panel A-Panel C describes the response of domestic macroeconomic variables to the innovation in foreign shocks. As depicted in Figure 2.2 in Panel A, a positive innovation in world oil prices growth lead to an increase in domestic output for up to four months. However, after four months the positive innovation of the world oil price growth leads to a decline in domestic output. For instance, within 9 months, the accumulated output has declined by 1.5 percent before reducing to 1.0 percent after 25 months. The positive response of output within a four month period is reasonable given that Malaysia is a net oil exporter country. An increase in world oil price has generated higher income for the petroleum industry, and subsequently leads to an increase in domestic output. However, after four months, output responds negatively to the world oil price because of the adverse supply shocks. For example, an increase in the world oil price will lead to an increase in firms' production costs, and subsequently the firms will respond by contracting their investment spending. Domestic inflation also positively responds to the positive shocks in the growth of world oil price. For instance, the highest effect is recorded in a 5 month period, at which point every 1 percent increase in world oil prices growth leads to an increase in the inflation rate of 0.225 percent. However, after 5 months the response of inflation has gradually declined, and vanishes within 40 months.

The exchange rate responds positively and significantly to the positive shock in the world oil price growth, and the accumulated effect is approximately 1.2 percent after 36 months. In other words, an increase in the world oil price triggers an appreciation in the domestic currency relative to other currencies because Malaysian is a net exporter of oil. In contrast, the stock market responds negatively to the positive shock in the world oil price growth after 4 months. For example, the highest accumulated effect is in 14 months, which is a one percent increase in world oil price growth leads to a decline in domestic asset prices of approximately 3 percent. One possible explanation is that firms will shrink their production and investments due to an increase in the costs of production, which in turn will reduce the firms' profit (cash flow), and subsequently reduce asset prices.

Panel B in Figure 2.2 plots the response of domestic macroeconomic variables to innovation in foreign income (US output). As can be seen, domestic output growth positively responds to the foreign demand shock. For example, after 30 months, the accumulated response of domestic output growth is 3.25 percent in response to a one percent increase in foreign income growth. The positive response of domestic income is reasonable since most of the Malaysian exports are concentrated in the US market. The effect of the US income shock to domestic inflation is positive within 10 months, whereas after 10 months domestic inflation has responded negatively. For example, in a five month period, a positive shock in US output leads to an increase in domestic inflation by 0.5 percent. On the contrary, within a 35 month period, a one percent increase in the US income growth leads to a reduction in domestic inflation of 0.3 percent.

A positive shock in the US income has caused the exchange rate to respond negatively within 5 months; however, after 5 months the negative response is getting smaller until it reaches zero in 25 months, and has positive effect after 25 months. The positive response of exchange rate (appreciation in domestic currency) occurs because an increase in foreign income has stimulated domestic exports, and afterwards has increased the demand for domestic currency. In contrast, the asset price shows no significant effect in responding to the foreign income shock within 5 months. However, between 5 and 10 months, there is a strong response of the asset price, which decline at 3 percent in 10 months in responding to one percent increase in foreign income growth. In contrast, after 10 months, the negative response of the asset price is beginning to reduce, and has positive effect after 30 months. This might be because of an increase in foreign income has stimulated the demand for domestic assets from the foreign country, and subsequently increased the asset price.

Panel C in Figure 2.2 shows the effect of foreign monetary shocks on domestic macroeconomic variables. As can be seen, the accumulated response of domestic output is positive within a 5 month period; however, the effect is relatively small. After 5 months, the accumulated response of domestic output has declined. For example, within 60 months period; the accumulated response of domestic output has decreased by 1 percent in responding to a one percentage point increase in FFR. A possible explanation is that an increase in the foreign interest rate has contracted foreign economic activity, which afterwards decreased foreign demand, and subsequently contracted the domestic economy. Domestic inflation has responded negatively to positive innovation in FFR after 5 month periods. For example, in 20 months, domestic inflation has decreased by 0.125 percent in responding to one percentage point increase in foreign monetary policy.

The accumulated response of exchange rate to the innovation in FFR is negative within a 5 month period. This could be due to the capital inflow to the US because an investment in the US's financial assets is more competitive than financial investment in Malaysia. Thus, demand for the US currency will be increased; meanwhile, demand for domestic currency will be decreased, which subsequently depreciates domestic currency. However, after 5 months the accumulated response of exchange rate to the FFR is positive. A possible reason is that the BNM has increased the domestic interest rates to offset the capital outflow to the foreign country. The accumulated response of stock market to the FFR shocks is relatively small, which is indicated that foreign monetary policy is not important in influencing the domestic stock market. For instance, a one percentage point increase in the FFR leads to a decrease in domestic asset price by 1 percent within a 3 month period. However, between 3 months up to 15 months, the stock price has responded positively with the positive innovation in FFR. After 15 months, the accumulated effect of stock price has gradually decreased in response to the foreign monetary policy tightening.

2.4.2.2 Monetary Policy Effects on Domestic Variables

Money Supply Shocks

Figure 2.3 in Panel A plots the money supply (narrow money M1) impulses on domestic macroeconomic variables. As can be seen, in one month, the accumulated response of domestic output is negative in response to positive innovation in money supply growth. However, after one month, there is a positive cumulative effect of the shocks in money supply growth on domestic output. For instance, the highest cumulative effect is shown in 3 months, where one percent increase in money supply growth leads to an increase in domestic output by approximately 0.6 percent. However, after five months, the positive accumulated response of domestic output has decreased. Specifically, after 15 months, the accumulated response of domestic output is 0.2 percent. This finding indicates that money supply plays an important role in stimulating domestic output growth. Money supply growth also leads to an increase in domestic inflation. However, the effect of money growth on inflation is not unity as postulated by economic theory. The highest effect of inflation is in 15 months, by which time a one percent increase in money supply growth has led to an increase in the inflation rate of 0.20 percent. The response of inflation gradually decreases, and returns to the equilibrium path after 50 months.

Interest rates respond negatively and contemporaneously to the innovation in money supply growth. For example, a one percent increase in money supply growth leads to a contemporaneous decrease in interest rates of 0.08 percentage point. This finding is consistent with the liquidity effect theorem, and rejects the liquidity puzzle hypothesis, which is well documented in the SVAR literature. However, after four months, interest rate has responded positively to the positive innovation in money supply growth, which indicates the existence of a liquidity puzzle. Some empirical studies, for example Reichenstein (1987), and Leeper and Gordon (1991) have supported the existence of the liquidity puzzle. In addition, the positive effect of interest rates gradually decreases and vanishes after 25 months. The effect of money on the exchange rate is also consistent with Mundell-Fleming-Dornbusch (MFD) predictions, which stated that monetary expansion leads to depreciation in domestic currency due to the capital outflow to the foreign country. For instance, after a period of 20 months, the accumulated response of exchange rate is approximately -0.002, which is indicated that a one percent increase in money supply growth leads to depreciation in domestic currency by 0.2 percent. In comparison, the stock market has a positive response to money supply shocks, which indicates that an expansionary monetary policy has stimulated the asset price. The positive response of the stock market to monetary easing can be explained by monetarist and Keynesian models. For example, according to monetarists, when the money supply increases, the public finds they have more money and try to reduce their money holding by increasing their spending, in particular spending more money in the stock market. Therefore, higher demand for equities leads to an increase in stock prices. In contrast, Keynesians postulated that monetary expansion leads to a fall in interest rates, which makes investment in bonds less attractive relative to equities, and hence causing the price of equities to increase.

Interest Rate Shocks

Figure 2.3 in Panel B indicates the effect of the interest rate shock on domestic macroeconomic variables. As can be seen, domestic output growth has responded negatively to a positive shock in interest rates. For instance, the accumulated response of domestic output is -0.2 percent in 3 months. However, after 20 months, the accumulated response of domestic output is -0.014, which is indicated that a one percentage point increase in interest rates (IBOR) leads to a contraction in domestic output of 1.4 percent. The negative response of domestic output to monetary policy tightening can be explained by standard economic theory, by which an increase in interest rates increases the firms' capital costs, while in turn the firms will respond by reducing their capacity of fixed investment. The response of inflation to monetary policy tightening is positive within 3 months, which indicates the existence of a price puzzle. For example, in 3 months, domestic inflation has increased at 0.08 percent in responding to the one percentage point increase in interest rates. Barth and Ramey (2000) have provided an alternative explanation of the price puzzle, where they argued that monetary policy tightening operates on aggregate supply as well as aggregate demand. Specifically, an increase in interest rates raises the cost of holding inventories (cost channel of monetary policy). This negative supply effect raises domestic inflation and lowers output. Meanwhile, after 4 months, it is clearly shown that the inflation rate responds negatively to the positive interest rate shock, which indicates that no price puzzle is present. In addition, the response of inflation has decayed after 50 months. One possible reason for the negative response in inflation is that an increase in interest rates has reduced aggregate demand (investment and consumption spending), which in turn decreased the level of inflation. Money supply has responded negatively to a positive shock in interest rates, where the maximum accumulated effect is -0.2 percent in 5 months. However, after 20 months, there is no significant effect of money supply in responding to monetary policy tightening.

The exchange rate responds positively to the positive innovation in interest rate. For instance, after 25 months, the accumulated response of nominal exchange rate is 0.006, which is indicated that a one percentage point increase in interest rates leads to appreciate the nominal exchange rate by 0.6 percent. A possible reason is that an increase in interest rates has stimulated the capital inflows to the domestic country, and subsequently increased the demand for domestic currency, and fuel exchange rate to appreciate. The stock market also responds negatively with a positive shock in interest rates; however, there is no significant effect of stock price after 15 months. Specifically, in 5 months, the accumulated response of asset price is -0.015, which is indicated stock price has declined by 1.5 percent in response to a one percentage point increase in interest rates. One possible reason is that an increase in interest rates has contracted economic activity and dividend payments, which in turn decreased the asset price.

2.4.3 Sub sample Analysis

This study has also divided the sample into two regimes, which represent the monetary targeting regime (January 1980 up to October 1995), and the interest rate targeting regime (November 1995 until present). The identification scheme during monetary targeting is similar to the baseline model. However, during interest rate targeting, money supply was allowed to respond contemporaneously to the innovation in interest rates, whereas interest rates does not respond contemporaneously to the innovation in money supply. Therefore, the ordering of the variables during interest rates targeting is $[\Delta LOIL \quad \Delta LIPIUS \quad FFR \quad \Delta LIPIM \quad INF \quad IBOR \quad \Delta LM \quad \Delta LNEER \quad \Delta LKLCI]'$. The lagged optimum is four months according to the AIC for both monetary policy regimes.

Figure 2.4-2.6 report the SIRF during monetary targeting, meanwhile Figure 2.7-2.9 shows the SIRF during interest rates targeting regime. Overall, the main results are robust, which indicates the stability in the IRF during the two monetary policy regimes. However, the main difference from the baseline IRF is the response of the monetary policy shocks to macroeconomic variables. For example, during monetary targeting, the accumulated response of output is 0.9 percent (within 3 months) in response to a one percent increase in money supply growth. In contrast, during interest rates targeting, within 3 months, the accumulated response of output is 0.3 percent in response to a one percent increase in money supply growth. The effect of the interest rate shock on domestic output is also larger during monetary targeting as compared to interest rate targeting. For example, during monetary targeting, the accumulated response of domestic output is -1.25 percent after 20 months in response to a one percentage point increase in interest rates. On the contrary, during interest rates targeting, the cumulative effect of interest rates shocks on domestic output is relatively low. For example, after 20 months domestic output has decreased at 0.3 percent in response to interest rate tightening. There is a price puzzle during interest rate targeting, which indicates that the inflation rate has positively responded to the interest rate shocks. During monetary targeting, there is also a price puzzle within two months, but after two months, an increase in interest rates leads to a decline in the inflation rate. There is also an output puzzle in first and three month during the monetary targeting. However, after three months there is no output puzzle, which indicates that domestic output has gradually decreased in response to the positive innovation in interest rates. In addition, there is also no liquidity puzzle, and exchange rate puzzle during the monetary targeting period.

2.4.4 Shutdown Methodology

Figure 2.10-2.11 reports the results of foreign shocks effects on domestic macroeconomic variables (output and inflation) by comparing the constrained IRF and baseline model for the whole sample, meanwhile Figure 2.12-2.13, and Figure 2.14-2.15 reports sub sample analysis (monetary targeting and interest rates targeting). The constrained IRF is reported in the left column, and the baseline model in the right column.

2.4.4.1 Whole sample

As can be seen in Figure 2.10-2.11 in the left column, the effect of world oil price shocks on domestic output and inflation is larger by shutting off an endogenous response of monetary policy as compared to the baseline impulse response. For example, after 25 months, in the constrained model, the accumulated response of domestic output growth has a negative effect by 2.5 percent, whereas, in the baseline model the accumulated output has declined by 1 percent in responding to a one percent increase in world oil price growth. The effect of the world oil price growth on domestic inflation is also higher without an endogenous response of monetary policy, with the highest effect being recorded at 0.35 percent in 10 months. In comparison, in the baseline model the highest effect of inflation is at 0.25 percent in 7 months. Therefore, we can conclude that monetary policy plays an important role in stabilizing the domestic economy from the adverse supply shocks (an increase in the world oil price growth).

The Malaysian economy is also influenced by the foreign demand shocks, in particular a foreign income shock from a major trading partner (US). A positive innovation in US income will generate an expansion of domestic output growth through an increase in exports, and can accelerate an inflation rates. Therefore, monetary policy can be used as a stabilization policy in minimizing the effect of a foreign shock on the domestic inflation rate. In Figure 2.11, by shutting off monetary policy (constrained IRF), a positive innovation in US income has increased the domestic inflation rate by approximately 0.2 percent within 8 months, while, by implementing monetary policy (baseline IRF), it can minimize an inflation rate at 0.05 percent in 8 months. However, after 18 months by shutting off monetary policy, the positive innovation in foreign income has decreased the inflation rate, with the highest level being recorded at -0.2 percent after 30 months. In contrast, in the baseline model, the inflation rate has decreased after 13 months, with the highest negative effect being recorded at -0.25 percent in 35 months.

A foreign monetary policy shock is also important in influencing the domestic economy. Therefore, monetary policy can be used to mitigate the negative effect of monetary policy tightening from a foreign country to the domestic economy. By shutting down the monetary policy variables, the accumulated response of domestic output has a negative effect after 5 months in response to the foreign monetary policy tightening. The maximum accumulated response is recorded in period 60 months, when a 100 basis point increase in FFR leads to a decline in domestic output of 1.2 percent. In the baseline model, domestic output has decreased after 5 months; however the accumulated effect is approximately 1.0 percent in 60 months. This finding shows that monetary policy plays a marginal role in minimizing the negative effect of foreign monetary policy shocks on domestic output growth. The effect of FFR on domestic inflation is negative either by shutting off monetary policy or in baseline model.

However, the effect of FFR shocks to domestic inflation is relatively low in the constrained model as compared to the baseline model. Specifically, after 20 months, the inflation rate has declined by 0.075 percent in the constrained model, whereas, in the baseline model the inflation rate has decreased by 0.12 percent.

2.4.4.2 Sub sample analysis

Monetary Targeting

During monetary targeting, monetary policy also plays an important role in stabilizing domestic output growth from an adverse supply shocks (an increase in the world oil price). As can be seen in Figure 2.12, without endogenous responses of monetary policy, the accumulated response of domestic output is -1 percent within 10 months, and gradually decreased to -0.75 percent in 60 months. In contrast, in the baseline model, the accumulated response of output is -0.5 percent in 10 months, and gradually decayed to the long run mean. However, in Figure 2.13, the effect of oil price shocks on inflation is relatively similar either with or without an endogenous response of monetary policy. This finding implies that during monetary targeting, monetary policy failed to stabilize the domestic price level in responding to an innovation in world oil price.

The effect of a foreign demand shock on domestic output growth and inflation is relatively similar either by shutting off monetary policy or in the baseline model. Therefore, during monetary targeting, monetary policy has no significant role in minimizing the effect of foreign demand shocks on the domestic economy.

The effect of foreign monetary policy shocks on domestic output is also significantly different in constrained and baseline model. In the constrained model, there is a negative effect on accumulated response of domestic output after 15 months, whereas, in baseline model, the accumulated response of output has a negative effect after 30 months. In the constrained model, output has decreased by 0.03 percent in 60 months, whereas, domestic output has decreased by 0.8 percent in the baseline model within 60 months. This finding implies that in the long run, monetary policy failed to minimize the negative effect of foreign monetary policy shocks on the domestic economy. However, the effect of positive innovation in FFR on the inflation rate is relatively similar in the constrained model and the baseline model, which indicates that there is no significant role for monetary policy in stabilizing the inflation rate from foreign monetary policy shocks.

Interest rates targeting

During interest rate targeting, monetary policy plays an important role in stabilizing domestic output and inflation from an adverse supply shock (an increase in the world oil price). For example, in Figure 2.14, without endogenous response of monetary policy, the accumulated output has decreased by approximately 0.5 percent after 10 months, whereas with monetary policy, there is no significant effect of the world oil price shock on domestic output after 10 months. This finding indicates that monetary policy plays a pivotal role to off-set the negative effect of an adverse supply shock on domestic output. In Figure 2.15, the inflation rate is also higher without pursuit of any monetary policy, as inflation has increased by 0.35 percent (0.25 percent in baseline model) within 5 months. This implies that, during interest rate targeting, monetary policy play a vital role in minimizing the negative effect of adverse supply shocks on the domestic price level.

The effect of a foreign demand shock to domestic output and inflation is relatively low by shutting off monetary policy. For example, the accumulated response of domestic output growth has the highest effect at 1.2 percent after 12 months, and gradually decreasing to 0.8 percent after 28 months. In contrast, in the baseline model, the highest effect of accumulated output is recorded at 2.25 percent after 15 months. The effect of foreign income shocks on inflation has a hump-shaped pattern in the constrained and baseline models. For instance, in the constrained model, inflation rate has the highest negative effect at -0.13 percent within 13 months, whereas in the baseline model the highest negative effect is recorded at -0.175 within 10 months. However, after 22 months, by shutting off monetary policy, inflation has responded positively to foreign demand shocks, which is the highest effect is at 0.04 percent within 30 months. In contrast, in the baseline model, inflation has also responded positively to foreign demand shocks after 22 months, with the highest effect at 0.08 percent after 30 months.

The effect of foreign monetary policy shocks on domestic output and inflation is also significantly different in the constrained model and the baseline model. For example, within 25 months, without endogenous response of monetary policy, the accumulated response of output has decreased by 0.7 percent, whereas in the baseline model, the accumulated response of output has decreased by 0.60 percent in responding to a 100 basis point increase in FFR. In a period of 60 months, by shutting off monetary policy, the accumulated effect of output has decreased by 0.5 percent, while, in the baseline model the accumulated output has decreased by 0.3 percent. This finding signals that during interest rate targeting, monetary policy plays an important role in stabilizing the domestic economy from the negative effect of foreign monetary policy shocks. By shutting off monetary policy, the inflation rate has decreased by 0.2 percent after 10 months and has a positive effect after 20 months, with the highest positive effect being recorded at 0.2 percent in 26 months, gradually decaying after 43 months. However, in the baseline model, inflation has decreased by 0.1 percent in 10 months and gradually decays after 25 months. This finding shows that monetary policy plays a significant role in stabilizing the domestic price level from foreign monetary policy shocks.

2.5 Robustness Checking[22]

This section discusses the robustness of the results by examining the stability of the IRF in the VAR system[23]. Several alternative procedures have been considered in this study; (i) estimating the recursive SVAR model; (ii) alternative contemporaneous structural identification schemes; (iii) model with money demand; and (iv) model without money.

2.5.1 Recursive Structural VAR Identification

To test the recursive structural VAR, we relaxed the assumption of the contemporaneous restrictions in equation (2.4) by allowing domestic income and inflation to respond contemporaneously to the innovation in foreign income and foreign monetary policy. Overall, the structural IRF are robust with the baseline restriction. For instance, the effect of foreign shocks on domestic monetary policy and macroeconomic variables are quite similar to the baseline model. However, there is an output puzzle in first and three months, which is that output has responded positively to the positive innovation in interest rate. However, after three months the accumulated response of output has a negative effect in response to the positive innovation in interest rates. The price puzzle has also existed within three months, however after three months the inflation rate has gradually declined, and decayed afterwards. There is no liquidity puzzle within 4 months, however after four months interest rates has responded positively with the positive innovation in money growth, which indicated the existence of a liquidity puzzle. In addition, the effect of money supply on interest rates has decayed after 25 months. The exchange rate has responded negatively to the positive innovation in money supply and positively to the innovation in interest rates, which indicates that no exchange rate puzzle has emerged.

[22] I do not report the full result of robustness checking to save space. However, the full results are available upon request.

[23] Faust (1998) has discussed extensively a new way to assess robustness of an identified VAR. He used all possible identifications scheme in 6-variable, and 13-variable model. His results conclude that monetary policy shocks contribute a small portion of the forecast error variance of post-war US output.

2.5.2 Alternative contemporaneous structural identification schemes

As shown in equation (2.4), the foreign block is identified recursively. Therefore, it is necessary to reorder the variables in foreign blocks. For example, by reordering $[\Delta LYUS \quad \Delta LOIL \quad FFR]$, it is assumed that US income is completely exogenous in the system, and allows the world oil price to respond contemporaneously with the US income. This alternative ordering is reasonable given that the US is a large country whose economic development can affect world oil price contemporaneously, because the US demand for oil is huge (Blanchard and Gali, 2007). In addition, the two variables, $\Delta LNEER$ and $\Delta LKLCI$ are reordered by putting $\Delta LNEER$ at the bottom and $\Delta LKLCI$ second from the bottom. Overall, the effects of foreign shocks on domestic monetary policy and macroeconomic variables are nearly identical with the baseline model. The effects of monetary policy shocks to domestic macroeconomic variables are also robust with the baseline model. For that reason, we do not discuss the full result.

2.5.3 Model with money demand

The baseline model in equation (2.4) has used money supply as a monetary policy variable. However, in money market equilibrium, monetary aggregate can also be represented as money demand. Therefore, we relaxed the baseline assumption by assuming monetary aggregate as a money demand instead of money supply. It is assumed that money demand has responded contemporaneously with the innovation in domestic income, interest rates and price level. Therefore, we have an over-identified model with seven zero restrictions below diagonal matrix A_0. Based on SVAR estimation, the χ^2 with 6 degree of freedom is 10.26, and the probability is 0.114, therefore the over-identified restrictions are valid. Overall, the result of IRF has shown that the effects of foreign shocks on domestic monetary policy and macroeconomic variables are relatively similar to the baseline model. However, there is an output puzzle within three months, which is that the accumulated response of output has a positive effect in response to positive innovation in interest rates. However, after three months, the accumulated response of output has a negative effect to the monetary policy tightening. There is also a price puzzle within four months, however the inflation has gradually decreased in response to an increase in interest rates, and the response has died after 50 months. The response of exchange rate to the positive innovation in interest rates is also consistent with standard economic theory, for example, after 15 months the exchange rate has appreciated at 0.6 percent in responding to a one percentage point increase in interest rates.

2.5.4 Model Without Money

As mentioned previously, monetary policy in Malaysia has changed from targeting monetary aggregate towards targeting interest rates since November 1995 until present. Thus, it is reasonable to exclude money from the SVAR baseline model. Therefore, without money, we allowed interest rates to respond contemporaneously to innovations of all foreign variables, domestic income, and inflation. In general, the effect of foreign shocks on domestic monetary policy (interest rates), and macroeconomic variables are relatively similar to the baseline model. However, there is an output puzzle in one month and three months. After three months, domestic output has responded negatively to the monetary policy tightening. For example, within 15 months, the domestic output has decreased by 1 percent in response to a one percentage point increase in interest rates. Inflation also responds positively to the positive innovation in interest rates in two months. However, the effect of inflation gradually decreases, and decays after 55 months. An increase in interest rates also appreciated the domestic currency, which indicates that there is no exchange rate puzzle. In addition, the stock price has also responded negatively to the monetary policy tightening.

2.5.5 Simultaneity problem of interest rate and exchange rate

In the baseline model in equation (2.4), the matrix appears to be recursive. It is believed that, in open economies there is a simultaneity problem among the interest rates and exchange rate. Most of the VAR studies deal with a possible simultaneity problem by either placing zero contemporaneous restrictions on the response of the interest rate to an exchange rate, or restricting the exchange rate from reacting immediately to the interest rate shock[24]. In Tang (2006), the contemporaneous movement in exchange rate do not affect the current BNM policy interest rates. Therefore, it is believed that his finding has produced inappropriate estimation of the monetary policy shock. Thus, in this study, we relaxed the assumption of the baseline model in equation (2.4), by allowing monetary policy (interest rate) to respond contemporaneously to the innovation in exchange rate, and exchange rate is assumed not react immediately to the innovation in interest rates, which is implied that the parameter a_{87}^{0} in the matrix of equation (2.4) is set equal to zero. However, the ordering of the variables is similar as in the baseline model. In general, the main results are robust, which indicates the stability of the impulse-response function for the whole sample, and sub-sample estimation. This findings indicate that the important role of foreign shocks in influencing domestic monetary policy and macroeconomic variables. Monetary policy variables (money supply and interest rate) also play a significant role in affecting macroeconomic variables. There is no monetary policy puzzles, except of the existence of liquidity puzzle after 5 months for the whole sample analysis. Interestingly, there is no monetary policy puzzles for the sub-sample period (monetary targeting, and interest rates targeting)[25].

---

[24]It is not possible to assume that the interest rate and exchange rate respond contemporaneously to each other in the baseline model because the matrix cannot be inverted (unidentified), therefore, there is no solution for the SVAR model. Another approach to deal the simultaneity problem is by using a sign restriction, where identification is by means of signs/shapes of the theoretical model.

[25] The full results are available upon request.

Figure 2.1: Structural Impulse-Response Function: The Effect of Foreign Shocks on Monetary Policy Variables (Baseline Model)

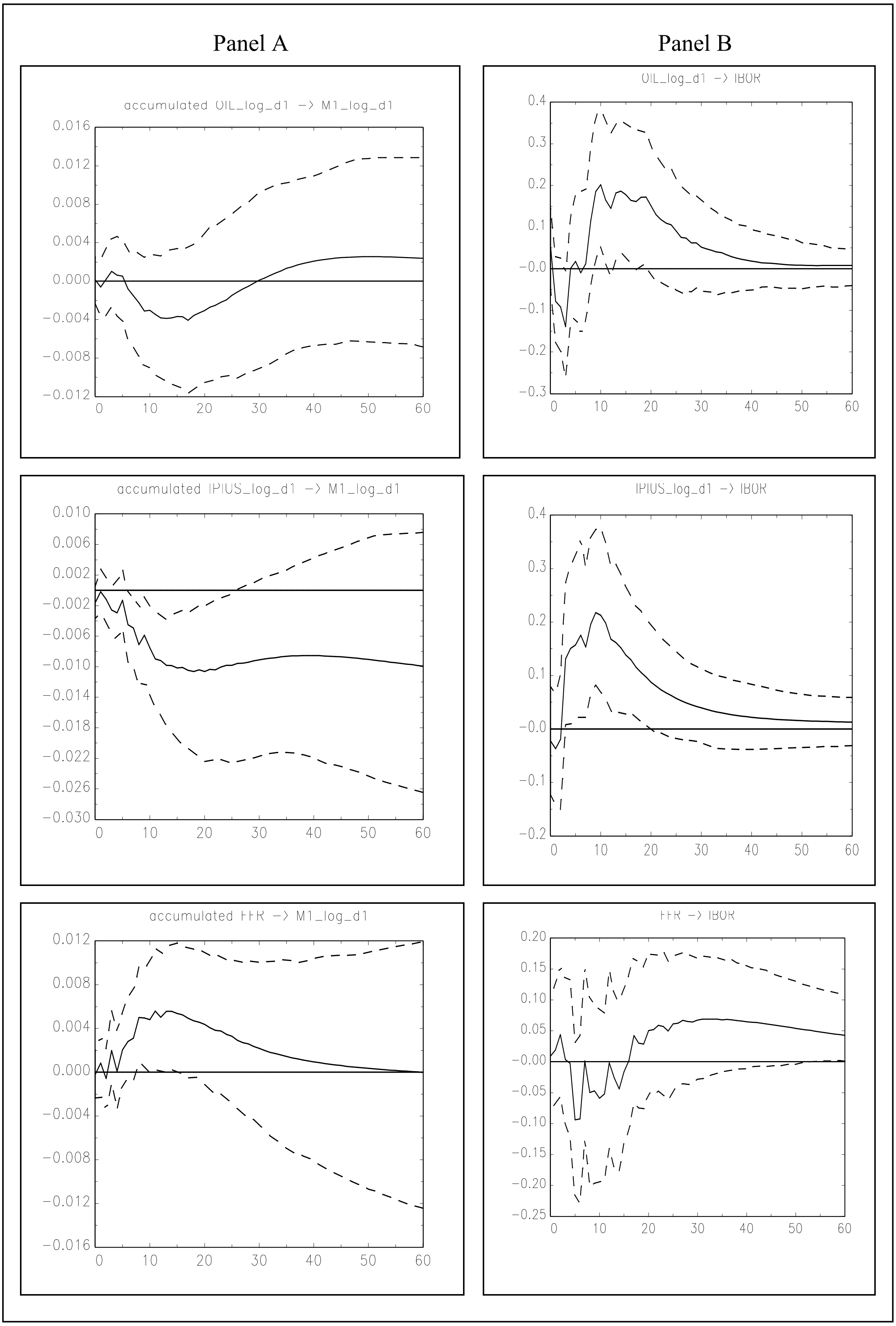


Figure 2.2: Structural Impulse-Response Function: The Effect of Foreign Shocks on Macroeconomic Variables (Baseline Model)

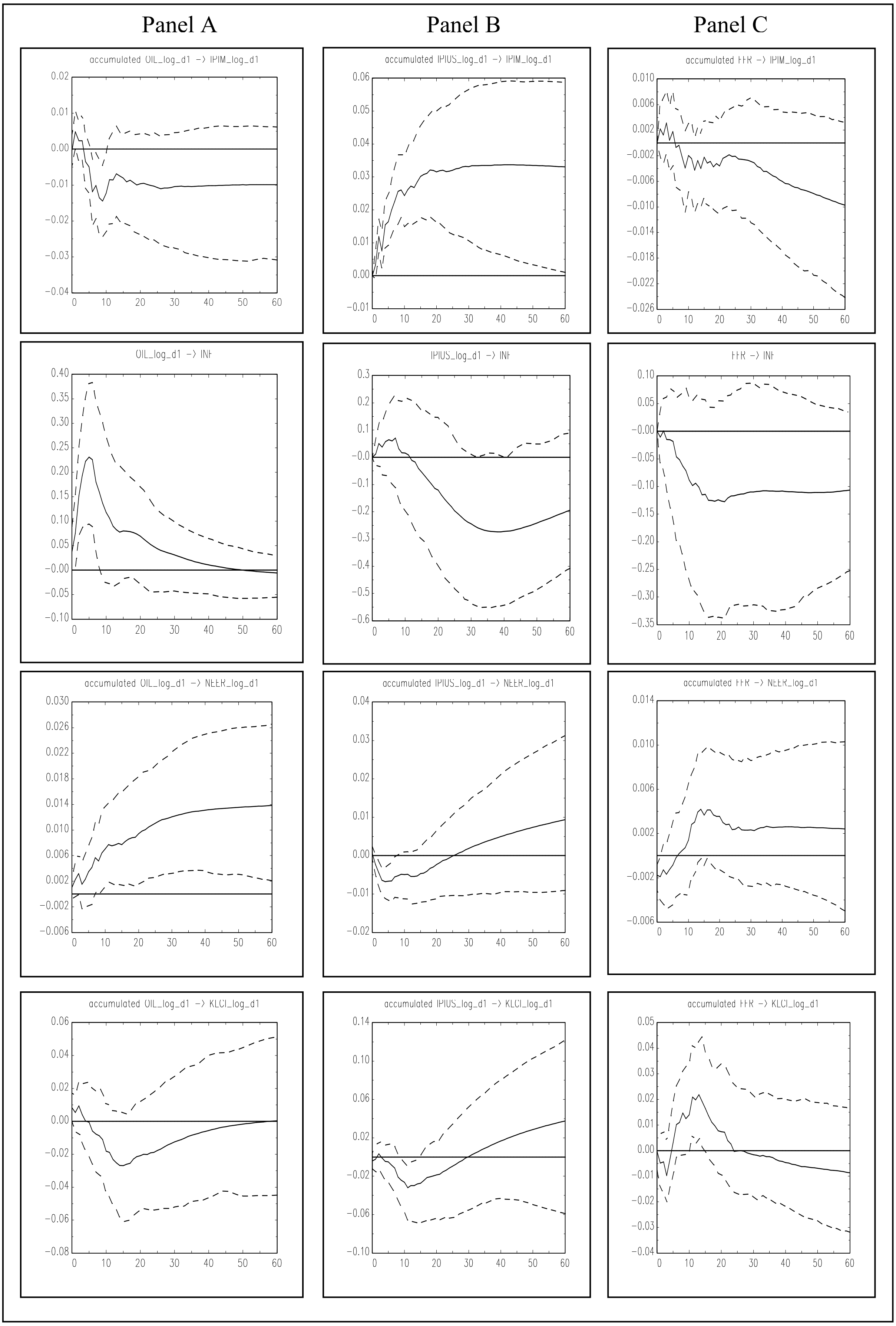


Figure 2.3 : Structural Impulse-Response Function: The Effect of Monetary Policy Shocks on Domestic Variables (Baseline Model)

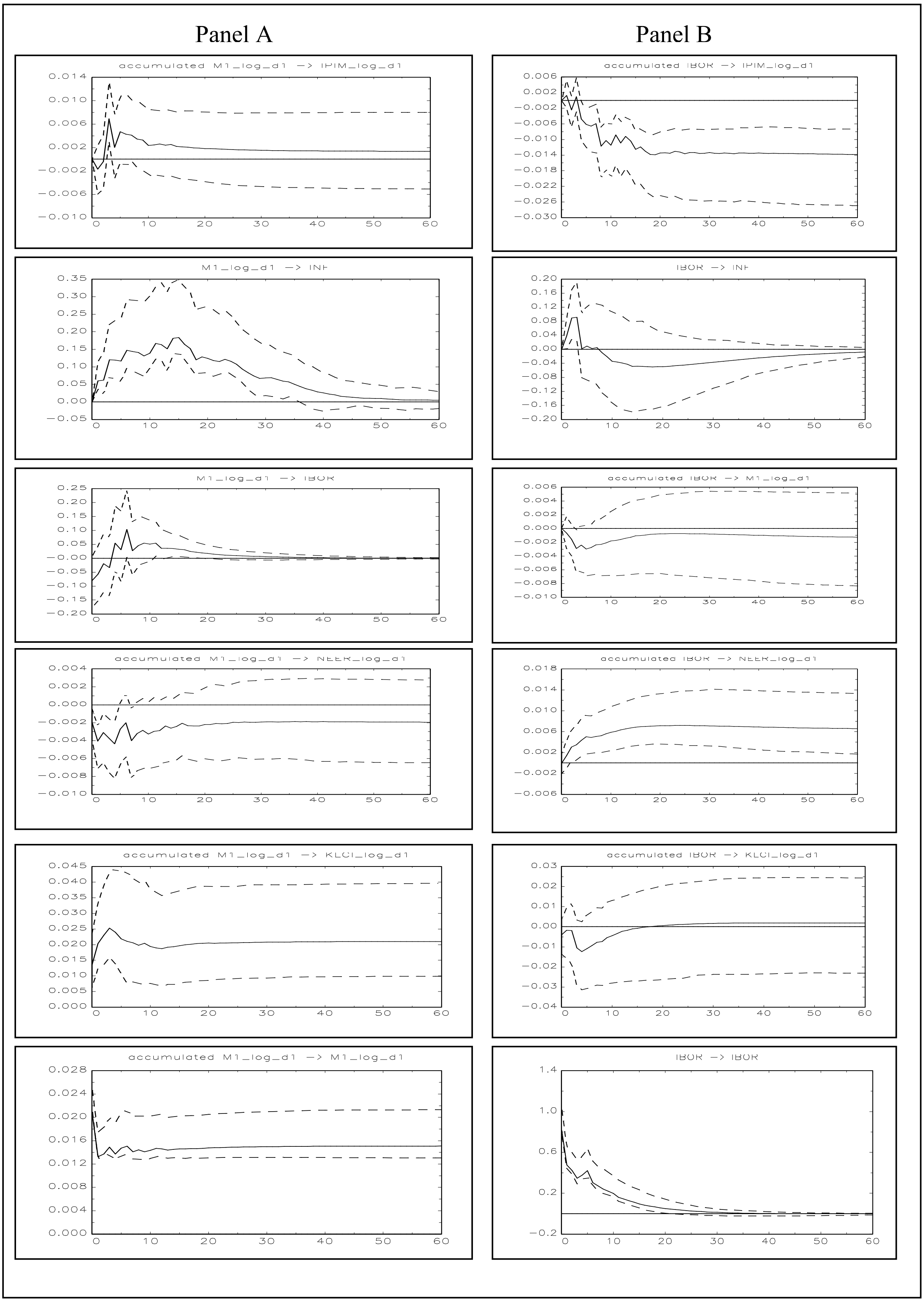


Figure 2.4 : Structural Impulse-Response Function: The Effect of Foreign Shocks on Monetary Policy Variables (Monetary Targeting)

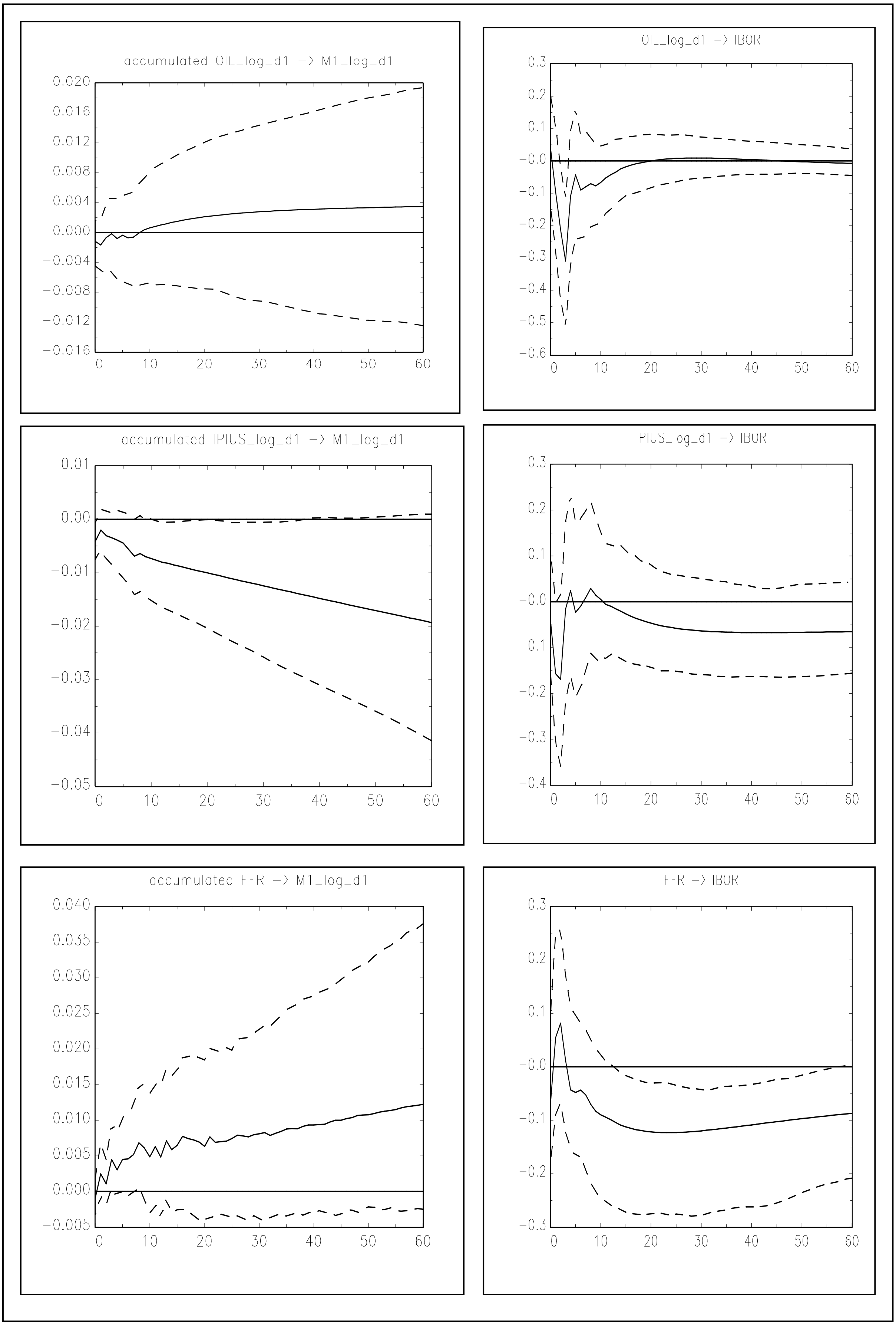


Figure 2.5 : Structural Impulse-Response Function: The Effect of Foreign Shocks on Macroeconomic Variables (Monetary Targeting)

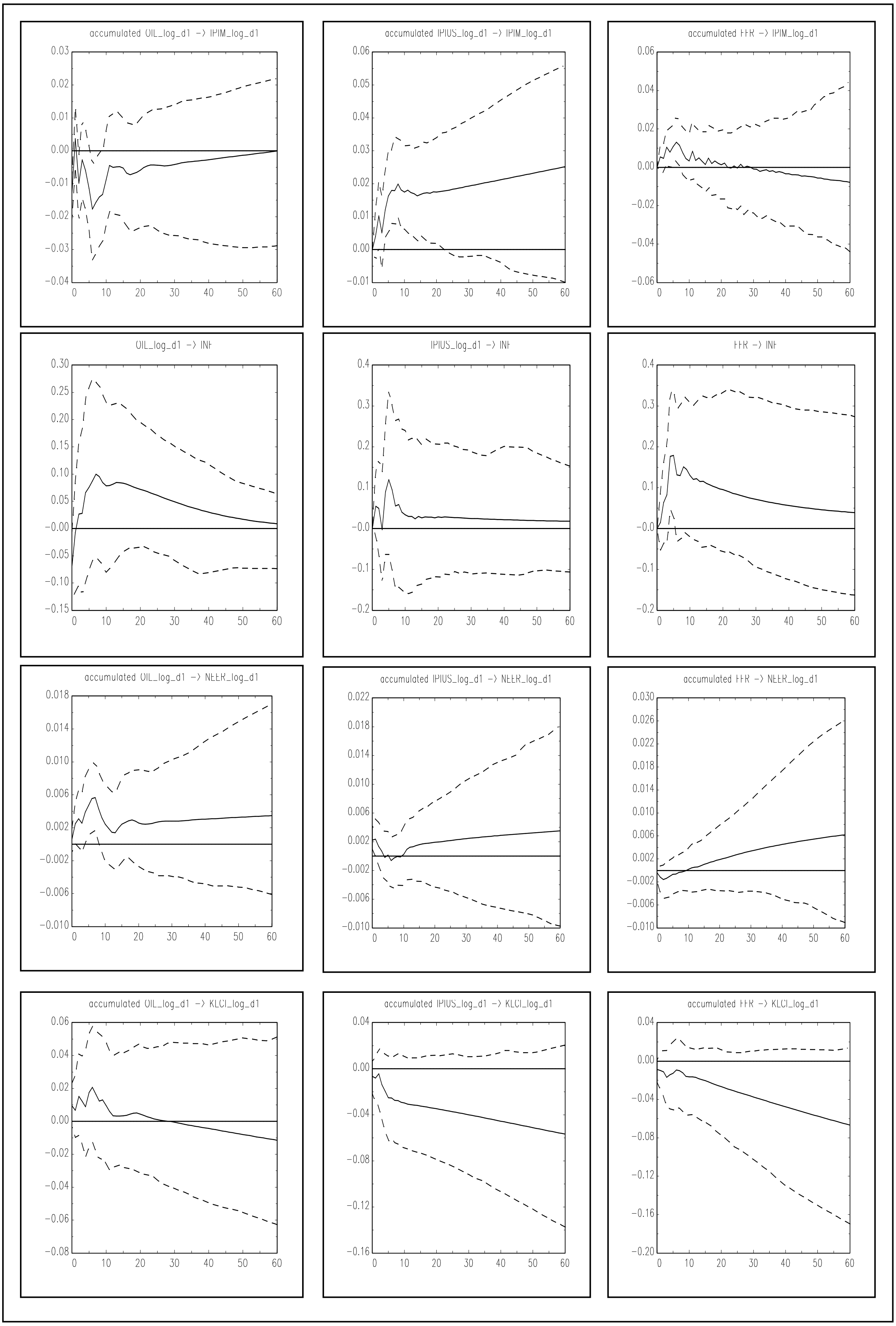


Figure 2.6 : Structural Impulse-Response Function: The Effect of Monetary Policy Shocks on Domestic Variables (Monetary Targeting)

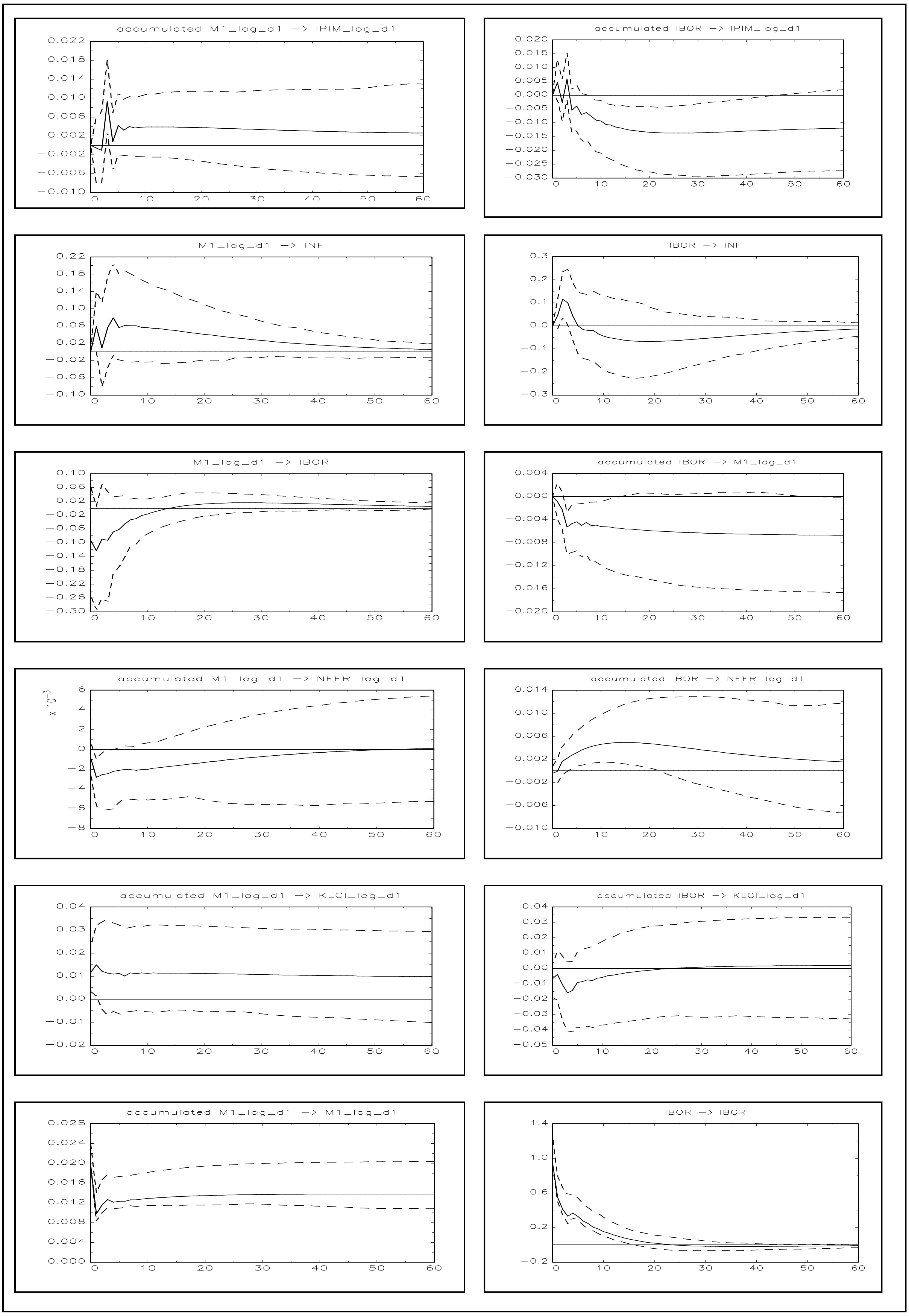


Figure 2.7 : Structural Impulse-Response Function: The Effect of Foreign Shocks on Monetary Policy Variables (Interest Rates Targeting)

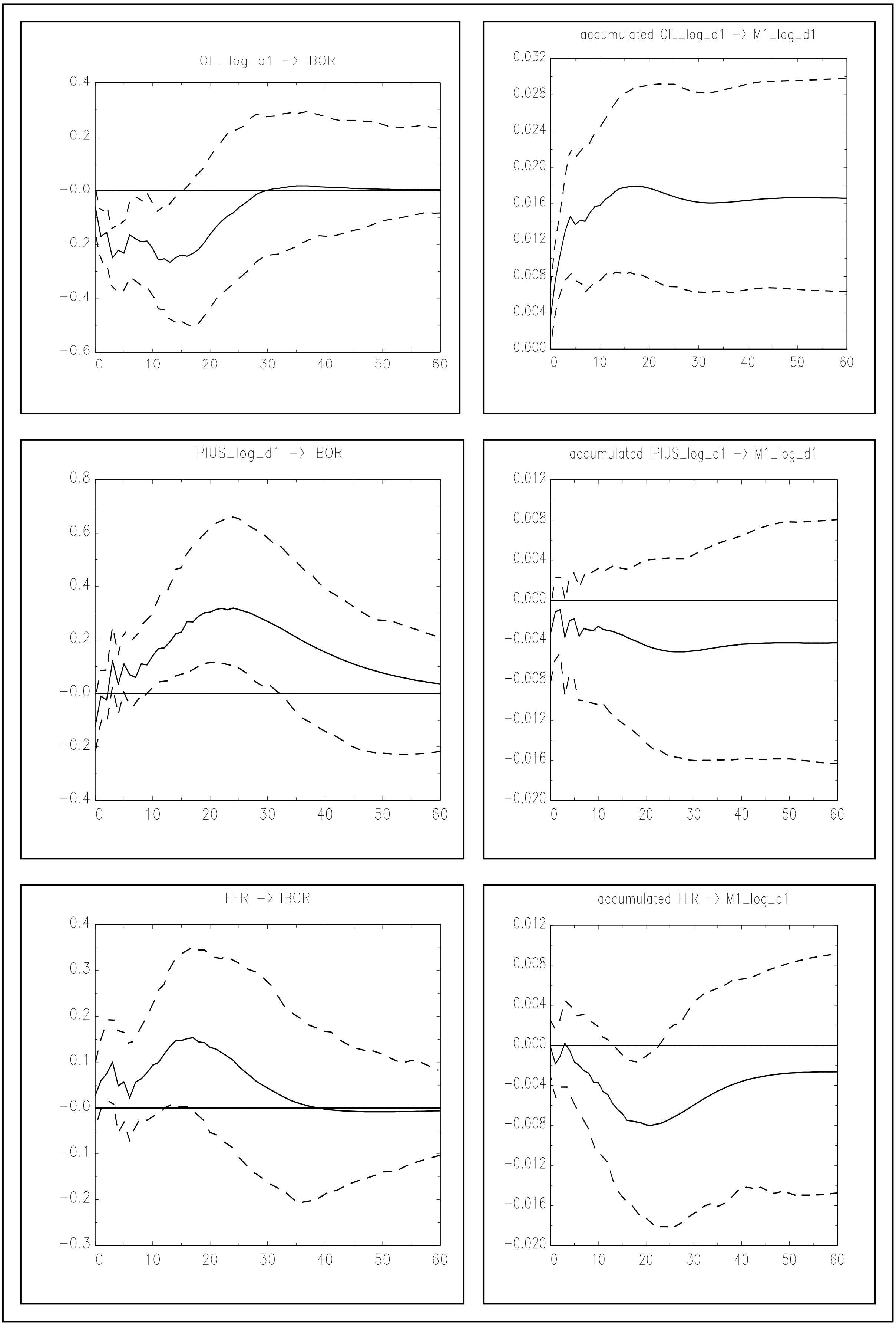


Figure 2.8 : Structural Impulse-Response Function: The Effect of Foreign Shocks on Macroeconomic Variables (Interest Rates Targeting)

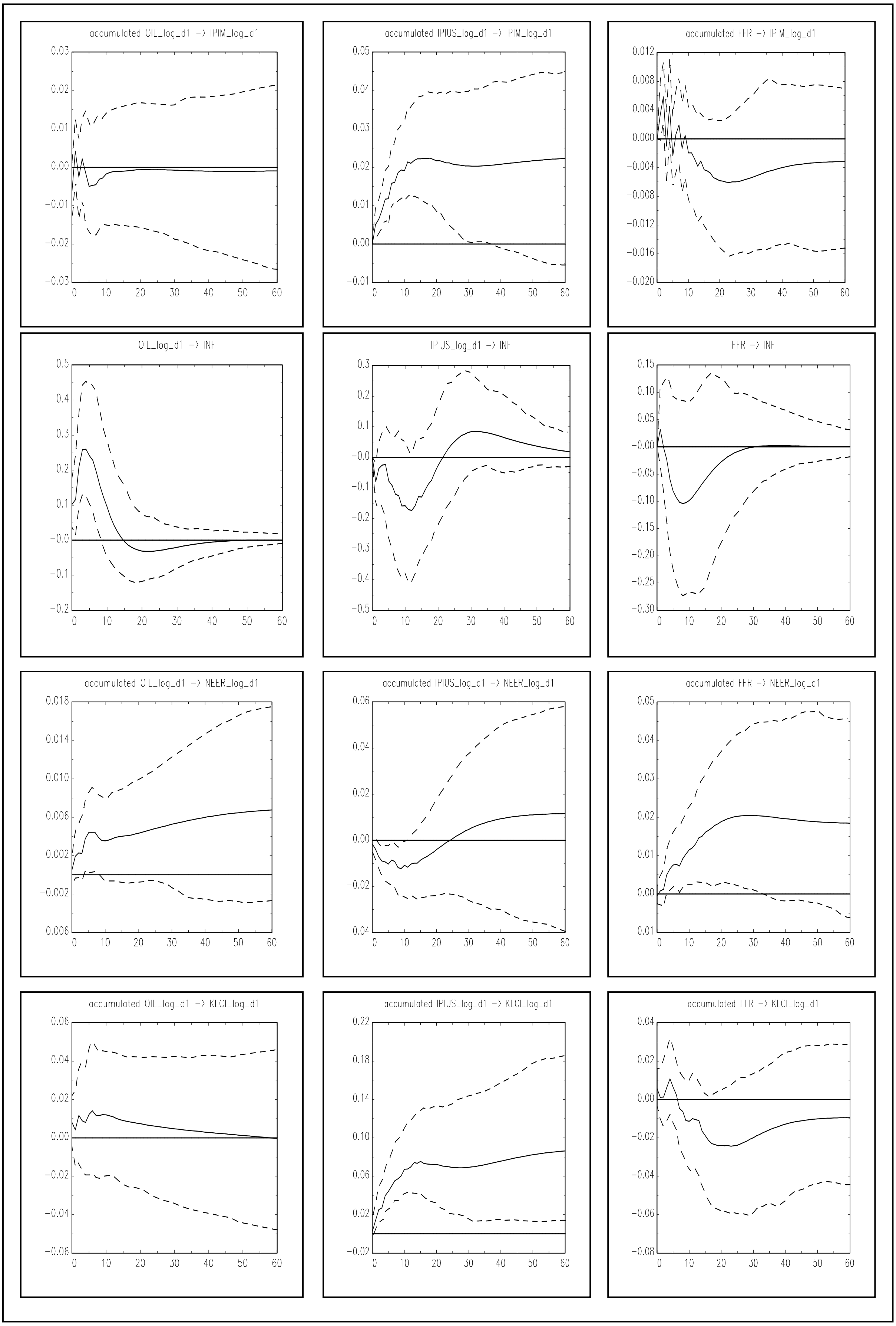


Figure 2.9 : Structural Impulse-Response Function: The Effect of Monetary Policy Shocks on Domestic Variables (Interest Rates Targeting)

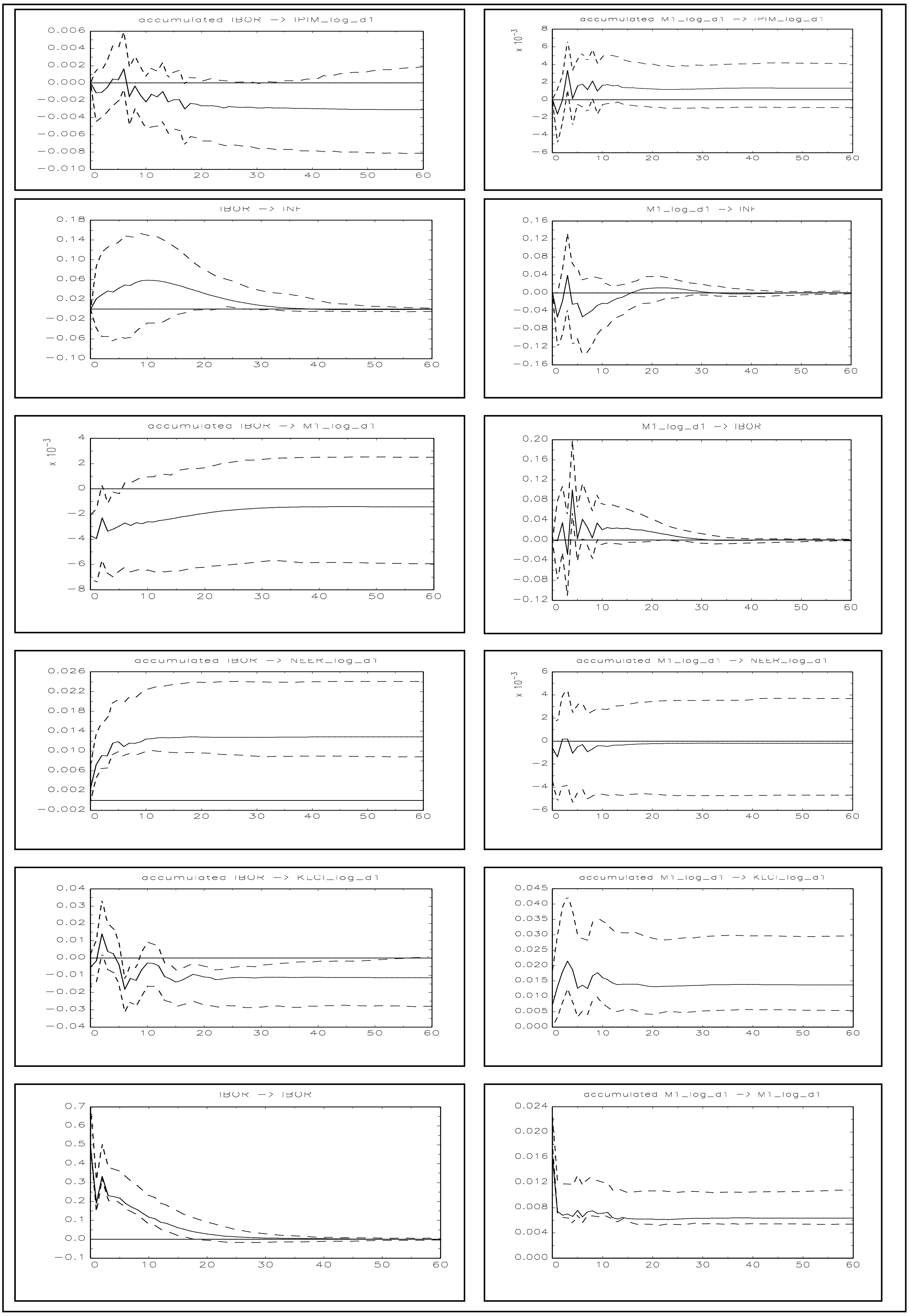


Figure 2.10 : Structural Impulse-Response Function: The Effect of Foreign Shocks on Domestic Output (Whole sample)

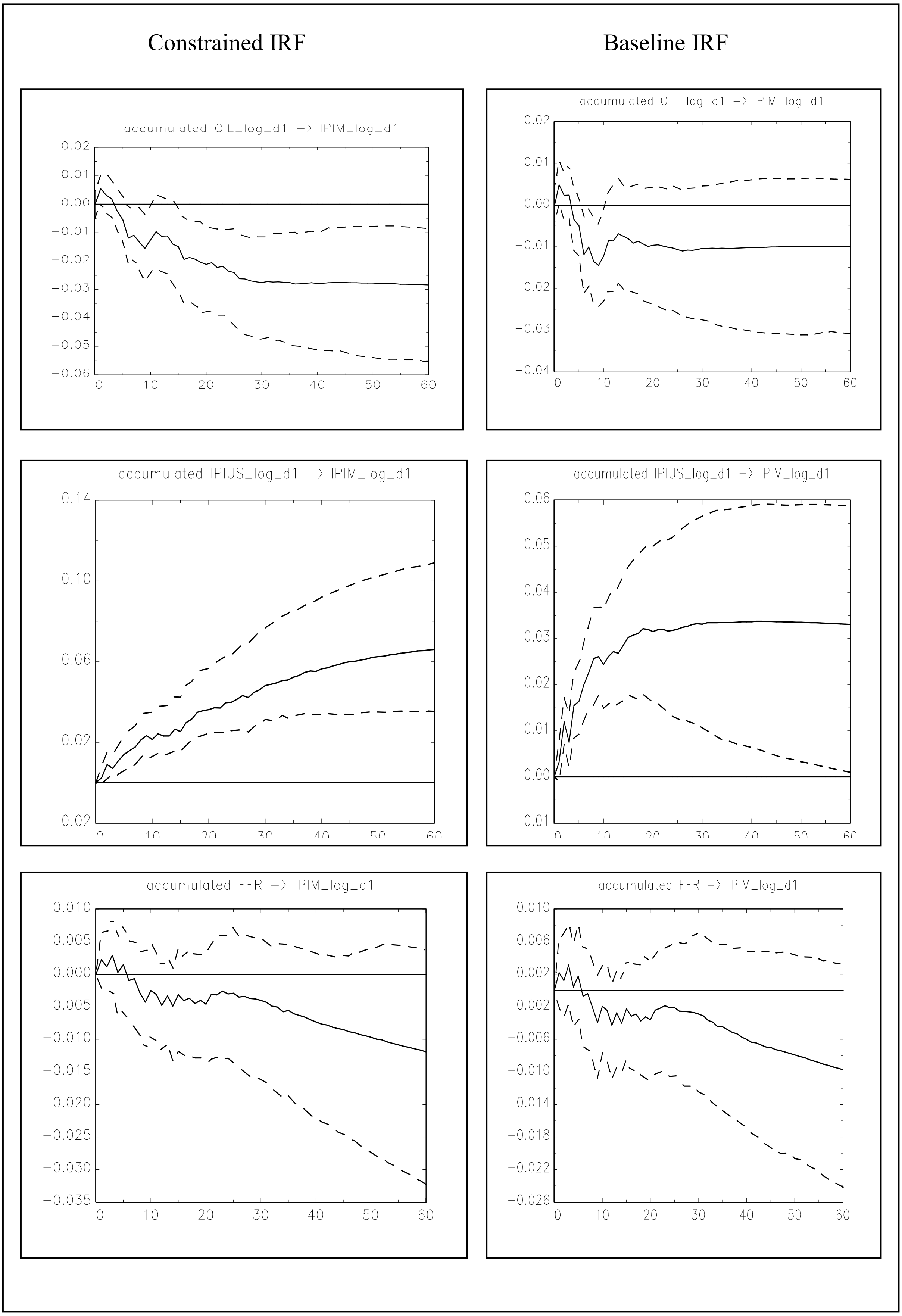


Figure 2.11 : Structural Impulse-Response Function: The Effect of Foreign Shocks on Inflation (Whole sample)

Constrained IRF | Baseline IRF

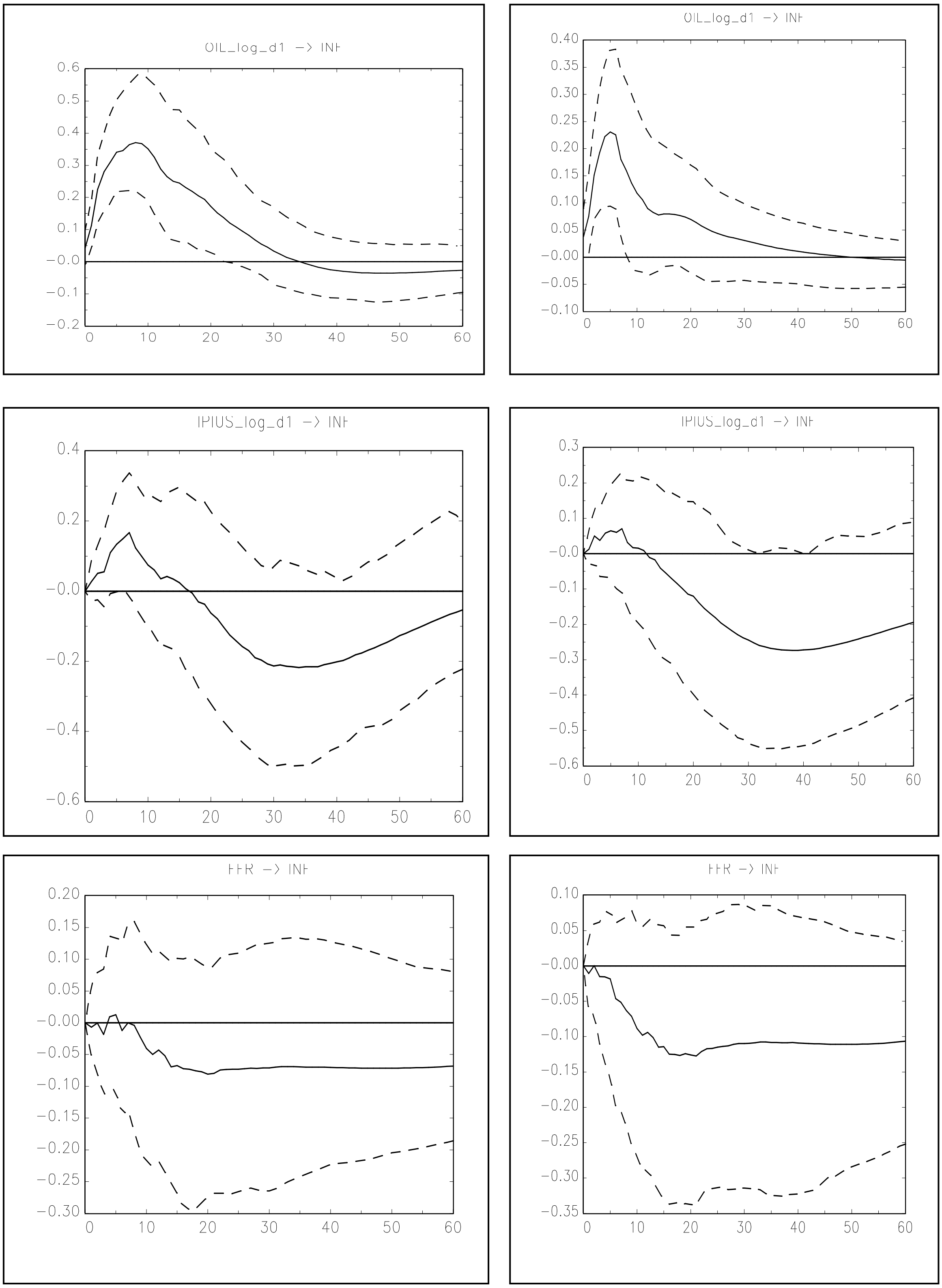


Figure 2.12 : Structural Impulse-Response Function: The Effect of Foreign Shocks on Domestic Output (monetary targeting)

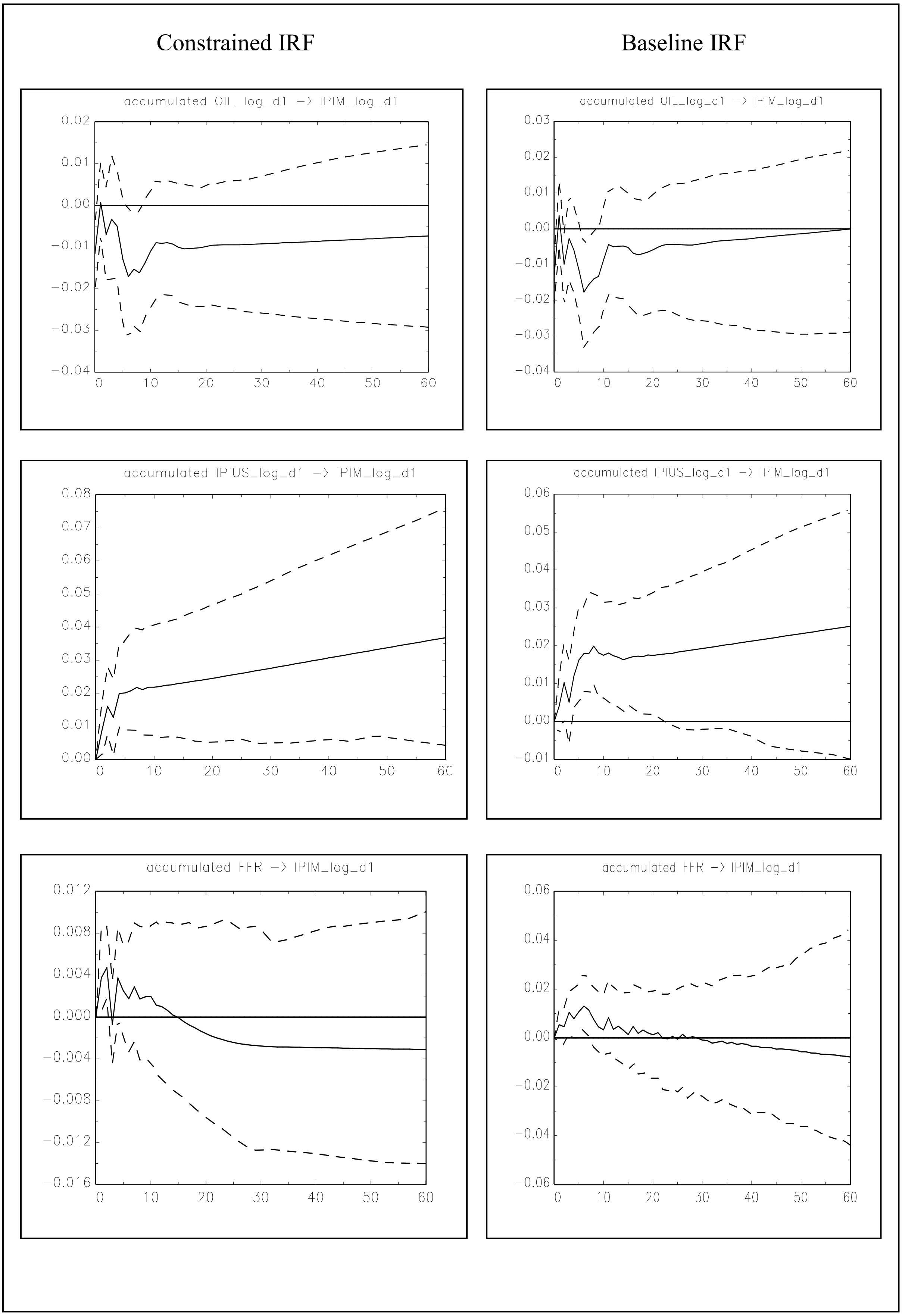


Figure 2.13 : Structural Impulse-Response Function: The Effect of Foreign Shocks on Inflation (monetary targeting)

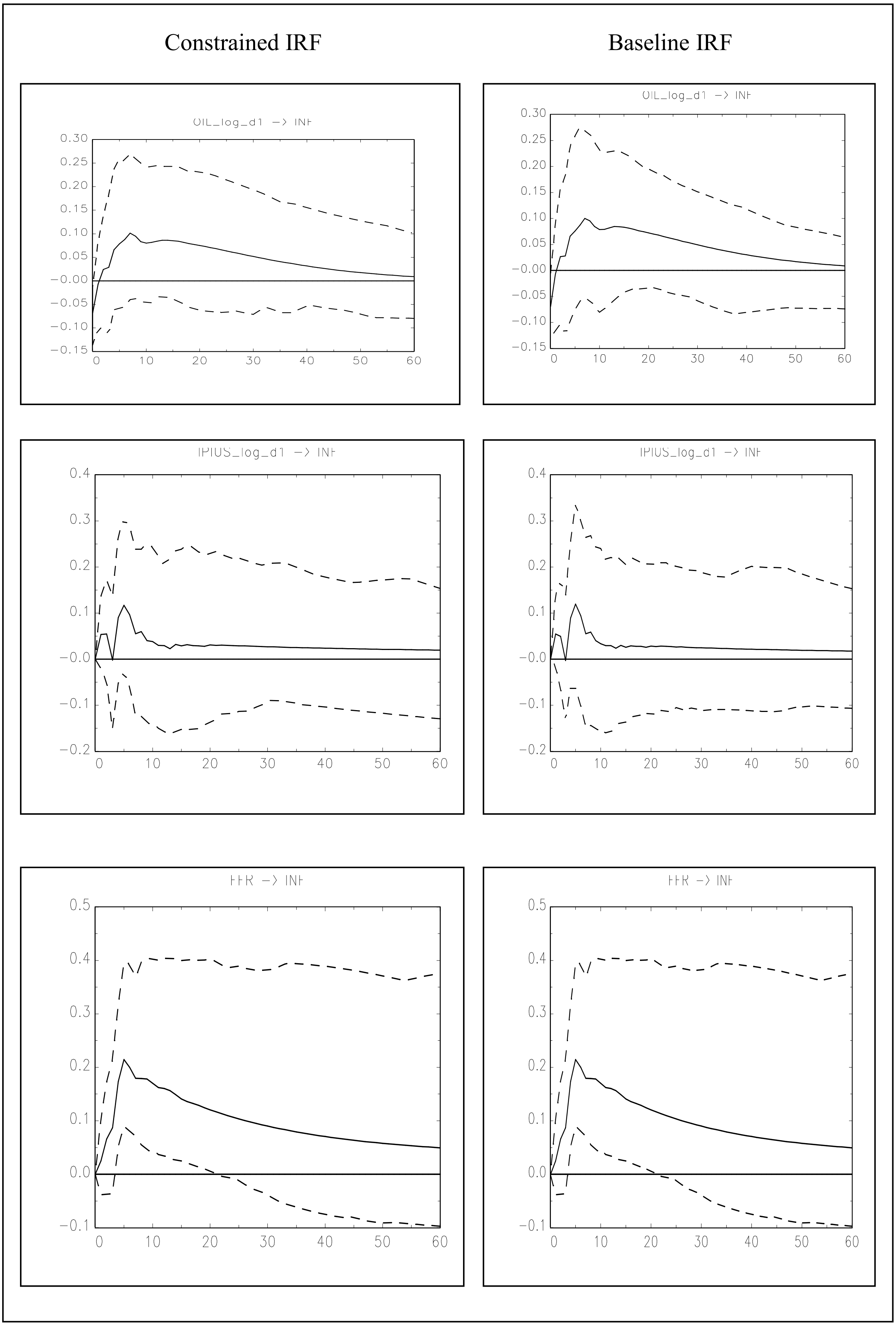


Figure 2.14 : Structural Impulse-Response Function: The Effect of Foreign Shocks on Domestic Output (interest rates targeting)

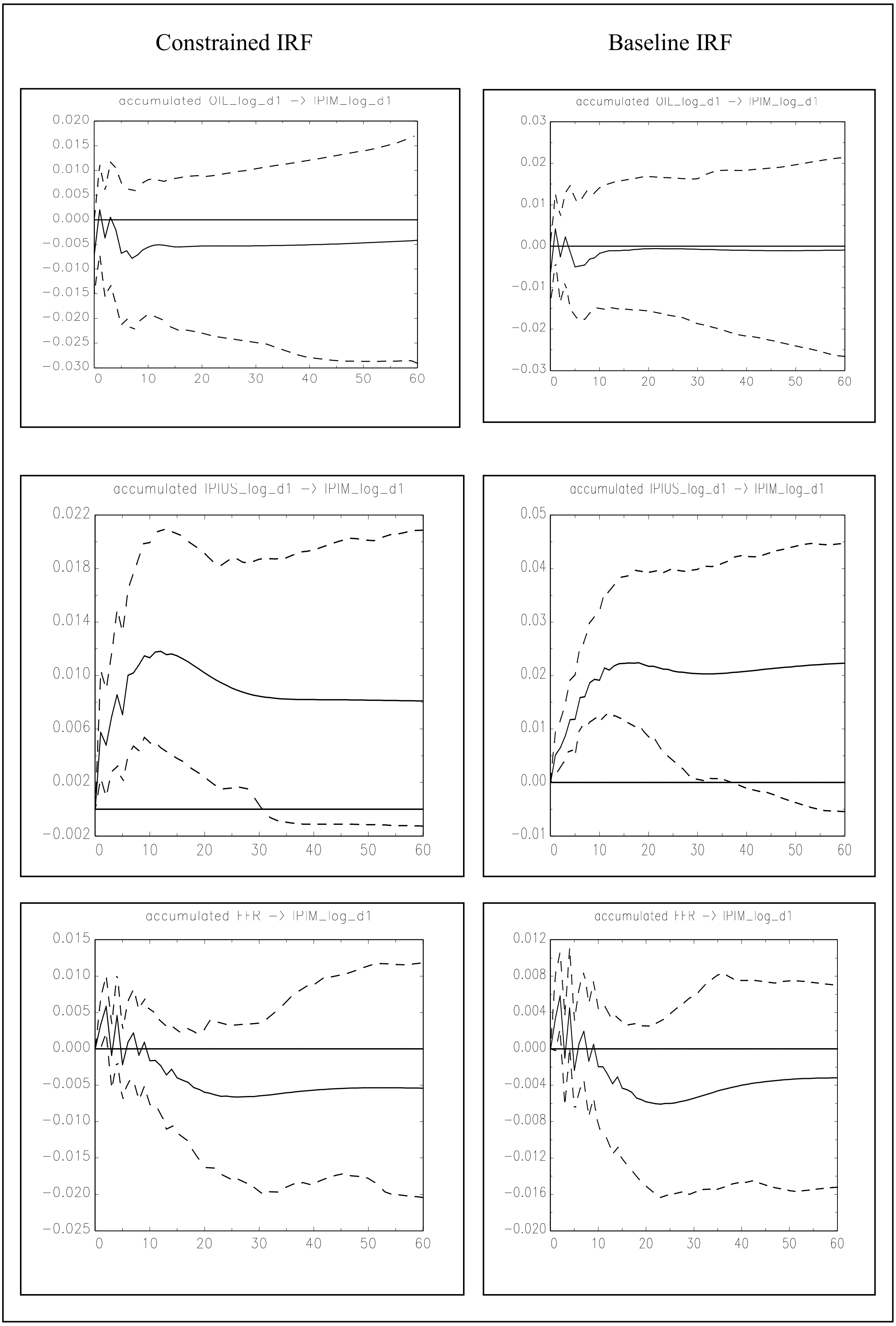
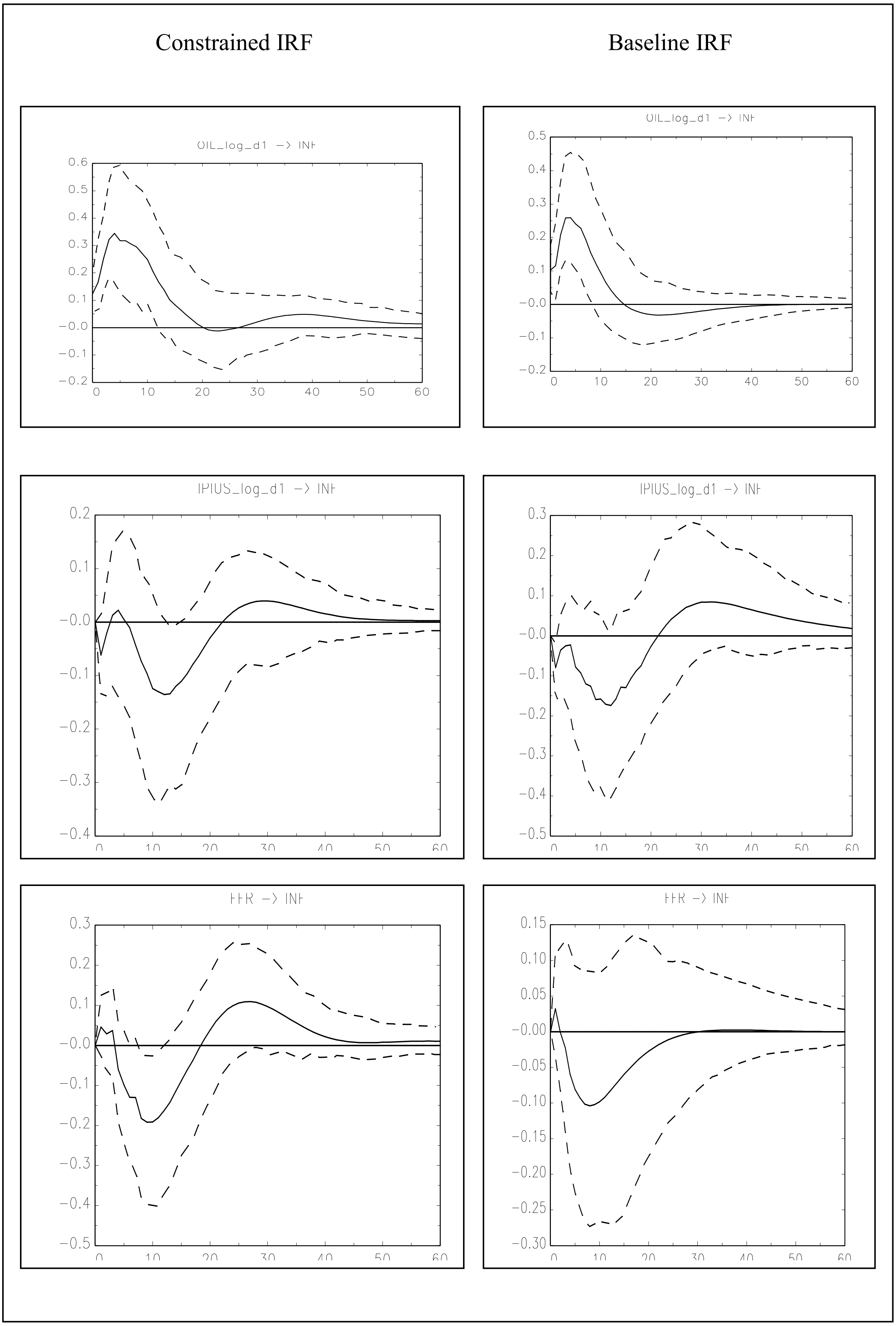


Figure 2.15 : Structural Impulse-Response Function: The Effect of Foreign Shocks on inflation (interest rates targeting)



2.6 Summary and Conclusions

The focal point of this study is to examine the effect of external shocks, namely the world oil price and the US international transmission (US income and US monetary policy) on domestic monetary policy and macroeconomic fluctuations. In addition, this study examines the effectiveness of domestic monetary policy in stimulating the macroeconomic variables. An open-economy SVAR modelling framework has been used in investigating the propagation of foreign shocks to domestic monetary policy and macroeconomic variables, and examines the dynamic responses of macroeconomic variables to monetary policy shocks. The effectiveness of monetary policy in mitigating the negative effect of external shocks on the domestic economy (output and inflation) has also been examined by using the shutdown methodology.

Several major conclusions can be drawn from the empirical findings. First, the world oil price shock has generated a significant effect in influencing domestic monetary policy implementation and macroeconomic variables in the Malaysian economy. Second, the US transmission in terms of the US income and the US monetary policy shocks have also played a prominent role in influencing domestic monetary policy and macroeconomic fluctuations. Third, domestic monetary policy, either money supply or interest rates have played a significant role in stabilizing economic activity. This finding was also supported by Tang (2006) who found that a significant role of monetary policy (interest rates) in influencing output and inflation. Fourth, there is no evidence of several empirical puzzles that are well-documented in the SVAR monetary policy literature. Fifth, monetary policy has also plays an important role in mitigating the negative effect of external shocks on the domestic economy (output and inflation). Finally, in general the empirical results are seen to be robust, which has been examined by using alternative identification scheme and sub-sample analysis (monetary and interest rates targeting regime).

The main findings from this study differ from Tang (2006) in two aspects. First, Tang (2006) has focused on the relative importance of the monetary policy transmission channel through the shutdown of the particular channel of monetary policy in the inflation and output equations. He found that the interest rates channel plays a more important role in influencing output and inflation than other monetary policy channels. Second, Tang (2006) also found the existence of exchange rate puzzle, which indicates that a monetary contraction (a positive innovation in interest rates) is associated with a depreciation of the domestic currency rather than an appreciation.

These findings have several implications for domestic monetary policy implementation. First, since the foreign shocks can influence domestic macroeconomic fluctuations, the BNM has to make an accurate assessment about the external events by monitoring international conditions in implementing monetary policy. This is very important for minimizing the negative effect of the foreign shocks on the macroeconomic fluctuations through proactive monetary policy measures. Second, there is a relevant role for monetary policy instruments (money supply and interest rates) in stimulating macroeconomic variables and mitigating the negative effects of foreign shocks to domestic economy, which suggests that monetary policy can be used as a stabilization policy.

Third, during the interest rate targeting regime, domestic monetary policy has positively responded to the foreign monetary policy shocks. It seems that the BNM has to follow the US monetary policy. This strategy is crucial under perfect capital mobility to maintain the competitiveness of the domestic financial assets, and it can stabilize the domestic currency. As noted by Umizaki (2007), the BNM not only has to consider the domestic factors such as inflation rates and output but also foreign variables, particularly foreign monetary policy and exchange rate, in designing an appropriate monetary policy rule. Fourth, since domestic output has responded negatively to interest rates, the BNM has a greater opportunity to stimulate economic activity by controlling the inter bank overnight interest rates. Finally, the monetary policy also plays an important role in stabilizing economic activity via the exchange rate and stock market effects. For example, the central bank can stimulate the export sector by easing monetary policy (either by an increase in money supply or decrease in interest rates). This strategy will depreciate domestic currency, and subsequently stimulate external demand and economic activity.

3. DOMESTIC MONETARY POLICY AND FIRM-LEVEL STOCK RETURNS IN AN EMERGING MARKET : DYNAMIC PANEL EVIDENCE FROM MALAYSIA

3.1 Introduction

Most economists agree that monetary policy plays a prominent role in stimulating real sector activity, and stabilizing domestic prices, at least in the short run[26]. However, the effects of monetary policy upon macroeconomic variables are often indirect, and do not manifest immediately. The most direct and immediate effect of monetary policy is through financial market variables.

Tobin (1969, 1978) discussed the way in which monetary policy can alter the market value of a firm's assets relative to their replacement costs (a ratio that became known as Tobin's q). Tobin argued that a contraction of monetary policy in response to an increase in the domestic price level will lower the firm's present value of future earning flows, and consequently depress the stock market. This idea has been supported by Bernanke and Kuttner (2005) who argued that by affecting asset prices, the monetary authorities endeavour to alter economic behaviour in order to achieve their ultimate targets in terms of macroeconomic variables, employment and inflation. Thus, understanding the link between monetary policy and asset prices (in particular stock returns) is crucial for the monetary authorities if they are to take advantage of the stock market channel in the monetary transmission mechanism. This is because monetary policy is believed to be transmitted to economic activity through the stock market via two possible mechanisms; Tobin-q [27] (for example, through changes in the cost of capital) and the wealth channel [28] (for example, changes in the value of private portfolios).

---

[26] For example, Bernanke and Blinder (1992) and Christiano et al.(1996).

[27] The transmission mechanism can be described as following;
$M\uparrow \Rightarrow P_S \uparrow \Rightarrow q\uparrow \Rightarrow I\uparrow \Rightarrow Y\uparrow$, which $M\uparrow$ indicates expansionary monetary policy, leading to an increase in stock prices $(P_S\uparrow)$, which raises q and investment $(I\uparrow)$ and subsequently increases output $(Y\uparrow)$.

[28] The transmission mechanism under household wealth effect channel can be described as following; $M\uparrow \Rightarrow P_S \uparrow \Rightarrow wealth\uparrow \Rightarrow consumption\uparrow \Rightarrow Y\uparrow$.

On the other hand, the financial market participants are also likely to be interested in the news of monetary policy. This is because monetary policy news is generally believed to have a significant effect on asset prices. For example, Bernanke and Kuttner (2005) show that an unexpected 25 basis point cut in the FFR leads to a one percent increase in the level of stock prices. Rigobon and Sack (2004) argued that having accurate estimates of the responsiveness of asset prices to monetary policy is crucial to the financial market participants for formulating an effective investment, and risk management decisions.

The negative response of stock market returns to monetary policy changes can be explained by two theories, namely, the 'financial propagation' mechanism as proposed by Bernanke and Gertler (1989), and the 'credit channel' mechanism as discussed by Bernanke and Gertler (1995). First, according to the 'financial propagation' mechanism, an adverse monetary policy shock raises the information and agency cost associated with external finance, which in general reduces access to bank loans and external finance. Thus, this forces the firm to decrease the investment level, and eventually reduces the cash flow and stock returns. Second, under the 'credit channel' mechanism, the effect of monetary policy on equity return works through the 'balance sheet channel' and the 'bank lending channel'. The mechanism under the 'balance sheet channel' is similar to the 'financial propagation' mechanism. In contrast, under the 'bank lending channel' it is expected that a contraction of monetary policy leads banks to shrink the supply of loans and charge higher interest rates for new loan contracts, subsequently causing a decline in firms' cash flow and real earnings as well as stock returns.

The aim of this paper is to provide empirical evidence about the effect of domestic monetary policy shocks upon stock returns in an emerging market economy (i.e. Malaysia). Specifically, this study investigates monetary policy's effects on stock returns in a Malaysian firm-level data set by augmenting a standard Fama and French (1992, 1996) multifactor model of stock returns through the inclusion of identified domestic monetary policy changes. The following research design has been used in this study. First, an identified domestic monetary policy change series is generated via an open economy recursive SVAR identification scheme using monthly macroeconomic data. In the SVAR model, domestic monetary policy variables (inter bank overnight rate) have been assumed to respond contemporaneously to the world oil price, foreign income, foreign monetary policy, domestic output and inflation. Second, the monthly monetary policy shocks are cumulated within year to obtain an annual monetary policy shock. Third, firm stock returns are assumed to follow an augmented Fama and French (1992, 1996) multifactor model, which is estimated using a dynamic panel technique (namely generalized method of moment or GMM).

The contribution of this study differs from previous work in three ways. First, there has been only limited study at either the macro or micro level of the stock market effects of domestic monetary policy in emerging market economies. In particular, this paper is the first attempt (as far as can be established) to estimate how Malaysian monetary policy shocks affect domestic firm-level stock returns. There have been a few studies [for example, Habibullah and Baharumshah (1996); Ibrahim (1999) and Ibrahim and Aziz (2003)] that have examined the link between a monetary policy measure and aggregate stock returns, but none of these studies used identified monetary policy changes. There have also been several studies that have examined the determinants of firm-level stock returns, but they have ignored the effects of domestic monetary policy [for example, see Allen and Cleary (1998); Clare and Priestley (1998); Lau et al. (2002) and Shaharudin and Fung (2009)]. Second, the paper considers how international monetary policy changes affect domestic firm-level stock returns. Much of the previous literature on the stock market effects of monetary policy in the developed world has focused on the effect of domestic monetary policy, with little attention given to the effects of international monetary policy (in particular, on firm-level stock returns). Third, there is no study has been undertaken in investigating the differential of monetary policy effects upon firm-level equity returns in an emerging market economy, in particular for the Malaysian context. Therefore, to fill this gap in the previous literature, this study extends the analysis of the differential of monetary policy effects by firm size (small and large firm), sub-sectors in economic activity, and financially constrained and less-constrained firm.

The results of the study indicate that monetary policy shocks (domestic and international) is statistically and negatively significant in influencing the firm-level stock returns in an emerging market economy. In general, firm-level stock returns have responded more to international monetary policy shocks than domestic monetary policy. For example, for the whole sample results (one-step system GMM estimation), firm equity returns have decreased by 8 percent and 4.5 percent in response to a 100 basis point increase in FFR (international monetary policy) and domestic monetary policy, respectively. The effect of domestic monetary policy shocks also have differential effects, having a statistically significant impact on small firms' equity returns, but not on large firms' stock returns. International monetary policy shocks are also statistically significant in influencing the stock returns of large firms, whereas, small firms' stock returns are not significantly affected. The effect of monetary policy shocks also varies by the sub-sector of the economy in which firms are operating. Domestic monetary policy only shows statistically significant effects on the stock returns of firms in the industrial products sector, whereas international monetary policy shocks only show statistically significant effects in influencing stock returns of firms in the industrial products and property sectors. In addition, the equity returns of financially constrained firms are significantly more affected by domestic monetary policy shocks than less constrained firm.

The remainder of the paper is organized as follows. Section 3.2 briefly reviews the previous literature that considers the effects of monetary policy upon the stock market at either the macro or micro levels. Section 3.3 discusses the estimation procedures, which are included the augmented Fama and French (1992, 1996) multifactor model, dynamic panel data framework, and data specification. Section 3.4 presents the main empirical results and a variety of robustness tests. Finally, section 3.5 summarizes and concludes.

3.2 Review of Literature

The literature on the effect of monetary policy upon the stock market focuses upon either the macro or micro level[29]. There are four main issues that have been discussed in previous studies, including the identification of monetary policy, the macro effects of monetary policy upon stock returns, the heterogeneity in the effects of monetary policy upon returns, and the effects of international monetary policy upon domestic stock return. This section briefly discusses these issues.

Identification of Monetary Policy

An important issue in any evaluation of monetary policy's effects is the appropriate identification of monetary policy. Previous studies have documented four approaches in measuring monetary policy changes. First, some studies, for example Jensen and Johnson (1995), Thorbecke (1997), Perez-Quiros and Timmermann (2000), and Jensen and Mercer (2002) have used changes in market interest rates or official rates for measuring monetary policy changes. However, the problem with this measure is that it makes strong assumptions that monetary policy is completely exogenous, that is unconnected with other economic variables. In fact, in reality monetary policy may be endogenous when the monetary authorities set the interest rate after considering the business cycle conditions and other relevant economic variables. This means that any changes in the interest rates correspond to changes in business cycle conditions and other relevant economic variables (Ehrmann and Fratzscher, 2004). Therefore, it is believed that this endogeneity could bias the estimated effect of monetary policy upon stock returns (Patelis, 1997). In order to solve the endogeneity problem of monetary policy, a number of empirical studies have used alternative approaches such as structural VAR (identified VAR) in measuring monetary policy shocks. For example, Christiano et al. (1996), Thorbecke (1997), Patelis (1997), Lastrapes (1998), Rapach (2001), and Bjørnland and Leitemo (2009) have extracted monetary policy shocks through orthogonalized innovations from a structural VAR approach.

[29] Sellin (2001) has provided an extensive survey of literature about monetary policy and stock market.

Another approach in identifying monetary policy shocks is through event study methodology that allows an analysis at higher frequency data compared to the SVAR literature, which is based on quarterly or monthly data. Examples of research using event study are Kuttner (2001), Ehrmann and Fratzscher (2004), Bernanke and Kuttner (2005), and Basistha and Kurov (2008) in the US economy, Bredin et al. (2007) in the UK economy, and Bredin et al. (2009) in the European economy. For example, Bernanke and Kuttner (2005) introduce the surprise component of monetary policy actions in an event study framework and they found that the stock market has a negatively strong response to the contraction of monetary policy.

In contrast, Rigobon (2003) and Rigobon and Sack (2004) and Caporale et al. (2005) have identified monetary policy through heteroskedasticity present in financial market based on high-frequency data set. In fact, this identification is closely related to the event study methodology. According to this identification strategy, the response of asset prices to changes in monetary policy can be identified based on an increase in the variance of policy shocks that occurs on days of FOMC meetings and of the Chairman's semi-annual monetary policy testimony to Congress (Rigobon and Sack, 2004). Although the prior studies have used different methodologies in measuring monetary policy shocks, their empirical results have produced a similar finding, which is that monetary policy shocks have influenced significantly and negatively the stock returns.

This study uses structural VAR (SVAR) approach in measuring monetary policy shocks due to three reasons. First, SVAR approach permit to solve the endogeneity of monetary policy, which is allows the monetary authority to set the interest rates after observing other macroeconomics variables and business cycle conditions. In fact, as mentioned previously, most recent empirical studies of monetary policy and real economic activity have adopted the SVAR approach in measuring the monetary policy shocks. Second, it is not possible to use event study methodology in Malaysia because data are not available at higher frequency level. In fact, the BNM does not have a proper-minuted meeting about the changes in monetary policy framework as compared to advanced countries like the UK and US[30]. Third, since this study uses panel data evidence at the firm level, the methodology proposed by Rigobon and Sack (2004) is inappropriate because it also needs a high frequency data set of financial market variables.

Monetary Policy and Stock Return: Macro Evidence

Most of the literature concerning the effect of monetary policy shocks on stock market has focused on macro level studies, particularly in the US economy. The empirical evidence (especially in the US) is in line with economic theory, finding a significant negative relationship between equity returns and the tightening of monetary policy. For example, Thorbecke (1997) uses three indicators of monetary policy – namely, innovations in the FFR and non-borrowed reserves, narrative indicators and event study. The results from VAR study indicate that tightening monetary policy (an increase in FFR) decreases stock returns for all of the 22 industry portfolio. The industry portfolio returns are equally-weighted averages of the returns on individual firms. In addition, he also found that by using ten size-ranked portfolios[31], monetary tightening has a stronger negative effect on the equity prices of small firms than large firms.

Patelis (1997) finds that monetary policy, measured by innovations in FFR and the Strongin indicator, has negative influences on expected excess returns and expected dividend growth. However, the role of monetary policy in explaining the variation of stock returns is relatively small, that is only 3 percent as compared to the dividend yield, which contributed more in explaining the unexpected return variance. Lastrapes (1998) using a sample of G-7 countries and Holland found that money supply shocks have a positive and significant effect on real equity prices for all countries except France and the UK. Rapach (2001), using SVAR in long run restrictions, also found that macro shocks such as money supply, aggregate spending and aggregate supply shocks have important effects on real stock prices in the US economy. Recently, Bjørnland and

[30] In Malaysia, since April 2004 the Central Bank of Malaysia has disclosed the schedule of Monetary Policy Committee (MPC) meeting and announced the decision about the monetary policy statement to the public after the meeting.

[31] The size portfolios are value-weighted and sorted into deciles based on market capitalization at the end of each quarter.

Leitemo (2009), using the short run and long run SVAR methodology, they found that an aggregate interdependence between interest rate setting and real stock prices. Specifically, real stocks price immediately fall by seven to nine percent due to the monetary policy shocks that raised the federal fund rate by a 100 basis point.

Besides the US study, there are some studies that have examined the impact of monetary policy in OECD countries, Euro area and UK, for example, Cassola and Morana (2004), Ioannidis and Kontonikas (2008), Kholodilin et al. (2009), and Gregoriou et al. (2009). For example, a recent study by Kholodilin et al. (2009) in the Euro area by using a heteroskedasticity approach proposed by Rigobon and Sack (2003) have found that an increase in the interest rate by 25 basis point results in a decrease in the aggregate stock market level of approximately 1 percent. In fact, the effects of monetary policy shocks by sectoral indexes vary, as the stock indexes have decreased in the range 0.3 percent and 2 percent in response to an increase in the interest rates by 25 basis points. In addition, Gregoriou et al. (2009) have examined the impact of anticipated and unanticipated interest rate changes on aggregate and sectoral stock returns in the UK, and showed that the existence of an asset price channel in the UK economy.

Monetary Policy and Firms Stock Return: Heterogeneity Evidence

It is generally believed that individual stock returns react differently to monetary policy according to their size (small and large firm), sub-sector economic activity, and financially constrained and less-constrained firms. Therefore, understanding why individual stock returns react so differently to monetary policy is an interesting issue to investigate. For example, Bernanke and Blinder (1992) and Kashyap et al. (1993) argued that a contraction of monetary policy predominantly affects firms that are heavily dependent on bank loans, as banks respond to a monetary contraction by shrinking their overall supply of credit[32]. Therefore, under imperfect capital markets with information asymmetries, for firms that are quoted on stock markets, their stock prices respond to monetary policy in different ways (Ehrmann and Fratzscher, 2004).

[32] Agency costs are usually assumed to be smaller for large firms because of the economies of scale in collecting and processing information about their situation. As a result, large firms can more easily finance directly from financial markets and less dependant on banks loans.

Specifically, small firms that have less information are affected more than large firms in response to a monetary policy contraction. This is because banks tend to reduce their credit lines and small firms have difficulty in finding alternative sources of financing, which should lead to a constraint of the supply of their goods.

On the other hand, the response of monetary policy shocks is also differs across firm in the sub-sector economic activity. Peersman and Smets (2005) and Dedola and Lippi (2005) have provided three possible reasons in explaining the differential response of monetary policy across sub-sector economy[33]. First, the interest-sensitivity of the demand for product differs across firms. For example, firms that produce goods for which demand is highly cyclical or interest-sensitive should see their expected future earnings affected relatively more following a monetary policy changes. Second, changes in the cost of capital induced by monetary policy are more important for capital-intensive industries. Third, if monetary policy affects exchange rate, tradable goods industries are likely to be affected more strongly. All these factors imply that expected future earning are affected in a heterogeneous across industries in response to monetary policy changes, which should be reflected in the responsiveness of stock returns. Therefore, we can expect that equity return of firms in cyclical industries, capital-intensive industries, and industries that are relatively open to trade to be affected more strongly to monetary policy shock (Ehrmann and Fratzscher, 2004).

The literature on the credit channel states that the effect of monetary policy upon firm-equity returns has also differed by financially constrained and less-constrained firm. In particular, firms that are financially constrained are likely to be affected more strongly by changes in interest rates than firms that are less constrained. The equity returns of financially constrained firm are responded more to monetary policy tightening because inability to fund investment due to credit constraints or inability to borrow, inability to issue equity, dependence on bank loans or illiquidity of asset. In contrast, the equity return of unconstrained firm are less responded to monetary policy shock because they are enable to access external financing due to the good credit condition. For example, study by Perez-Quiros and Timmermann (2000) by using the

[33] Ganley and Salmon (1997) and Hayo and Uhlenbrock (2000) have also found the cross-industry heterogeneity of the impact of monetary policy shocks in UK and Germany, respectively.

size of firms as a proxy for the degree of credit constraints have found that smaller firms' returns are more affected by monetary policy tightening than large firms.

Ehrmann and Fratzscher (2004), using a multifactor model in panel-corrected standard error approach, found that the firms stock return reacts differently to the US monetary policy shocks. Changes in monetary policy are measured by the unexpected component of the FOMC announcements on the days of policy decisions. Specifically, the industrial sectors that are cyclical and capital-intensive (for example, technology, communications, and cyclical consumer goods) often react two to three times more strongly to the US monetary policy shocks than non-cyclical industries. The effect of monetary policy shocks is also differs by firms size, which is the small firms, based on either on the number of employees or the market value of firms are reacted more to monetary policy shocks than medium-sized and large firms. In addition, by using various measures of financial constraints[34], they also found that firms that are financially constrained with low cash flow, poor credit ratings, low debt to capital ratio, high price-earning ratio, and high Tobin's q have responded significantly more to monetary policy than less constrained firms.

This findings have been supported by Basistha and Kurov (2008) in a US study which shows that the size of the response of stock returns to monetary policy shocks is more than twice during recession and tight credit conditions as in good economic times. In fact, the response of firm stock returns to monetary news depends on the individual credit characteristics of firms. For example, the equity return of the companies that are likely to be credit constrained react more strongly to monetary news in recessions and in tight credit market conditions as compared to the company that is relatively unconstrained. The effect of monetary policy shocks is also differs by sub-sector economic activity, which is the business equipment, telecom and durable sectors have responded more in response to a 100 basis point increase in FFR. This finding supports the relevance of traditional interest rates channel of monetary transmission, which is the

[34] Ehrmann and Fratzscher (2004) used more direct measures of financial constraints namely the cash flow to income ratio, the ratio of debt to total capital, and Moody's investment and bank loan rating. In theory, firms with large cash flow should be immune to changes in interest rates as they can rely more on internal financing of investment. Firms with a lower ratio debt to capital are affected more by monetary policy because they are more bank-dependant.

stronger response of cyclical and capital-intensive industries can be explained by sensitivity of the demand for their products to interest rates fluctuations.

International Monetary Policy Shocks and Domestic Stock Return

Most of the literature on the stock market channel has focused on the effect of domestic monetary policy. There has been little interest in investigating the effect of international monetary policy shocks on domestic market stock returns. However, a few studies have investigated the transmission mechanism of international monetary policy to domestic stock returns, in particular at the macro level. For example, Conover et al. (1999), using monthly data for 16 industrialised countries, found that the equity markets in several countries have reacted more to the US monetary policy than to local monetary policy. In fact, the response of stock markets is generally higher in expansive than in restrictive US monetary policy periods. Ehrmann et al. (2005) estimate the effect of US monetary policy on stock markets for the Euro area and found that a 100 basis point increase in US monetary policy dropped Euro area stock markets by nearly 2 percent. In comparison, the effect of Euro monetary policy on the US stock market is relatively smaller, that is 0.5 percent. Recently, Ehrmann and Fratzsche (2006) by analyzing 50 equity markets worldwide, found that on average global equity market returns fall by 3.8 percent in response to a 100 basis point tightening of US monetary policy. Some countries, for example Indonesia, Korea and Turkey have experienced stock return declines of more than 10 percent in response to the US monetary policy shocks.

Therefore, with this background, this study makes a novel contribution to literature on the effects of monetary policy shocks on the asset price channel, in particular on the stock market return, by using a disaggregated firm-level data set in an emerging market economy, in which special attention is given to the main board publicly listed companies in Malaysian Bourse. The focus of this study is to examine the differential of monetary policy effects upon the firm-level stock returns by firm size (small and large firm), by sub-sector (product types), and by financially constrained and less constrained firms.

3.3 Estimation Procedures

In this paper, the standard Fama and French (1992, 1996) multifactor model is augmented to enable an examination of the determinants of firm-level stock returns. This section briefly explains the multifactor modelling, dynamic panel data model and data specification.

3.3.1 Multifactor Model

Fama and French (1992, 1996) have developed a three factor model as an alternative to single factor model (capital asset pricing model or CAPM) which perform poorly in explaining realised returns. This is because market return itself in the single factor model is an inadequately in explaining the behaviour of the individual stock return. Indeed, in empirical tests of the CAPM, others factors such as dividend yield, firm size, price-earning ratio, the ratio of book value to market equity, and growth rates are also important in explaining returns. In addition to the market factor, Fama and French (1992, 1996) identified two other factors which are relating to the firm size, and the ratio of book value to market equity.

The three factor model as proposed by Fama and French (1992, 1996) can be represented as follows:

$$R_{it} - RF_t = \alpha_i + \beta_i\left[RM_t - RF_t\right] + s_i\left(SMB_t\right) + h_i\left(HML_t\right) + \varepsilon_{it} \quad (3.1)$$

where, R_{it} is the return on asset i in period t, RF_t is the risk-free rate, β_i is the coefficient loading for the excess return of the market portfolio, s_i is the coefficient loading for the excess average return of portfolio with small equity class over portfolios of big equity class, h_i is the coefficient loading for the excess average returns of portfolio with high book-to-market equity class over those with low book-to-market equity class, and ε_{it} is the error term for asset i at time t.

In equation (3.1), the sensitivity of the excess return of asset i at time t $(R_{it} - RF_t)$ is determined by three factors: (i) the excess return on a broad market portfolio $(RM_t - RF_t)$; (ii) the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks (SMB, small minus big); and (iii) the difference between the return on a portfolio of high-book-to-market stocks and the return on a portfolio of low-book-to-market stocks (HML, high minus low). According to Fama and French (1992, 1996), the two additional variables that are SMB and HML are provided the possible usefulness of a firm characteristics in explaining the returns. This means that the SMB (as a proxy for size variable), and the HML (as a proxy for the ratio of book value to market equity) are related to the risk factors in explaining the returns.

However, the three factor model developed by Fama and French (1992, 1996) is an inadequately in explaining the security returns. As noted by Daniel and Titman (1997), Fama and French multifactor model is not sufficient to rule out the characteristic-based explanation and does not directly explain average return. In fact, much of the returns on securities can be explained by certain anamolies such as dividend yield, price-earning ratio, the ratio of book value to market value, firm growth rates, leverage, and also policy variable (for example, monetary policy).

3.3.2 Augmented Fama and French multifactor model

In order to investigate the role of monetary policy on firm stock return, this study has added two monetary policy variables namely domestic and international monetary policy to the Fama and French (1992, 1996) three factor model. In addition to the monetary policy variables, other variables namely, international market returns and four firm specific financial variables have been considered in the model. Therefore, the baseline augmented Fama and French (1992, 1996) multifactor model can be represented as follows:

$$R_{it} - RF_t = \alpha_0 + \beta_1 [(RM_t) - RF_t] + \beta_2 (SMB_t) + \beta_3 (HML_t) + \beta_4 [(IR_t) - USTB_t] + \beta_5 DMPS_t$$
$$+ \beta_6 IMPS_t + \beta_7 RSALEG_{i,t-1} + \beta_8 \ln\left(\frac{BV_{i,t-1}}{MV_{i,t-1}}\right) + \beta_9 \ln\left(\frac{LIQ_{i,t-1}}{TA_{i,t-1}}\right) + \beta_{10} \ln\left(\frac{DEBT_{i,t-1}}{EQUITY_{i,t-1}}\right) + \varepsilon_{it} \quad (3.2)$$

In Equation (3.2), there are two types of risk-free interest rates, namely the Malaysian twelve months Treasury Bill rate (RF), and the US twelve months Treasury Bill rate $(USTB)$. Therefore, Equation (3.2) can be re-expressed in term of excess return[35] as following;

$$r_{it} = \alpha_0 + \beta_1 rm_t + \beta_2 (SMB_t) + \beta_3 (HML_t) + \beta_4 ir_t + \beta_5 DMPS_t$$
$$+ \beta_6 IMPS_t + \beta_7 RSALEG_{i,t-1} + \beta_8 \ln\left(\frac{BV_{i,t-1}}{MV_{i,t-1}}\right) + \beta_9 \ln\left(\frac{LIQ_{i,t-1}}{TA_{i,t-1}}\right) + \beta_{10} \ln\left(\frac{DEBT_{i,t-1}}{EQUITY_{i,t-1}}\right) + \varepsilon_{it} \quad (3.3)$$

Specifically, the definitions and justifications of the variables in the augmented Fama and French (1992, 1996) multifactor model are the following;

(a) Firm stock returns in terms of excess returns (r_{it}) have been calculated as follows;

$$r_{it} = \left[\frac{SP_{it} - SP_{i,t-1}}{SP_{i,t-1}} + DY_{it}\right] - RF_t \quad (3.4)$$

Where SP_{it} is a closing stock price at year-end for firm i at time t, DY_{it} is the dividend yield for firm i at year-end at time t, and RF_t is a risk-free asset proxy, namely the Malaysian twelve months Treasury bill rate.

(b) Market return variables

In equation (3.2), there are two market return variables namely domestic (RM) and international market (IR) returns. The domestic market return (RM) proxies by the return of Kuala Lumpur Composite Index (KLCI). According to CAPM theory, the domestic market return has a positive relationship with the security returns. It measures the sensitivity of the security returns to the market returns. For example, if the coefficient of β_1 in equation (3.2) is greater than one, the security is known as an

[35] In the capital market theory, excess return or risk premium measured the difference between the expected market rate of return and the risk-free rate of return.

aggressive stock, since its price is more volatile than the market. In contrast, if the security has a β_1 less than one, the security is known as a defensive stock, since its price is less volatile than the market. The domestic market return is also expressed in term of excess returns as follows;

$$rm_t = \left(\frac{KLCI_t - KLCI_{t-1}}{KLCI_{t-1}} \right) - RF_t \tag{3.5}$$

As international financial market integration increases, international market returns (IR) become more important in influencing domestic firms' stock returns. Therefore, the return of Standard & Poor 500 Index (SP500) is used as a measurement of an international market return. The selection of this variable is reasonable given that the Malaysian stock market is an emerging and relatively small market, which is has exposed to international financial conditions, in particular to the stock market development from large country like US. There are two possible reasons why the US stock market is an appropriate proxy for international market returns. First, the US is the largest of Malaysia's trading partners. For example, on average, from 1997 to 2008, exports to the US have constituted 20 percent of total Malaysian exports. Second, US is also the major investor in the Malaysian equity market. For example, from 2000 to 2008, on average the equity investment from US is approximately 20 percent of the total equity investment by country[36]. Therefore, the international market return in terms of excess return can be expressed as follows;

$$ir_t = \left(\frac{SP500_t - SP500_{t-1}}{SP500_{t-1}} \right) - USTB_t \tag{3.6}$$

Where, $USTB$ in the 12 months US Treasury Bill rate as a proxy for a risk-free asset.

(c) Firm financial characteristics

In equation (3.2), there are four firm specific financial variables that have been considered in the augmented Fama and French (1992, 1996) multifactor model. The variables include the ratio of book value to market value (BVMV), leverage (debt-equity ratio), real sales growth, and liquidity ratio. These variables can capture the role

[36] This figure is based on the author's calculation from the Bank Negara Malaysia, Monthly Statistical Bulletin.

of company-specific idiosyncratic risk factors in explaining the returns. All firm specific variables are expressed with a lagged effect in the augmented multifactor model. All variables except real sales growth ($RSALESG$) have been transformed into logarithms.

BVMV is the ratio between the book value of common equity and the market equity at the fiscal year-end in the previous period. Market equity is computed by multiplying shares outstanding with the price per share. High BVMV tend to exhibit higher average returns, whereas stocks with low BVMV ratios tend to exhibit lower returns. This is because a financially strong and established company will have a relatively high book value (strong balance sheet position), which results in a high BVMV as well. In addition, the BVMV is also a good indicator of market efficiency. If a market is efficient, the price of a stock is expected to reflect all the information relevant to investors for the purpose of security analysis, and trade. Therefore, we predict a significant positive sign for the BVMV upon firm equity returns.

Firm financial leverage is also play an important role as risk factor in explaining the equity returns. For example, firms with a higher leverage (higher debt-equity ratio) are likely to experience a greater price decline because of worries to the firms' possible inability to make interest and loan payments, which may lead bankruptcy (Wang et al., 2009). Therefore, the relationship between financial leverage and returns should be negative.

Liquidity ratio is measured as liquid assets (LIQ) divided by total assets. Liquid asset comprises total cash plus marketable securities. The liquidity has been found to be an important factor in explaining the stock return. As argued by Wang et al. (2009), investors favour the stocks of firms with larger cash holdings than cash-constrained firms because a high liquidity level indicates that the firm is better to meet its maturing obligations. In fact, firms with higher liquid asset are safer against bankruptcy because higher cash holdings reduce the probabilities that a cash shortage will force the firm into default. Therefore, we predict a positive sign for the liquidity ratio upon firm equity returns.

The important role of sales growth in explaining the stock return have been discussed by Lakonishok et al. (1993), Davis (1994), and Lau et al. (2002). All studies found that, stock returns are negatively related to the past sales growth. Lakonishok et al. (1993) argued that stocks with high past sales growth are typically glamour stocks, and stocks with low past sales growth are out-of-favour or value stocks. They found that, the stocks with low growth in sales (value stocks) earn an abnormal return of 2.2 percent, whereas the stocks with high growth in sales (glamour stocks) earn abnormal return of -2.4 percent. This finding indicates that the value stock outperformed the glamour stock.

In order to control for inflation, firm sales are expressed in real terms $(rsales)$ by dividing the year-end nominal sales in period t by the consumer price index (CPI) in period t. Therefore, the firm real sales growth $(RSALESG)$ is calculated as follows;

$$RSALESG_{it} = \left[\frac{rsales_{i,t} - rsales_{i,t-1}}{rsales_{i,t-1}} \right] \tag{3.7}$$

(d) Monetary Policy Shocks

As mentioned before, the main objective of this study is to examine the effect of monetary policy shocks on firm-level equity returns. In equation (3.3), there are two monetary policy shocks variables, which are domestic monetary policy shocks $(DMPS)$, and international monetary policy shocks $(IMPS)$. In order to deal with the endogeneity problem associated with monetary policy variables, monetary policy is measured through a recursively identified structural VAR (SVAR). Therefore, the SVAR model has been estimated with six variables in level form. The data are at a monthly frequency, spanning January 1990 until December 2008, and are collected from International Monetary Fund (IMF) database. According to the Akaike information criteria (AIC), the optimal lag length is six months. The SVAR-A model proposed by Amisano and Giannini (1996) can be expressed as follows:

$$A_0 Y_t = \Gamma_0 D_0 + A(L) Y_t + \varepsilon_t \tag{3.8}$$

where A_0 is an invertible square matrix of coefficients relating to the structural contemporaneous interaction between the variables in the system, Y_t is a (6×1) matrix or

$[LOIL \quad LYUS \quad FFR \quad LYM \quad INF \quad IBOR]'$, that is the vector of system variables, where $LOIL$ is log of world oil price (in US $ per barrel), $LYUS$ is log of US income proxy by Industrial Production Index, FFR is the US Federal Fund Rate as a proxy for an international monetary policy stance, LYM is log of Malaysian income proxy by Industrial Production Index, INF is the inflation rate which is computed from the Consumer Price Index (CPI), and $IBOR$ is the inter-bank overnight rate as a proxy for domestic monetary policy. D_0 is a vector of deterministic variables (which may include constant, trend and dummy variables), $A(L)$ is a k^{th} order matrix polynomial in the lag operator L, and $\varepsilon_t = [\varepsilon_{loil} \quad \varepsilon_{lyus} \quad \varepsilon_{ffr} \quad \varepsilon_{lym} \quad \varepsilon_{\inf} \quad \varepsilon_{ibor}]$ is the vector of structural shocks which satisfies the conditions that $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_s^{'}) = \Omega_\varepsilon = I$ (identity matrix] for all $t = s$.

International monetary policy, that is US monetary policy (FFR), has been assumed to respond contemporaneously to world oil prices and US income. In contrast, domestic monetary policy variables, that is inter bank overnight rate (IBOR), is ordered last in the VAR system, by assuming the Malaysian monetary policy is responded contemporaneously to all variables in the VAR. However, equation (3.8) cannot be directly observed or directly estimated to derive the true value of A_0, $A(L)$ and ε_t. Hence, equation (3.8) has estimated by transforming to the reduced form representation as follows;

$$Y_t = A_0^{-1}\Gamma_0 D_0 + A_0^{-1}A(L)Y_t + A_0^{-1}\varepsilon_t \tag{3.10}$$

or

$$Y_t = \Pi_0 D_0 + \Pi_1(L)Y_t + \mu_t \tag{3.11}$$

Where, $\Pi_0 = A_0^{-1}\Gamma_0$, $\Pi_1 = A_0^{-1}A(L)$, $\mu_t = A_0^{-1}\varepsilon_t$ and $E(\mu_t \mu_t^{'}) = A_0^{-1}\Omega A_0^{-1'} = \Sigma.$

Monetary policy structural shocks are generated from $\mu_t = A_0^{-1}\varepsilon_t$. Specifically, monthly monetary policy shocks are computed by mapping the residual from the reduce form VAR, ε_t with contemporaneous matrix A_0. Then, monthly structural shocks are cumulated within year in order to compute the annual monetary policy shock. The expected sign of monetary policy shocks on equity returns is negative, which is indicate that firm-level equity returns will decrease in response to a 100 basis point increase in policy rates. In addition, as mentioned before, the effect of monetary policy shocks is expected to be heterogeneous according to the firm sizes (small and large), by sub-sectors economic activity, and financially constrained and less-constrained firms.

3.3.3 Dynamic Panel Data

The firm-level equity returns in current year can also be explained by its past returns[37]. Some studies, for example, Jegadeesh (1990), Jegadeesh and Titman (1993), Grinblatt and Moskowitz (2004), and Wang et al. (2009) have discovered that past returns contain information about the current expected return. Therefore, the dynamic version of the augmented Fama and French (1992, 1996) multifactor model in equation (3.3) can be rewritten as follows:

$$r_{it} = \sum_{j=1}^{p} \alpha_j r_{i,t-j} + \beta_1' X_t + \beta_2' X_{it} + \delta_1' W_t + \eta_i + v_{it}$$

$$\text{for } i = 1,....,N \text{ and } t = 1,....,T \qquad (3.12)$$

where, r_{it} is the firm stock return (excess return) as the dependent variable, $r_{i,t-j}$ is the lagged dependent variable (past excess returns), X_t and X_{it} are weakly exogenous (endogenous) or predetermined variables, and W_t is the strictly exogenous variable. In addition, it is assumed that the error term $(\varepsilon_{it} = \eta_i + v_{it})$ follows a one-way error component model, where η_i is an unobserved firm-specific time-invariant effect which allows for heterogeneity in the means of the r_{it} series across individuals where $\eta_i \sim IID(0, \sigma_\eta^2)$, and v_{it} is the stochastic disturbance term which is assumed independent across individuals, where $v_{it} \sim IID(0, \sigma_v^2)$.

The inclusion of the lagged dependent variables in equation (3.12) implies that there is correlation between the regressors and the error term since the lag of firm excess returns $r_{i,t-1}$ depends on $\varepsilon_{i,t-1}$. The present of lagged dependent variables, show that OLS, fixed effects and random effects are biased and inconsistent for fixed T as N

[37] According to the weak form efficient market hypothesis (EMH), all past prices of a stock are reflected in today stock price. Therefore, the past return of the stock has also connected to the current stock return.

gets large. Hence, due to this correlation, the dynamic panel data estimation in equation (3.12) suffers from Nickell (1981) bias, which disappears only if T is large or approaches to infinity. In order to deal with the endogeneity issue, this study used the generalized method of moments (GMM) estimators which was developed by Anderson and Hsiao (1982), Arellano and Bond (1991), Arellano and Bover (1995), and recently extended by Blundell and Bond (1998). This estimator is designed for dataset with a large number of individual observations (N) over a limited number of time periods (T).

In equation (3.12), the lagged value of firm excess return, $r_{i,t-1}$ are correlated with the firm-specific effect (η_i). Arellano and Bover (1995) proposed a forward orthogonal deviation transformation or forward Helmert's procedure to eliminate the firm-specific effect. This transformation method essentially subtracts the mean of future observations available in the sample from the first $T-1$ observations and its main advantage is to preserve sample size in panels with gaps[38]. This procedure can be expressed as follows:

$$x_{it}^{*} = c_{it}\left[x_{i,t-1} - \frac{1}{T_{it}-t+1}\left(x_{it} + x_{i,t+1} + \ldots. + x_{iT}\right)\right] \tag{3.13}$$

where, T_{it} is the number of time-series observations on firm i and c_{it} is the scale factor, that is $\sqrt{\frac{T_{it}-t+1}{T_{it}-t+2}}$. This transformation has an important property, that is if x_{it} is serially correlated, then it is implied that $x_{i,t-1}$ will be uncorrelated with x_{it}^{*} for $s \geq 2$. This implies that if the error term ε_{it} in equation (3.12) is serially uncorrelated, lagged values of the untransformed dependent variable, and other explanatory variables dated $t-s$ will be uncorrelated with the transformed error term ε_{it}^{*} for $s \geq 2$. Therefore, this lagged value of the untransformed variable will be a valid instrument in the transformed model.

[38] According to Roodman (2009a), the first-difference transformation has some weakness, which is, if some explanatory variable (x_{it}) is missing, then both $\Delta x_{i,t}$ and $\Delta x_{i,t+1}$ are missing in the transformed data. However, under orthogonal deviations, the transformed $x_{i,t+1}$ need not go missing. Hayakawa (2009), using a Monte Carlo simulation study, that the GMM estimator of the model transformed by the forward orthogonal deviation tends to work better than when transformed by the first difference.

3.3.3.1 Instrument Choice

However, by transforming equation (3.12) using forward orthogonal deviation, a new bias is introduced, that is the correlation between the transformed error terms, and the transformed lagged dependent variable. Similarly, the transformed explanatory variables also potentially become endogenous because they are related to the transformed error term. In order for the estimation to be valid, three assumptions can be made regarding to the explanatory variables. First, an explanatory variable (X_{it}) can be a predetermined variable that is correlated with the past error or $E[X_{it}\varepsilon_{is}] \neq 0$ for $s < t$ but $E[X_{it}\varepsilon_{is}] = 0$ for all $s \geq t$. Second, an explanatory variable (X_{it}) can also be an endogenous variable, which is potentially correlated with the past and present error or $E[X_{it}\varepsilon_{is}] \neq 0$ for $s \leq t$ but $E[X_{it}\varepsilon_{is}] = 0$ for all $s > t$. Third, X_{it} is said to be strictly exogenous if $E[X_{it}\varepsilon_{is}] = 0$ for all t and s which is uncorrelated with either current, past or future error.

In this study, the lagged dependent variable $(r_{i,t-j})$, X_t variables [domestic market return (rm_t), small minus big (SMB_t) and high minus low (HML_t)], and X_{it} variables [all firm financial characteristics namely the ratio of book value to market value $(BVMV)$, real sales growth $(RSALESG)$, debt-equity ratio and liquidity ratio] are all assumed to be endogenous variables. Therefore, the set of moment conditions can be written as following:

$$E\left[r_{i,t-s}\left(\varepsilon_{it}^{*}\right)\right] = 0 \quad for \quad t = 3,....T; s \geq 2 \tag{3.14}$$

$$E\left[X_{t-s}\left(\varepsilon_{it}^{*}\right)\right] = 0 \quad for \quad t = 3,....T; s \geq 2 \tag{3.15}$$

$$E\left[X_{i,t-s}\left(\varepsilon_{it}^{*}\right)\right] = 0 \quad for \quad t = 3,....T; s \geq 2 \tag{3.16}$$

Monetary policy shocks (domestic and international) are assumed to be strictly exogenous. In addition, since the Malaysian stock market is an emerging market and a relatively small market that is vulnerable to the international stock market, the international stock return (ir_t) is also considered as a strictly exogenous variable. Therefore, the additional set of moment condition is:

$$E\left[W_{t-s}\left(\varepsilon_{it}^{*}\right)\right]=0 \quad for \quad t=1,2,3,4,...,T; s=0 \tag{3.17}$$

Where, W_t is a strictly exogenous variable (monetary policy shocks and international market return). Equation (3.17) indicates that the complete series of $W_t' = (W_{t1}, W_{t2}, ..., W_T)$ become valid instruments in each of the transformed equations. Equation (3.14)-(3.17) shows that the endogenous variables in the transformed equation will be instrumented with the lagged level of the regressors. The GMM estimator based on moment conditions in (3.14)-(3.17) is known as the difference GMM.

However, Alonso-Borrego and Arellano (1999) and Blundell and Bond (1998) show that if the lagged dependent and the explanatory variables are persistent over time or nearly a random walk, then lagged levels of these variables are weak instruments for the regression equation in differences. This happens either as the autoregressive parameter (α) approaches unity, or as the variance of the individual effects (η_i) increases relative to the variance of the idiosyncratic error (v_{it}). Hence, to decrease the potential bias and imprecision associated with the difference estimator, Blundell and Bond (1998) have proposed a system GMM approach by combining regressions in differences and in levels. In addition to the regression in differences, the instruments for the regression in levels are the lagged differences (transformed) of the corresponding instruments. Consequently, the extra moment conditions for the second part of the system, that is the regression in levels, can be written as follows:

$$E\left[r^{*}{}_{i,t-s}\left(\eta_i + v_{i,t}\right)\right]=0 \quad for \quad s=1; t=3,4,...T \tag{3.18}$$

$$E\left[X^{*}{}_{t-s}\left(\eta_i + v_{i,t}\right)\right]=0 \quad for \quad s=1; t=3,4,...T \tag{3.19}$$

$$E\left[X^{*}{}_{i,t-s}\left(\eta_i + v_{i,t}\right)\right]=0 \quad for \quad s=1; t=3,4,...T \tag{3.20}$$

$$E\left[W^{*}{}_{t-s}\left(\eta_i + v_{i,t}\right)\right]=0 \quad for \quad s=0; t=2,3,4,...T \tag{3.21}$$

By combining the set of moment conditions in the transformed equations (3.14)-(3.17) and in the levels equations (3.18)-(3.21), the system GMM can be constructed by stacking a system of $(T-2)$ transformed equations and $(T-2)$ untransformed equations, corresponding to periods $3,....,T$ for which instruments are observed.

However, as noted by Roodman (2009b), the system GMM can generate moment conditions prolifically. Too many instruments in a system GMM overfits endogenous variables even as it weakens the Hansen test of the instruments' joint validity. Therefore, this study has used two main techniques in limiting the number of instruments, namely; (i) use only certain lags instead of all available lags for instruments, and (ii) combine instruments through addition into smaller sets by collapsing the block of the instrument matrix. These two techniques have been proposed by Beck and Levine (2004), Calderon et al. (2002), Cardovic and Levine (2005) and Roodman (2009).

In addition, this study uses a one-step system GMM in the baseline multifactor model. However, for robustness checking, a two-step system GMM estimation has also been considered. As argued by Baltagi (2008), the parameters are asymptotically similar if the ε_{it} is $i.i.d$. However, Bond (2002) stated that a one-step result is to be preferred to two-step results. This is because his simulation studies have shown that the two-step estimator is less efficient when the asymptotic standard error tends to be too small or the asymptotic t-ratio tends to be too big. Therefore, Windmeijer (2005) has provided a bias correction for the standard errors in the two-step estimators. As noted by Windmeijer (2005), the two-step GMM performs somewhat better than the one-step GMM in estimating the coefficients, with lower bias and standard errors. In fact, the reported two-step standard errors with the correction are work well; therefore, the two-step estimation with corrected standard errors seems modestly superior to cluster robust one-step estimation.

The success of the GMM estimator in producing unbiased, consistent and efficient results is highly dependent on the adoption of appropriate instruments. Therefore, there are three specifications test as suggested by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). Firstly, Sargan or Hansen tests of over-identifying restrictions, which tests the overall validity of the instruments by analyzing the sample analogue of the moments conditions used in the estimation process. If the moment condition holds, then the instrument is valid and the model has been correctly specified. Secondly, the serial correlation tests, that is there is no serial correlation in the transformed error term. Finally, to test the validity of extra moments conditions on the system GMM, the difference in Hansen test is used. This test measures the difference between the Hansen statistic generated from the system GMM and the difference GMM. Failure to reject the three null hypotheses gives support to the estimated model.

3.3.4 Data Specification

The data set is observed at a yearly frequency collected from various sources. The year-end firm's stock prices, KLCI and SP500 Index are collected from the Bloomberg database; the year-end firm's financial characteristics, namely, book-value-market-value, sales, liquidity and financial leverage are collected from Thompson Financial DataStream. All data sets are spanning from 1990 to 2008.

This study has focused on the main board publicly listed companies in the Malaysian Bourse. Currently, there are 650 companies listed in the main board which cover various sub-sectors of economy activity such as plantations (agriculture), property, consumer products, industrial products, services, technology and financial services. However, not all of the firms have been considered in this study. The firm-level data has refined by deleting some firms such as the financial firms and firms that have a data set covering less than 5 years. Thus, only non-financial firms have been considered in estimating the determinants of firm-level equity return. There are three reasons for the exclusion of the financial firms in the sample. First, financial firms have large cash-flow but low fixed investment. Therefore, it is believed that their equity return is not much affected by the monetary policy shocks. Second, the financial firms are the main lenders to the non-financial firms. Therefore, during monetary contraction, their equity returns will not be much affected by monetary contraction as compared with non-financial firms. Third, the nature of their product is also different from non-financial firms. For example, the equity return of non-financial firms will be exposed to the monetary policy shock according to the interest-sensitivity of the product, capital intensity, and tradable goods industries. Therefore, after refining the data, there are 449 firms in the sample.

3.3.5 Detecting Outliers

In order to deal with the influential data points, two statistics are used, namely DFITS and DFBETA statistics as proposed by Belsley et al. (1980), and a later extended version by Belsley (1991). The DFITS measure is a scaled difference between the in-sample and out-of-sample predicted value for the j_{th} observations (Baum, 2006). It also evaluates the result of fitting the regression model including and excluding that observation. The DFITS statistics is computed as follows; $DFITS_j = r_j \sqrt{\frac{h_j}{1-h_j}}$, where r_j is a studentized (standardized) residual, which is $r_j = \frac{e_j}{s_{(j)}\sqrt{1-h_j}}$ with $s_{(j)}$ referring to the root mean squared error of the regression equation with the j_{th} observation removed, e_j is the residual, and h_j is the value of leverage[39]. Belsley et al. (1980) suggest that a cut-off value of $|DFITS_j| > 2\sqrt{\frac{k}{N}}$ indicates highly influential observations, therefore the firms have to be removed from the regression model. By using DFITS statistics, there are 88 firms out of 449 firms or 19 percent of the firm observations are removed from the sample. Finally, we have 361 firms in this study (see Appendix 3.1 for the detailed firm by sub-sector category).

There are two possible reasons to believe that using 361 non-financial firms in estimating the determinants of firm-level equity return can represent the full set of 650 listed companies. First, the 361 non-financial firms have comprised the major sub-sector of economy (see Appendix 3.1). Therefore, it is possible to investigate the heterogeneity of monetary policy effects across firm size, and by sub-sector of economy. Second, the ratio of market capitalization, sales, and asset for 361 non-financial firms as a percentage of total market capitalization, sales, and asset of 650 firms is 55.86 percent, 56.35 percent, and 57.87 percent, respectively. Since the ratio is above 50 percent, it is believed that 361 non-financial firms can be representative of the total firms listed on the stock market.

---

[39] The value of leverage (h_j) is computed from the diagonal elements of the 'hat matrix' as follows: $(h_j) = x_j (X'X)^{-1} x'_j$, where x_j is the jth row of the regressor matrix.

In addition to DFITS statistics, we can also detect the outliers on one regressor by using DFBETA statistics. The DFBETA for regressor ℓ measures the distance that this regression coefficient would shift when the j_{th} observation is included or excluded from the regression, scaled by the estimated standard error of the coefficient (Baum, 2006). The DFBETA statistics is computed as follows; $DFBETA_j = \frac{r_j v_j}{\sqrt{v^2(1-h_j)}}$, where the v_j are the residuals obtained from the partial regression of x_ℓ on the remaining columns of X, and v^2 is their sum of squares. Belsley et al. (1980) suggest a cut-off value of $\left|DFBETA_j\right| > 2\sqrt{N}$ for the highly influential observations.

3.3.6 Splitting the sample size

As argued earlier that there may be significant differences in the way that the monetary policy shocks affects firms' equity returns of different sizes (large and small firm), firms operating in different sub-sectors of the economy, and financially constrained and less-constrained firm.

The sample has been split into large and small firms in the following way. First, the share of market capitalization for each firm was computed by expressing the market capitalization for each firm as a percentage of total market capitalization in a particular year. Second, the average (mean) value of market capitalization share is computed for each firm over all years. Third, the median value of these averages is then computed to generate the threshold. The firm is considered large if the mean value of market capitalization share is greater than the median value, and small otherwise. According to this criterion, there are 180 firms in the large category, and 181 firms in the small category.

In addition, this study also examines the effect of monetary policy shocks on different sub-sectors of the economic activity. However, not all of the sub-sectors in the economy can be considered in estimating the dynamic multifactor model due to there being insufficient observations[40]. Therefore, this study only examines four sub-sectors of economic activity, namely industrial products, consumer products, property and the services sector.

The firm-level data have also been split into financially constrained and less-constrained firms. In doing so, the methodology proposed by Kaplan and Zingales (1997), Lamont et al.(2001) and Ehrman and Fratzscher (2004) is followed, which uses a direct measure of financial constraints, that is the cash flow to income ratio. The cash flow is measured as the sum of earning before income tax (EBIT) and depreciation. In order to segment the constrained and less constrained firms, first the average value of the cash flow to income ratio was computed for each firm over all years. Then, the median values of this ratio are computed to generate the threshold level. A firm is considered constrained if the mean value of cash flow to income ratio is less than the median value and considered less constrained otherwise. According to this criterion, there are 181 financially constrained firms and 180 financially less-constrained firms. The hypothesis to test is that firms with a lower ratio of cash flow to income are affected more by monetary policy because they are more bank-dependent and bank-dependent borrowers are hit more strongly by a change in the supply of credit.

[40] The standard rule of thumb to estimate dynamic panel data is large cross-section (N) observation which is at least 50 and short time series observation.

3.4 Empirical Results[41]

This section reports the estimation results of the dynamic augmented Fama and French (1992, 1996) multifactor model by using one-step system GMM estimation for the full-sample, and sub-sample analyses (large and small firms, sub-sectors, and financially constrained and less-constrained firms). For the robustness test, alternative estimation techniques namely two-step system GMM and difference GMM estimation (one and two-step estimation) were also considered. Particular focus is given to the effects of monetary policy shocks (domestic and international monetary policy) upon firm-level stock returns by examining the whole sample and sub-sample analyses.

3.4.1 Whole Sample

As can be seen in Table 3.1, for whole sample estimation, firm-level stock returns are statistically significantly influenced by the lagged dependent variable, domestic market returns, small minus big, international market returns, monetary policy shocks (domestic and international), and several firm financial characteristics variables namely the ratio of book value to market value (BVMV) and liquidity. The contemporaneous effect of domestic monetary policy shocks is negatively and statistically significant, at least at the 10 percent significance level in influencing the firm-level stock returns. A 100 basis point (one percentage point) increase in the domestic inter bank overnight rate (IBOR) leads to a decrease in firms' stock returns by 4.5 percent. The negative reaction of firms' stock returns to monetary policy tightening is also consistent with the standard economic theory prediction. There are two possible explanations of the negative response of firm-level stock returns to monetary policy tightening. First, monetary tightening leads to an increase in the interest rates at which firms' future cash flows are capitalised, causing stock prices to turn down. This is valid under two assumptions namely that the discount factors used by market participants are

[41] As a preliminary test, this study also estimated a simple model of the determinants of firm-level equity returns by using fewer control variables. Only three independent variables have been considered, namely, domestic market returns, domestic monetary policy shocks, and international monetary policy shocks. In the simple model, the determinants of firm-level equity returns have been estimated by using static panel data estimation (fixed, and random effects). In general, both monetary policy shocks (domestic, and international monetary policy) are negative, and statistically significant in influencing the firm-level equity returns. However, the response of firm-level equity returns to monetary policy shock is low. For example, a one percentage point increase in domestic monetary policy leads to a decrease in the firms equity return by less than 1 percent, whereas a one percentage point increase in international monetary policy leads to a decrease in the firms' equity returns by approximately 2 percent. (The full results are available upon request).

linked to the market interest rates, and the monetary authority is capable of controlling market interest rates. Second, monetary policy changes have an indirect effect on the firm's stock value by influencing market participants' expectation of future economic activity and thus altering expected future cash flows. For instance, a tight monetary policy is expected to contract the overall level of economic activity, and the stock price responds negatively because of lower expectations of cash flow in the future. This is because lower cash flow will be associated with lower dividends in the future, and consequently decreased stock prices and returns.

The effect of foreign monetary policy shocks on domestic firms' stock returns is significantly larger than domestic monetary policy shocks, which is a 100 basis point increase in FFR (international monetary policy) leads to a decrease in contemporaneous firm stock returns by 8 percent. The larger role of foreign monetary policy in transmitting to domestic stock return is reasonable given that the Malaysian stock market is an emerging market and relatively smaller than other markets, so is more vulnerable to an exogenous shock from a large country. The significant influence of US monetary policy supports the view that US monetary policy is a risk factor in global financial markets, therefore it can directly and immediately influence the domestic economy through financial markets.

The market returns (domestic and international market returns) are contemporaneously statistically significant in influencing the firms' stock returns, at least at the 1 percent significance level. A one percent increase in domestic market returns leads to an increase of 1.099 percent in firms' stock returns. This finding shows that the firms' stock return is an aggressive stock, because the stock price is more volatile than the market. In contrast, the effect of international return is smaller than domestic return, which is a one percentage increase in international market returns leads to an increase in firm-level equity returns of 0.297 percent. This finding clearly shows that the Malaysian stock market is also affected by international surroundings, in particular to developments in international stock markets.

Small minus big (SMB) is also statistically significant in influencing the firm-level stock returns, which is every 1 percent increase in SMB return leads to an increase in the firms' stock return by 0.963 percent. However, high minus low (HML) is not statistically significant.

The lagged dependent variable is also statistically, and positively significant in influencing the firm-level stock returns. This finding shows that the higher stock return in previous year tends to bring higher future returns in the current period. Market participants will use the historical return performance in order to make buying decisions. Therefore, a higher return in the previous year will encourage the investor to buy the stock in the present year. Since the demand for stock is increased, therefore the stock prices and returns also increase. The positive response of firm stock returns to lagged stock returns is also consistent with previous studies, for example, Jegadeesh and Titman (1993), Grinblatt and Moskowitz (2004), and Wang et al. (2009).

Several firm financial variables such as book-value-market-value (BVMV) and liquidity are also very important in influencing firms' stock returns. The coefficient of the ratio of BVMV is 0.137, which indicates that a one percent increase in the BVMV ratio leads to an increase in firms' stock returns by 0.137 percent. Firm liquidity also positively and significantly influences the returns, as a one percent increase in the liquidity ratio leads to an increase in the returns of 0.035 percent. The significance of these variables suggests that the firms have to maintain a better financial performance in order to attract the market participants in the stock market.

As stated before, the validity of the system GMM depends on the three specification tests namely the AR(2) test for serial correlation test, the Hansen test for testing the validity of instrument adopted and the difference in Hansen tests. As can be seen from Table 3.1 (column 1), the p-value for the AR (2) and Hansen tests are higher, that is statistically insignificant, at least at the ten percent significance level. This result implies that the empirical model has been correctly specified due to there being no serial correlation (autocorrelation) in the residuals; also the instruments used in the models are valid. In addition, the validity of additional moment conditions that is difference in Hansen tests are also statistically insignificant in all models.[42]

3.4.2 Heterogeneity effect of monetary policy: Sub-Sample Results

As noted before, there is a differential effect of monetary policy with respect to the firm size, sub-sectors of economic activity and financially constrained and less-constrained firm. This section provides detailed explanation for investigating the heterogeneity effects of monetary policy.

3.4.2.1 Large and Small Firm

The results of sub-sample analysis are reported in Table 3.1 in column 2 (large firm) and column 3 (small firm). According to the credit channel theory, the presence of an asymmetric information problem in the credit market causes firm-level equity returns behave differently in response to monetary policy shocks. As can be seen in Table 3.1 in column 2 (large firm), and column 3 (small firm), large firms' stock returns are not significantly affected by domestic monetary policy shocks, whereas, small firms' stock returns are significantly affected. The small firms' stock returns decrease by 8.7 percent in response to a 100 basis point increase in domestic monetary policy. As noted by credit channel theory, the large firms are less dependent on bank loans, therefore during monetary contraction they will not contract their business activity (for example, investment). This is because they are able to raise alternative funds through international money markets, and by issuing the private bonds. In contrast, small firms are more reliant on domestic bank credit; hence, contraction of monetary policy will reduce the demand for credit, and subsequently lead to a decline in the cash flow, sales and stock returns.

In comparison, international monetary policy shocks significantly influence the large firm equity returns, this is not the case for small firms' equity returns. A 100 basis point increase in US monetary policy is associated with a decline in the large firms' stock returns of 6.2 percent. Ehrmann and Fratzscher (2006) provide three plausible reasons for microeconomic effects on the individual firms equity return in response to

[42] The difference in Hansen test has not been reported in the Table 3.1 in order to save space. However, the results are available upon request.

US monetary policy shocks. First, firms' stock prices are affected through the financing costs from international financing. For instance, large firms are more reliant on obtaining some of their funds from foreign markets (for example from the US money market) and are exposed to two sources of risks, namely foreign interest rate and exchange rate risk. Therefore, an increase in US interest rates due to tightening of monetary policy would increase the financing cost and diminish the cash flow, which would subsequently decrease the investment level, firm sales and stock returns. Second, the stock price evaluation of firms with business links with the US is affected indirectly through the impact of US monetary policy on real economic activity in the US. Finally, for financial investors, a change in US interest rates is likely to trigger a portfolio rebalancing by investors (local, global investors or US). For example, an increase in US interest rates due to monetary tightening will stimulate capital outflows from domestic to foreign markets. The investors, in particular the fund managers, will liquidate domestic assets (for example, by selling their shares) and invest it in foreign-denominated assets such as bonds, money market instruments and bank deposits, because an investment in the foreign country is more profitable than in the domestic country. This action will reduce domestic stock returns because of the portfolio adjustment from the investors.

The market returns (domestic and international) are also statistically significant in influencing the firm level stock returns. However, the firm stock returns are more affected by domestic market returns than international market returns. The coefficient of domestic market return for large and small firm is greater than 1, which indicates that the firm-level stock returns are very sensitive to domestic risk. In contrast, the firms' stock returns are less sensitive to international risk, as the coefficients are 0.143 and 0.132 for the large firms and small firms, respectively.

Large firms' stock returns are only significantly influenced by real sales growth, whereas for the small firm, their returns are only statistically significantly influenced by book-value-market-value (BVMV). The other firm financial variables are statistically insignificant in influencing the returns. Therefore, the large firms have to maintain a strong sales growth, whereas for a small firm they have to maintain a strong book-value-market-value (BVMV) in order to signal to investors that they are doing well in managing their business. This finding seems to suggest that the BVMV and sales growth convey information to investors for stock valuation in Malaysia.

The AR(2) and Hansen test are insignificant, at least at the 10 percent significance level, which indicates that the specification tests such as serial correlation and over identifying restriction are valid for the small and large samples.

3.4.2.2 Sub-sectors of economic activity

Table 3.2 reports the effects of monetary policy shocks upon stock returns in sub-sectors of the economy. Four sub-sectors have been considered namely, consumer products, industrial products, property and services. As can be seen in Table 3.2, the effect of monetary policy upon equity returns varies across industries, as some industries are significantly affected by monetary policy shocks, whereas some industry are not. Domestic and international monetary policies are statistically insignificant in influencing the stock returns of firm in the consumer products and services sectors. In contrast, stock returns of firms in the industrial products sector are significantly affected by monetary policy shocks (domestic and international monetary policy). A one percentage point increase in domestic monetary policy leads to a decrease in industrial firms' stock returns by 3.2 percent. However, the effect of international monetary policy shocks upon industrial firm stock returns is larger than that of domestic monetary policy, as the stock returns declines by 9.1 percent in response to the shock. This suggests that the stock returns of firms in the industrial products sector are more sensitive to international monetary policy shocks than to domestic monetary policy. Ehrmann and Fratzscher (2004) have suggested that this is because the industrial products are tradable goods industry (open to trade or export-oriented industry), and capital-intensive industry, therefore very sensitive to the interest rates changes. International monetary policy shock is also statistically significant in influencing stock returns of firms in the property sector, whereas domestic monetary policy is not significant.

The domestic returns are also statistically significant in influencing sectoral stock returns, as the coefficient is greater than one for firms in all sub-sectors of the economy. This finding suggests that the sectoral stock returns are very sensitive to market returns, which indicates that domestic market returns may be seen as a main source of risk in explaining the firm equity return. However, the effect of international market returns is only significant in influencing the property firms' stock returns, whereas the other sub-sectors are not statistically influenced by international market returns.

Small minus big (SMB) is also statistically significant in influencing all sectoral firms' stock returns, with the most sensitive firms being those in the property sector. A one percent increase in SMB leads to an increase in the stock returns of firms in the property sector by 1.624 percent. However, HML is not statistically significant in influencing the stock returns in any sector except the industrial products sector, where the return is negatively related to the HML.

The returns for firms in the industrial products, property and services sector are not significantly affected by the firms' financial variables. However, real sales growth and financial leverage are statistically significant in influencing the stock returns for consumer products firms.

All specification tests in terms of AR(2) for serial correlation and the Hansen test are also statistically insignificant, at least at the 10 percent significance level, which indicates that there is no serial correlation and that the instruments adopted in the model are valid.

3.4.2.3 Financially constrained and less-constrained firms

The stock returns of financially constrained firms are likely to be more affected by changes in interest rates than less-constrained firms. This is because financially constrained firms have limited internal funds due to the credit constrains or inability to borrow, inability to issue equity, dependence on bank loan, or illiquidity of asset. Therefore, during the monetary tightening, they have to shrink their activity (for example, investment). A decrease in investment will also reduce the firms' sales, cash flow, and equity returns. Table 3.3 reports the effect of monetary policy shocks upon financially constrained and less-constrained firms. As can be seen in Table 3.3, the stock returns of financially constrained firms are more affected by monetary policy shocks. A 100 basis point increase in domestic interest rates leads to a decrease in the stock returns of financially constrained firms by 13.5 percent, whereas for less-constrained firms the stock returns decrease by 4.1 percent. Since financially constrained firms have no access to international money markets, their equity returns are not significantly affected by international monetary policy. In contrast, for less-constrained firms, they can access the international money market, and therefore their equity return will be affected by international monetary policy. In response to a one percent increase in international monetary policy, the stock returns for less-financially constrained firm decreases by 3.2 percent.

Table 3.1: Augmented Fama-French Multifactor Model: System GMM Estimation (one step estimation)

	whole sample			Large firm			Small firm		
Explanatory variables	coef.	Robust std. error	p-value	coef.	Robust std. error	p-value	coef.	Robust std. error	p-value
Lagged Dependent Variable									
$r_{i,t-1}$	0.032	0.042	0.445	0.076	0.036	0.036**	0.108	0.038	0.005***
$r_{i,t-2}$	0.043	0.018	0.015**	0.065	0.031	0.037**	0.161	0.038	0.000***
Domestic Market Return	1.099	0.049	0.000***	1.201	0.1556	0.000***	1.316	0.133	0.000***
Small Minus Big (SMB)	0.963	0.077	0.000***	0.603	0.204	0.003***	1.849	0.266	0.000***
High Minus Low (HML)	0.064	0.108	0.556	-0.027	0.299	0.928	-0.343	0.217	0.113
International Market Return	0.297	0.044	0.000***	0.143	0.060	0.018**	0.132	0.095	0.000***
Domestic Monetary Policy Shocks	-0.045	0.026	0.090*	-0.004	0.011	0.706	-0.087	0.051	0.091*
International Monetary Policy Shocks	-0.080	0.131	0.000***	-0.062	0.025	0.014**	-0.032	0.022	0.136
Book-Value-Market Value	0.137	0.023	0.000***	0.003	0.031	0.909	0.105	0.038	0.006***
Lagged of real sales growth	0.007	0.009	0.453	0.033	0.011	0.002***	0.002	0.006	0.798
Financial leverage	0.011	0.009	0.191	0.018	0.030	0.554	-0.011	0.017	0.521
Liquidity	0.035	0.015	0.026**	0.031	0.042	0.458	-0.036	0.032	0.256
Number of observations		2695			1297			952	
Observations per group		7.86			7.67			5.50	
Number of firms		343			169			173	
Number of instrument		274			105			97	
AR(2) –p-value		0.441			0.686			0.324	
Hansen test-p-value		0.203			0.153			0.318	

Note: *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Constant not included in order to save space.
The dependent variable is firm-level equity return (r_{it}) in terms of excess returns.
All *p-values* of the difference in Hansen tests of the exogeneity of the instruments subsets are also rejected at least at the 10 percent significant level, but not reported here. The full results are available upon request.
Instrument for orthogonal deviation equation:
Lags 2 to 4 for all endogenous variables and all lags for strictly exogenous variable (whole sample). Lags 2 to all available lags for all endogenous variables and all lags for strictly exogenous variable (large firm and small firm).

The estimation also collapses the columns of the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009b) except for the whole sample. Specifically, by collapsing, it creates one instrument for each variable and lag distance, rather than one for each time period, variable, and lag distance.

Table 3.2: Augmented Fama-French Multifactor Model by Sub-sector Economy: System GMM Estimation (one step estimation)

Explanatory variable	Consumer product			Industrial product			property			services		
	coef.	Robust std. error	p-value	coeff.	Robust std. error	p-value	coef.	Robust std. error	p-value	coeff.	Robust std. error	p-value
Lagged Dependent Variable												
$r_{i,t-1}$	0.088	0.063	0.160	0.086	0.036	0.018**	0.156	0.057	0.006***	0.008	0.084	0.919
$r_{i,t-2}$	-	-	-	-	-	-	0.174	0.050	0.000***	0.132	0.072	0.068*
Domestic Market Return	1.021	0.176	0.000***	1.318	0.116	0.000***	1.411	0.282	0.000***	1.187	0.166	0.000***
Small Minus Big (SMB)	0.957	0.288	0.001***	0.630	0.258	0.015**	1.624	0.310	0.000***	0.906	0.342	0.008***
High Minus Low (HML)	0.331	0.333	0.321	-1.163	0.312	0.000***	0.696	0.469	0.138	0.578	0.764	0.449
International Market Return	0.027	0.103	0.794	0.143	0.118	0.227	0.276	0.144	0.055*	0.050	0.136	0.717
Domestic Monetary Policy Shocks	-0.061	0.065	0.314	-0.032	0.012	0.008***	-0.064	0.083	0.444	-0.008	0.020	0.665
International Monetary Policy Shocks	-0.003	0.021	0.872	-0.091	0.025	0.000***	-0.073	0.041	0.081*	-0.002	0.009	0.849
Book-Value-Market Value	-0.014	0.024	0.558	0.000	0.026	1.000	0.009	0.051	0.859	-0.006	0.094	0.949
Lagged of Real sales growth	0.238	0.139	0.088*	-0.032	0.069	0.642	0.015	0.039	0.692	0.032	0.035	0.354
Financial leverage	-0.059	0.035	0.093*	0.013	0.028	0.635	0.012	0.030	0.700	0.103	0.089	0.249
Liquidity	-0.044	0.061	0.468	-0.033	0.048	0.497	0.022	0.058	0.712	0.034	0.054	0.535
Number of observations		362			546			398			567	
Observations per group		6.70			6.66			6.86			6.83	
Number of firms		54			82			58			83	
Number of instrument		28			44			28			36	
AR(2) –p-value		0.793			0.735			0.251			0.258	
Hansen test-p-value		0.610			0.135			0.125			0.520	

Note: *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Constant not included in order to save space.
The dependent variable is firm-level equity return (r_{it}) in terms of excess returns.

All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at 10 percent significant level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:
Lags 2 to 3 for all endogenous variables and all lags for strictly exogenous variable (for consumer product and property), lags 2 to 5 for all endogenous variables and all lags for strictly exogenous variable (for industrial product) and lags 2 to 4 for all endogenous variables and all lags for strictly exogenous variable (for services).

The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009b) for all sub-sector economy activity.

Table 3.3: Augmented Fama-French Multifactor Model by Financially constrained and less-constrained: System GMM Estimation (one step estimation)

	Financial constraint firm			Financial less-constraint firm		
Explanatory variable	coeff.	Robust std. error	p-value	coeff.	Robust std. error	p-value
Lagged Dependent Variable						
$r_{i,t-1}$	0.040	0.112	0.725	0.056	0.035	0.112
$r_{i,t-2}$	0.178	0.046	0.000***	0.051	0.039	0.195
Domestic Market Return	1.730	0.266	0.000***	1.554	0.180	0.000***
Small Minus Big (SMB)	2.573	0.645	0.000***	1.669	0.280	0.000***
High Minus Low (HML)	-0.171	0.283	0.547	0.026	0.254	0.919
International Market Return	0.168	0.149	0.260	0.147	0.089	0.099*
Domestic Monetary Policy Shocks	-0.135	0.062	0.031**	-0.041	0.013	0.002***
International Monetary Policy Shocks	-0.009	0.077	0.221	-0.032	0.016	0.051
Book-Value-Market Value	-0.019	0.044	0.664	-0.021	0.028	0.444
Lagged of Real sales growth	0.086	0.131	0.509	-0.021	0.104	0.837
Financial leverage	0.060	0.048	0.212	0.016	0.025	0.517
Liquidity	0.125	0.096	0.195	0.092	0.043	0.032**
Number of observations		1001			1169	
Observations per group		5.82			6.96	
Number of firms		172			168	
Number of instrument		28			28	
AR(2) –p-value		0.945			0.176	
Hansen test-p-value		0.672			0.500	

Note: *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Constant not included in order to save space.
The dependent variable is firm-level equity return (r_{it}) in terms of excess returns.
All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at 10 percent significant level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:
Lags 2 to 3 for all endogenous variables and all lags for strictly exogenous variable for financially constrained and less-constrained firm.

The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009b).

3.5 Robustness Checking

For robustness checking, the baseline model in equation (3.12) has been re-estimated with various strategies, namely by using two-step system GMM estimation, difference GMM (one-step and two-step estimation), various instrumental strategies (for example, using different assumptions about endogenous and pre-determined variables), and the combination of instruments with levels and differences equations. In general, the main results are robust, which are that monetary policy shocks (domestic and international) are statistically and negatively significant in influencing the firms stock returns. In fact, the effects of monetary policy shocks also vary according to firm size (large and small firm equity), by sub-sector and by financially constrained and less-constrained firms. Appendix 3.2-3.10 summarized the main results by using alternative estimation methods. However, the focus in this section is to examine the effect of monetary shocks upon firm-level equity returns by using two-step system GMM estimation and difference GMM (one-step and two-step estimation).

3.5.1 System GMM: two-step estimation

Appendix 3.2 reports the estimation results by using two-step system GMM estimation. In general, the results are consistent with the baseline results (one-step system GMM estimation). Monetary policy shocks (domestic and international monetary policy) are statistically and negatively significant in influencing the firm-level stock returns. The effect of domestic monetary policy varies between small and large firms, in that small firm equity returns have statistically significantly responded to monetary policy shocks, whereas large firms returns do not significantly respond. A 100 basis point increase in the domestic policy rate leads to a decrease in the small firms' equity returns of 8.0 percent. The effect of foreign monetary policy shocks on the firm-level stock returns is also heterogeneous, with the returns for large firms responding more than for small firms. A 100 basis point increase in US monetary policy leads to a decrease in the large firms' stock returns by 6.7 percent, whereas for the small firms returns decrease by 4.6 percent.

In Appendix 3.3, the effect of monetary policy shocks also vary by sub-sector of the economy. Several sub-sectors, for example, consumer products, property and services are statistically insignificantly influenced by domestic monetary policy shocks. However, the industrial firms' stock returns are statistically significantly influenced by domestic monetary policy shocks, with equity returns decreasing by 3.4 percent in response to a one per cent shock. The effect of international monetary policy shocks also varies by sub-sector, with only industrial products and property firms being significantly affected. The stock returns for industrial product and property decrease by 10.7 percent and 7.8 percent, respectively, in response to a one percentage point increase in US monetary policy. In Appendix 3.4, financially constrained firm respond significantly to domestic monetary policy shocks, but not to international monetary policy shocks. In contrast, financially less-constrained firm respond significantly to domestic and international monetary policy shocks. However, the effect of domestic monetary policy shocks on less-constrained firms' equity returns is smaller than for financially constrained firms.

All the specification tests, that is AR(2) and Hansen tests are also insignificant at least at the 10 percent significance level, which implies that there is no serial correlation among the residuals and that the instruments used in the two-step system GMM estimation are valid.

3.5.2 Difference GMM estimation

The results by using difference GMM estimation are reported in Appendix 3.5-Appendix 3.10. As can be seen in Appendix 3.5 (one-step estimation) and in Appendix 3.6 (two-step estimation) for the whole sample, monetary policy shocks (domestic and international) are statistically significant in influencing the firm-level equity returns. However, in one-step and two-step estimation, domestic monetary policy shocks are not significant in influencing the large and small firm equity returns. Conversely, in one-step and two-step estimation, the international monetary policy shock is statistically significant in influencing the large and small firms' stock returns. For example, in one step estimation, large firm and small firm equity returns decreased by 5.6 percent and 4.4 percent, respectively in responding to a positive innovation in US monetary policy.

In two-step estimation, the returns for large and small firms decrease by 5.8 percent and 6.4 percent, respectively.

In Appendix 3.7 (one-step estimation) and Appendix 3.8 (two-step estimation), the effects of monetary policy shocks on sub-sector economic activity are also heterogeneous. In one-step and two-step estimation, the equity returns in property and services sectors are not significantly affected by domestic and international monetary policy shocks. In contrast, the equity return in consumer products firms is statistically significantly influenced by domestic monetary policy shocks, whereas the equity return of industrial products firms is significantly affected by international monetary policy shocks. In Appendix 3.9 (one-step estimation) and Appendix 3.10 (two-step estimation), financially constrained firms' equity returns respond more to domestic monetary policy shocks than less-constrained firms. In comparison, less-constrained firms' equity returns respond more to international monetary policy shocks than financially constrained firms.

3.6 Summary and Conclusions

Although the effect of monetary policy shocks on stock market returns has been heavily studied at the macro level, so far less attention has been given to examining the impact of monetary policy shocks upon firm-level stock returns, particularly in an emerging market economy. Therefore, this paper extends the existing literature by providing new empirical evidence about the effect of monetary policy shocks (domestic and international monetary policy) on firm-level stock returns in an emerging market, with reference to the Malaysian stock market, using a dynamic panel data framework. An augmented Fama and French (1992, 1996) multifactor model has been used to estimate the determinants of firm-level stock returns by focusing on the heterogeneous effects of monetary policy shocks according to firm size (large and small firm equity returns), sub-sectors of the economy, and financially constrained and less-constrained firms. In addition, the role of international market returns and several firm financial characteristics variables have also been considered in estimating the determinants of firm-level stock returns.

The main findings can be summarized as followed; First, monetary policy shocks (domestic and international monetary policy) are statistically and negatively significant in influencing firm-level stock returns. In fact, the effect of domestic monetary policy shock varies in firms of different size. The equity returns of small firms are statistically significantly affected by monetary policy shocks, whereas this is not the case for large firms. Second, in general, firm-level stock returns have responded more to international monetary policy shocks than domestic monetary policy. The higher response of domestic stock returns in response to a US monetary policy shock is also consistent with previous studies, for example Conover et al. (1999) in 16 industrialised countries. International monetary policy shocks are also statistically significant in influencing large firms' stock returns, whereas small firms' stock returns are not significantly affected. Third, the effect of monetary policy shocks is also heterogeneous by firm's nature of the business (sub-sector). For example, domestic monetary policy shocks are only statistically significant in influencing the stock returns of firms in the industrial products sub-sector, whereas international monetary policy shocks are only statistically significant in influencing the stock returns of firms in the industrial products and property sectors. The other sectors are not significantly affected by monetary policy shocks. Finally, the equity returns of financially constrained firms are significantly more affected by domestic monetary policy than less-constrained firms. This finding suggests that the asymmetric response of individual firms to monetary policy shocks is influenced by the different degree of financial constraints.

This study has three important suggestions for policy. First, the domestic monetary authority should monitor the external environment, such as international stock markets and international monetary policy, in formulating their monetary policy. This is because the effect of international spill over to firm-level equity returns is also important, which suggests that foreign variables are a risk factor in domestic stock markets and can also influence the domestic economy through financial market variables. In the meantime, the domestic monetary authority should also observe the fluctuations and developments in the domestic stock market in order to take advantage of the stock market channel to the whole economy. From the perspective of practitioners or market participants, in particular investors, they should observe all relevant information in the market (internal or external information), in particular monetary policy changes, in formulating an effective investment strategy and minimizing the risk. From the firms' point of view, they should maintain sound financial performance and observe the international and domestic environment in order to stabilize their share prices.

4. MONETARY POLICY AND FIRM-LEVEL INVESTMENT IN MALAYSIA: DO THE INTEREST RATE AND BROAD CREDIT CHANNELS MATTER?

4.1 Introduction

A good understanding of the channels of monetary transmission mechanism is crucial to the monetary authority in evaluating the effectiveness of monetary policy, in particular to promote a sustainable growth, and price stability of the economy. Since the effectiveness of monetary policy depends on the responsiveness of the components of aggregate expenditure (for example, investment spending) to the interest rate changes, it is apparent that the monetary authorities must have a direct intervention on the interest rate. Indeed, since 1990s most of the central banks in many countries (including the BNM) realized the importance of the interest rate in the economy, and therefore have shifted their monetary policy strategy towards interest rate targeting as an operating targets.

Monetary policy has been commonly thought to influence firm investment spending through two main channels, that is through the interest rate and credit. First, the interest rate channel refers to the direct impact of interest rate changes through the user cost of capital on firms' investment activity. According to this channel, firms adjust their level of capital stock until the marginal productivity of capital equals the cost of funds given a perfect capital market. Second, changes in interest rates affect the net cash flow (i.e. cash flow after interest payments) available to a firm. Given imperfect capital markets due to information asymmetry, the availability of net cash flow will have a direct effect on investment. This mechanism is generally referred to as the 'broad credit channel' (Chatelain et al., 2003b). The existence of a credit channel would imply that monetary policy affects not only current interest rates, but also the size of the external finance premium through reduced current and expected future profits, lowering equity prices and hence collateral, which in turn amplifies the monetary policy effect on firms' investment. Therefore, under asymmetric information, the sensitivity of investment to cash flow should be different across firms. For instance, the effects on investment by small firms which have information problems are likely to be severe. This suggests that investment by small firms should be more sensitive to the cash flows than for large firms.

In examining the channels of monetary policy, the existing literature has mainly relied on using macro level data. However, the mechanism through which monetary policy influences the economy is still debatable. The previous literature has identified two main channels (the interest rate and credit channels) in the transmission of monetary policy to the real sector economy at macro level[43]. As argued by Chirinko et al. (1999) in their US study, studies at the aggregate level commonly fail to find an economically significant relationship between investment spending and the firm user cost of capital. This failure has been caused by biased estimates due to problems of simultaneity, capital market frictions, and firm heterogeneity that may better addressed with micro data. In addition, by using micro panel data it is also possible to measure firm-specific variables such as the user cost of capital, sales and cash flow in estimating the determinants of firm-level investment spending.

This paper explores the role of the monetary policy transmission mechanism on firms' investment spending through interest rates, and the broad credit channel by using disaggregated publicly listed companies' data set. For this purpose, the following research design has been employed in examining the relevance of both monetary policy channels. First, the interest rate channel of monetary policy is identified through the firm user cost of capital proposed by Chirinko et al. (1999), Mojon et al. (2002), and Chatelain et al. (2003b). Second, the broad credit channel of monetary policy is measured through the firms' liquidity, which is proxied by the cash flow to capital stock ratio. Third, the disaggregated firm-level investment function has been estimated using the dynamic neoclassical model, which links firm-level investment spending to firm

[43] For example, Bernanke and Gertler (1995) have identified two mechanisms through which the credit channel of monetary policy operates, namely, the balance sheet channel (BSC), and the bank-lending channel (BLC). The BSC emphasis the impact of changes in monetary policy on the borrower's balance sheet, whereas BLC focuses on the possible effect of monetary policy actions on the supply of loans by the banking system. The interest rates channel is also known as the money channel, and has been a standard feature in the traditional Keynesian model using the IS-LM framework.

sales growth, the cash flow to capital stock ratio (broad credit channel), and more importantly the growth of user cost of capital (interest rate channel). Fourth, the significant role of the interest rate and broad credit channels will be investigated by examining the elasticity of firm-level investment with respect to the user cost of capital growth and cash flow to capital stock ratio, respectively, in the short-run and long-run.

This paper contributes to the existing literature by extending the analysis of the transmission mechanism of monetary policy in several important aspects. First, this study provides new empirical evidence using micro level data in investigating the monetary policy transmission channel, namely, the interest rate and the broad credit channel in a small open emerging market economy, i.e. Malaysia. Second, by studying the effect of monetary policy on firm-level investment, the paper also investigates the relevance of the firm's balance sheet conditions in the monetary transmission mechanism. Third, this study contributes to the existing literature by estimating the determinants of firm investment using an augmented dynamic neoclassical model in an autoregressive distributed lagged (ARDL) model. Using the neoclassical model allows us to link the firm-level investment spending to the growth of user cost of capital (interest rate channel), cash flow to capital stock ratio (broad credit channel), and sales growth. Fourth, this study investigates the heterogeneous effects of monetary policy by splitting the sample according to firm size, and by sub-sectors in the economy. By understanding the differential monetary policy effects, the monetary authority can make an accurate assessment about the overall economic effects of policy transmission process. Finally, this study uses the panel data technique, that is the generalized method of moment (GMM) proposed by Arellano and Bond (1991), Arellano and Bover (1995), and recently extended by Blundell and Bond (1998). This technique has an advantage for addressing the Nickell (1981) bias associated with the fixed effects in short panels (for example, bias due to the presence of the lagged dependent variable and bias due to the endogeneity of other explanatory variables).

Several interesting features have emerged from this study. First, this paper shows that the monetary policy transmission mechanism works through both interest rate and broad credit channels in influencing firms' investment spending in the

Malaysian economy. Second, monetary policy has heterogeneous effects in respect of firm size and sub-sectors of the economy. Third, the role of the interest rates channel is low relative to that sales growth in influencing the firm-level investment spending. For example, in the long run, the elasticity of firm investment with respect to the user cost of capital growth is less than -0.10 for the whole sample, and sub-sample (by firm size). However, in the long run, the coefficient user cost of capital growth is greater than -0.10 for the consumer and industrial product[44]. Finally, since the firm-level investment is less sensitive to the interest rate channel, monetary policy has a modest effect in stimulating national income via investment spending.

The rest of the paper is structured as follows. Section 4.2 provides the literature review about firm investment, and the channel of monetary transmission. Section 4.3 describes the theoretical framework, and section 4.4 explains the econometric framework. Section 4.5 presents the empirical results and robustness checking, and finally section 4.6 summarises and concludes.

4.2 Review of the Literature

Most of the literature on transmission mechanism of monetary policy has focused on the macro level in investigating the main channel of the monetary policy transmission mechanism[45]. However, there are a few studies that have examined the transmission mechanism of monetary policy by using firm-level data (disaggregated data set), in particular to investigate the relevance of the two main channels of monetary transmission on firm balance sheet variables such as investment spending.

[44] Chirinko et al. (1999) have found that the elasticity of the user cost of capital ranges from -0.06 to -0.56 by using a difference specification and econometric technique. In contrast, Mojon et al. (2002) have found the elasticity of user cost of capital ranging from -0.5 to -1 in the Euro area.

[45] An excellent literature survey about the monetary transmission mechanism can be found in Egert and MacDonald (2009).

Most of the empirical studies at micro-level[46], for example Mairesse et al. (1999), Chirinko et al. (1999), Chatelain et al. (2003b), and Bond et al. (2003) have used a neoclassical demand for capital framework in investigating the determinants of firm-level investment spending. A dynamic neoclassical model has been estimated using an autoregressive distributed lagged (ARDL) model, which relates investment spending to current and lagged values of the user cost of capital, sales and other factors (for example, cash flow). There are two possible strategies for estimating the neoclassical investment model in an ARDL model. One approach is to transform the ARDL model into an error correction model (for example, Mairesse et al., 1999 and Bond et al., 2003). The second strategy works by first differencing the ARDL model (for example, Chirinko et al., 1999 and Chatelain et al., 2003b). According to the neoclassical model, the firm investment is positively connected with firm output growth (sales growth), and negatively related with firm user cost of capital growth. Using the neoclassical model also permits an investigation of the role of the interest rate channel through the user cost of capital, and the broad-credit channel through the cash flow to capital stock ratio. For example, a series of studies organized by the European Central Bank (ECB) (Angeloni et al., 2001) have estimated the dynamic neoclassical investment model by using a first differencing ARDL model, and found the existence of the interest rate and broad credit channels in affecting firm-level investment in the Euro area[47].

Chirinko et al. (1999) in their US study have examined the responsiveness of business capital formation to the user cost of capital, sales and cash flow to capital stock ratio. They have estimated ARDL (6,4,4) which is six lags for user cost of capital and four lags for sales and cash flow capital ratio. The empirical finding stated that the user cost of capital is negative and significant, whereas sales and cash flow to capital stock ratio are positive and significant in influencing firm-level investment in the short-run.

[46] Excellent reviews of modeling strategies, empirical results and policy implications relating to business fixed investment can be found in Chirinko (1993), Bond and Reenen (1999), and Mairesse et al. (1999).

[47] For example, Kalckreuth (2003) in Germany; Chatelain and Tiomo (2003) in France; Gaiotti and Generale (2003) in Italy; Butzen et al. (2003) in Belgium; Valderrama (2003) in Austria, and Lunnemann and Matha (2003) in Luxembourg. All studies have found that the interest rate channel is relevant in transmitting to firm-level investment spending. In addition, the internal funds (cash flow capital ratio) are a crucial determinant of firms' investment, with the effect being stronger for the financially constrained firms (small firms).

However, the effect of the user cost of capital on capital expenditure is modest, which implied a modest effect of interest rates on investment and that the traditional monetary transmission mechanism is relatively weak.

Chatelain et al. (2003b) have also supported the relevance of the two monetary policy channels in transmitting to firm-level investment in the Euro area. Specifically, with the cash flow to capital stock ratio in the investment model, they find that the user cost of capital has a significant long-run effect upon firm investment in Germany, Italy, Belgium and Luxembourg, but no significant effect in France, Spain and Austria. The point estimate of the long-run elasticity of capital stock with respect to user cost of capital is in the range of -0.03 to -0.52. This means that a one percentage point increase in the user cost of capital growth (which is influenced by monetary policy) in the Euro area lead to a decrease in the range of -0.03 to -0.52 percentage point in firm investment spending. This finding suggests that monetary policy plays a significance role on corporate investment through the interest rates channel. The cash flow to capital stock ratio as a proxy for broad credit channel is also statistically significant in influencing the firm investment in all countries except Luxembourg. The point estimate of the long run elasticity of capital stock with respect to cash flow to capital stock ratio is in the range of 0.08 to 0.30. This indicated that a one percentage point increase in cash flow to capital stock ratio lead to an increase the investment spending in the range of 0.08 to 0.30 percentage point. The effect of cash flow to capital stock ratio to the firm investment spending is also heterogeneous by firm characteristics. For instance, in France and Germany, firms with poor credit ratings show higher cash-flow sensitivity. In Italy and Belgium, small firms are more sensitive to cash flow. Small services firms in Belgium and equipment manufacturers in France have found to be more sensitive to the cash flow. This finding indicated that internal funds (cash flow) are a crucial determinant of firms' investment in Euro area, which is the effect is stronger for the firms that are more likely to face financial constraints. Therefore, the broad credit channel is operative in the Euro area.

Another study by Mojon et al. (2002) has examined the effects of the interest rate channel and sales on firm investment in the Euro area by using an error correction framework in the dynamic neoclassical model. By identifying the interest rate channel using the user cost of capital, they also found a significant negative effect of the user cost of capital upon firms' investment spending in Germany, France, Italy and Spain. In the short run, the effect of the user cost of capital on firm-level investment is substantial with the elasticity ranging from -0.23 (in Italy) to -0.69 (in Spain). This means that a one percentage point change in the user cost of capital growth (which is affected by interest rates) lead to a decrease the firm investment spending by 0.23 percentage point in Italy, and 0.69 percentage point in Spain. In the long run, the elasticity of capital with respect to the user cost of capital is ranging from -0.15 (in Germany) to -0.88 (in France). This finding indicated that the interest rate channel of monetary policy is operative in the Euro area. Additionally, although the average interest rate on debt is generally higher for small firms than for large firms, there is no evidence that the effects of the interest rate channel on small firms' investment are stronger than for large firms.

In Japan, Nagahata and Sekine (2005) have examined the effect of monetary policy on firm investment after the collapse of asset price bubble. They have estimated the accelerator-type of firm-level investment functions augmented with variables relating to the firm balance-sheet conditions (for example, debt-asset ratio and the adjusted capital adequacy ratio)[48] in a first differenced autoregressive distributed lag (ARDL) model, and error correction model (ECM). The empirical findings stated that monetary policy in Japan worked through the interest rate channel; however, the effect of monetary policy through the credit channel was blocked due to the weakening in the Japanese firms' balance sheet. By using an ECM framework for the sample of all industries, the sum of coefficients on the change in user cost of capital is -0.13 for the bond-issuing firms, and -0.16 for the non-bond issuing firms. This finding stated that, the investment by non-bond issuing firms is more affected by monetary policy through interest rates channel than bond-issuing firms. However, the effect of cash flow to capital stock ratio is not significant in influencing firm investment. This indicated that a

[48] The adjusted capital adequacy ratio is calculated as follows:
(Shareholders' equity + capital gains/losses from securities + Loan-loss provisioning – Risk management asset – Deferred tax assets) /Total assets.

broad credit channel is not operative in transmitting to firm-level investment spending. Besides user cost of capital and cash flow, the firm balance sheet condition, namely the debt-asset ratio, and the main bank balance sheet condition proxies by the adjusted capital adequacy ratio are also considered in estimating the investment spending. The debt asset-ratio is negatively statistically significant in influencing the firm investment, and the coefficient is quite similar for the non-bond issuing firms and bond-issuing firms in the manufacturing sector. The weakening in the main bank balance sheet conditions (the adjusted capital adequacy ratio) hindered investment more severely for the smaller non-bond issuing firms as compared to the larger bond-issuing firms. The significant of the debt-asset ratio and the adjusted capital adequacy ratio in influencing the firm investment spending have indicated that the credit channel had been blocked because of the deterioration in the balance sheet conditions (an increase in debt-asset ratio, and a decrease in the adjusted capital adequacy ratio).

A recent study by Guariglia and Mateut (2006) has examined the credit and trade credit channel on inventory investment in the UK manufacturing firms. By estimating the error correction inventory investment equations augmented with the coverage ratio[49] and trade credit (for example, accounts payable)[50] to assets ratio, they found that both the credit and the trade credit channel operate in the UK, which suggests that the trade credit channel tends to dilute the role of the traditional credit channel. As a result, if firms also have access to the trade credit, they can avoid the external financing constraint in the period of monetary tightening by increasing trade credit as an alternative to the bank and market financing.

Only a limited number of studies have investigated the channels of the monetary policy transmission mechanism in the context of a small open economy using micro level data. For example, Agung (2000) has estimated the firm investment model in Indonesia by using Tobin's-q and an Euler equation investment model, and found evidence of the existence of financial constraints and agency costs for the listed firms in

[49] The coverage ratio is defined as the ratio between the firm's total profits before tax and before interest and its total interest payments.
[50] Trade credit is short-term loans provided by suppliers to their customers upon purchase of their product

raising external funds. This study also indirectly supports the existence of the broad credit channel of monetary policy in Indonesia. Therefore, the response of real sector activity (investment) to monetary policy in Indonesia depends on three factors, namely, the financial structures of firm, the segmentation of the financial market between large and small firms and the degree of financial or credit friction in the credit or capital market. Another study by Rungsomboon (2005) using Tobin's-q investment model has supported the existence of the balance sheet channel in Thailand and also found that the firms have faced greater liquidity constraints due to the financial crisis. In addition, small firms and non-bond-issuing firms are found to have been more adversely affected by the financial crisis than large and bond-issuing firms. However, Agung (2000) and Rungsomboon (2005) do not take into account the role of the interest rate channel (user cost of capital) in their investment model. As noted before, the interest rate channel plays a vital role in influencing firms' investment spending in Japan and the Euro area.

In the Malaysian context, the few studies that have been undertaken relating to issues of the monetary policy transmission mechanism have focused on macro level data (for example, Azali (1998), Azali and Matthews (1999), Ibrahim (2005) and Tang (2006)). In fact, no previous studies in Malaysia have examined the effect of monetary policy on investment. A recent study by Ang (2009) has examined the effects of three financial policies (interest rate restraints, directed credit programmes, and reserve and liquidity requirements) on private investment in Malaysia at the macro level. The interest rates restraint is measured by collecting six series of interest rates repressionist policies imposed on Malaysian financial system. These include a maximum lending rate for priority sectors, a policy intervention rate, a minimum lending rate, a maximum lending rate, a minimum deposit, and a maximum deposit rate. These policy controls are translated into dummy variable that take the value of 1 if a control is present, and 0 otherwise. The directed credit program is measured by the priority sector targeting lending rate of the native Malay community. The reserve and liquidity requirement is measured by the sum of the cash liquidity ratio, and the statutory reserve requirement. By estimating the neoclassical investment model in a time series ARDL model, he found that interest rate restraints appear to have a positive and statistically significant effect on private investment. This means that by controlling the interest rate, the BNM can stimulate the capital formation in the private sector. In addition, the directed credit programmes has a negative and significant effect on private sector capital formation, whereas, higher reserves and liquidity tend to encourage private investment.

To the author's best knowledge, so far there is no empirical study that has investigated the transmission mechanism of the monetary policy at the micro level, in particular examining the role of interest rates and the broad credit channel in transmitting to the firm-level fixed investment spending in a small open economy such as Malaysia. In addition, there is also no empirical study in Malaysia that has examined the heterogeneity effects of monetary policy channel by firm size (small and large firm) or by sub-sector. Therefore, based on this backdrop, this study makes a novel contribution to the existing literature by exploring the issue of the monetary policy transmission mechanism via interest rates and the broad credit channel upon investment spending by using a disaggregated firm-level data set.

4.3 The Theoretical Framework

4.3.1 Neoclassical Investment Model

According to the neoclassical theory, the demand for capital is derived from the firm's production function[51]. It links the firm-level investment spending to sales and, more importantly, the user cost of capital. Therefore, the role of interest rate channel in monetary policy transmission mechanism can be examined by checking the expected sign of the user cost of capital in the neoclassical investment model.

Assuming a constant elasticity of substitution (CES), the neoclassical production function can be parameterised as;

$$F\ \left(L_{it,} K_{it}\right) = TFP_i A_t \left[\beta_i L_{it}^{\frac{\sigma-1}{\sigma}} + \alpha_i K_{it}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}\upsilon} \quad , \ \alpha_i + \beta_i = 1 \qquad (4.1)$$

[51] The detailed derivation of neoclassical demand for capital is provided in Appendix 4.1.

Where, σ is the elasticity of substitution between capital (K) and labour (L), υ represents returns to scale, and $TFP_i A_t$ is total factor productivity. The first-order condition for a firm's optimisation problem leads to the equality between the marginal product of capital (F_K), and the user cost of capital (UC_{it}) as follows;

$$F_K(L_{it}, K_{it}) = UC_{it} \tag{4.2}$$

By substituting the marginal productivity of capital in equation (4.2) into the production function in equation (4.1), the first order conditions of firm profit maximization are;

$$\log K_{it} = \theta \log Y_{it} - \sigma \log UC_{it} + \log H_{it}$$

or

$$k_{it} = \theta y_{it} - \sigma uc_{it} + h_{it} \tag{4.3}$$

Where, k_{it} is log of capital stock, y_{it} is log of sales, uc_{it} is log of user cost of capital, $h_{it} = \log\left[(TFP_i A_t)^{\frac{\sigma-1}{\upsilon}} (\upsilon\alpha_i)^{\sigma}\right]$ is log of total factor productivity, and $\theta = \left(\sigma + \frac{1-\sigma}{\upsilon}\right)$. The total factor productivity is assumed to have two components; firm-specific variables (TFP_i), and year-specific variable (A_t). Equation (4.3) states that the stock of capital (k_{it}) firm i at time t is determined by three factors: firm output or sales (y_{it}), firm user cost of capital (uc_{it}), and total factor productivity (h_{it})[52]. In the long run, it is assumed that the firm changes its capital stock in the direction of a long-run target value of k^* as follows;

$$k_{it}^* = \theta y_{it} - \sigma uc_{it} + h_{it} \tag{4.4}$$

However, the long run target value of k^* is not observable in empirical estimation. Therefore, in order to estimate equation (4.4), a new specification in terms of an autoregressive distributed lag model (ARDL) is used in this study. The dynamic neoclassical investment model has been estimated by Chirinko et al. (1999), Mairesse et al. (1999), Mojon et al. (2002), Chatelain et al. (2003b), Bond et al. (2003), and

[52] The elasticity of capital to sales is unity $(\theta = 1)$, if the production function has constant returns to scale $(\upsilon = 1)$, or if the elasticity of substitution is unity $(\sigma = 1)$, that is in the Cobb-Douglas function.

Nagahata and Sekine (2005)[53]. In this study, the dynamic neoclassical investment model in $ARDL(2,2)$ can be written as follows[54];

$$k_{it} = \alpha_1 k_{i,t-1} + \alpha_2 k_{i,t-2} + \theta_0 y_{it} + \theta_1 y_{i,t-1} + \theta_2 y_{i,t-2} + \sigma_0 uc_{it} + \sigma_1 uc_{i,t-1} + \sigma_2 uc_{i,t-2} + \phi_0 h_{it} + \phi_1 h_{i,t-1} + \phi_2 h_{i,t-2} \tag{4.5}$$

In order to transform equation (4.5) into a neoclassical investment model, Chirinko et al. (1999) and Chatelain et al. (2003b) proposed a first differenced ARDL model, and using the approximation of capital stock, $k_t - k_{t-1} = \frac{I_t}{K_{t-1}} - \delta$[55]. The $t-1$ subscript on the capital stock (K_{t-1}) indicates that it is measured at the beginning of each accounting year (Chirinko et al. (1999)). In addition, replacing year-specific productivity growth $(\Delta \log A_t)$ by time dummies (λ_t), a firm-specific effect productivity growth $(\Delta \log TFP_i)$ by firm-specific effects (η_i), and adding a random term υ_{it}, yields;

$$\left(\frac{I_{it}}{K_{i,t-1}}\right) = \alpha_1\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \alpha_2\left(\frac{I_{i,t-2}}{K_{i,t-3}}\right) + \theta_0 \Delta y_{it} + \theta_1 \Delta y_{i,t-1} + \theta_2 \Delta y_{i,t-2} + \sigma_0 \Delta uc_{it} + \sigma_1 \Delta uc_{i,t-1} + \sigma_2 \Delta uc_{i,t-2} + \lambda_t + \eta_i + \upsilon_{it} \tag{4.6}$$

Equation (4.6) states that the firm investment spending is expressed in term of investment ratio $\left(\frac{I_{it}}{K_{i,t-1}}\right)$ which is equivalence to the net growth in capital stock (Δk_{it}). The investment spending is determined by the lagged dependent variable, the sales growth (Δy_{it}), and the growth of user cost of capital (Δuc_{it}). The inclusion of the lagged dependent variable attempts to capture the effects of delays in the installation of capital goods, expectation buildings, and investment decisions.

---

[53]For example, Mairesse et al. (1999) consider an ARDL (2,2) but do not include the user cost of capital, whereas Chatelain et al. (2003b) consider an ARDL (3,3) and include the user cost of capital in the investment model.

[54] In principle, we can estimate ARDL model with more than two lags, however this leads to a degree of freedom loss in estimation.

[55] $\Delta k_{it} = \log\left[\frac{K_{it}}{K_{i,t-1}}\right] = \log\left[1 + \frac{\Delta K_{it}}{K_{i,t-1}}\right] \cong \frac{\Delta K_{it}}{K_{i,t-1}} \cong \frac{I_{it}}{K_{i,t-1}} - \delta$, where Δk_{it} is the net growth in capital stock (K), δ is the average depreciation rate and I_{it} is the investment of firm i in year t.

4.3.2 User Cost of Capital (UC)

According to the neoclassical model, monetary policy through a change in interest rate will alter the user cost of capital. For example, monetary policy tightening through an increase in interest rate will increase the firm user cost of capital. Therefore, the relevance of the traditional interest rates channel in monetary policy transmission mechanism can be examined through the firm user cost of capital. Most of the previous studies have derived the firm user cost of capital by using the Hall and Jorgenson (1967) approach. Following Mojon et al. (2002), and Chatelain et al. (2003b), the firm user cost of capital (UC_{it}) based on the accounting proportions of debt and equity can be expressed as follows;

$$UC_{it} = \frac{P_{st}^{I}}{P_{st}} \frac{(1 - itc_t - \tau_t z_s)}{(1 - \tau_t)} \left[AI_{it} \left(\frac{D_{it}}{D_{it} + E_{it}} \right) (1 - \tau_t) + (LD_t) \left(\frac{E_{it}}{D_{it} + E_{it}} \right) - (1 - \delta_s) \frac{\Delta P_{st+1}^{I}}{P_{st}^{I}} + \delta_s \right] \tag{4.7}$$

Where, s is the sector-specific index, p_{st} the price of final goods, p_{st}^{I} is the price of capital goods of sector s, τ_t the corporate income tax rate, z the present value of depreciation allowances per unit of investment[56], and itc is an investment tax credit. In Malaysia, the investment tax allowance (ITA) or tax credit is 60 percent on its qualifying capital expenditure (such as factory, plant machinery or other equipment used for the approved project) incurred within five years from the date the first qualifying capital expenditure is incurred[57]. AI is the apparent interest rate, measured as interest payment (interest expense) over gross debt for each firm, LD the long-term debt rate used as a proxy for the opportunity cost of equity, E is the book value of equity, D the book value of debt, and δ_s is the industry-specific rate of economic depreciation.

[56] The present value of depreciation allowance is computed as $\frac{a_{i,t}}{(1 + r_t)}$, where a_i is the depreciation in each year as a percentage of capital, and r is the interest rate.

[57] In Malaysia, tax incentives are provided for in the Promotion of Investment Act 1986, Income Tax Act 1967, Custom Act 1967, Sales Tax Act 1972, Excise Act 1976 and Free Zones Act 1990. These Acts cover investments in the manufacturing, agriculture, tourism (including hotel) and approved services sectors as well as R &D.

However, it is very difficult to verify the price of capital goods (p_{st}^{I}), and the price of final goods (p_{st}) in Malaysian firm level data. Therefore, the price index of machinery and transport equipment has been used as a proxy for the price of capital goods. The selection of this variable is appropriate because machinery and transport equipment is an important sector in constructing the Producer Price Index, with a weighting of 50.49 percent. The Consumer Price Index (CPI) is used as a proxy for the price of final goods. The selection of CPI as the price of final goods is appropriate because it measures the average price of a fixed basket of goods and services that represents the expenditure pattern of final users (households). In fact, in Malaysia the CPI is constructed by taking into account the major final products such as food, beverages and tobacco, clothing and footwear, gross rent, fuel and power, furniture and household equipment, medical care and health expenses, transport and communications and recreation, entertainment, education and cultural services.

However, there are some limitations in using the user cost of capital as a proxy for monetary policy. First, the user cost of capital cannot explain directly how a monetary policy change (for example, a change in interest rates policy) affects the firm's investment decision. Therefore, it cannot explain the standard monetary policy experiment; for example, how the growth rates of the capital stock change in response to a one percentage point rise in the policy interest rates. Second, using the firm apparent interest rates as a proxy for monetary policy changes may be inappropriate, because monetary policy is not the only factor influencing the firm's interest rates payment. For example, in the financial market, the firm can also borrow from international market (foreign debt), or from the bond market by issuing their debt securities. This indicates that the interest rates payment is not only determined by monetary policy, but also by all aspects of interest bearing, and capitalised lease obligations.

4.3.3 Monetary policy and firm apparent interest rates

In equation (4.7), the firm apparent interest rates (AI) is positively related to the firm user cost of capital (UC_{it}). This means that, an increase in the apparent interest rates leads to an increase in the user cost of capital. Therefore, monetary policy variable is believed to affect the user cost of capital through the apparent interest rates. The firm apparent interest rates is also a proxy for the expected market interest rate, which is what firms need to pay on new loans (Mojon et al., 2002). Following Mojon et al. (2002), in order to link the effect of monetary policy variables on the firm apparent interest rate (AI), this following regression model has to be estimated;

$$\Delta AI_{it} = \alpha_0 + \alpha_1 AI_{i,t-1} + \alpha_2 \Delta r_t + \alpha_3 r_{t-1} + \varepsilon_{it} \qquad (4.8)$$

where, r_t is the short term (inter bank overnight rate) or long-term (10 years Malaysian Government Securities) nominal interest rate, and $AI_{i,t}$ is the interest rate paid on debt by firm i at time t. Specifically, equation (4.8) can explain the sensitivity of the industry-specific nominal interest rates on debt to changes in monetary policy variables that is short and long-term interest rates.

4.3.4 Monetary policy, financial constraints, and broad credit channel

Besides the traditional interest rate channel, monetary policy can also influence firm-level investment spending through the broad credit channel. According to the broad credit channel theory, the credit market imperfections are not limited to the market for bank loans but also connected to all credit markets in the economy such as bond and equity markets[58]. The problem of asymmetric information between borrowers (for example, firms), and the lenders (banks) in the credit market will create a wedge between internal and external financing, that is, the firm faces a different interest rate depending on its risk premium. This wedge arises because of agency costs associated with information asymmetries, and the ability of lenders to monitor borrowers costlessly.

[58] The credit market imperfection emphasize the effects of imperfect information on the relationship between borrowers and lenders, which can be explained by four models, namely, an adverse selection, moral hazard, monitoring cost and agency cost. According to these models, the effect of monetary policy is heterogeneous among borrowers, such that some borrowers may be more vulnerable to changes in credit conditions than others.

As a result, cash flow and net worth become important in affecting the cost, availability of finance, and the level of investment spending (Walsh, 2003). Bernanke et al. (1996) list three empirical implications of the broad credit channel. First, external finance is more expensive for borrowers than internal finance. Second, because the cost differential between internal and external finance arises from agency costs[59], the gap should depend inversely on the borrower's net worth. For example, a fall in net worth raises the costs of external finance. Third, adverse shocks to net worth should reduce borrowers' access to finance, thereby reducing their investment, employment, and production.

Under the broad credit channel, agency costs increase during recessions and in response to the tightening of monetary policy. For example, monetary policy tightening (an increase in interest rates) lowers asset values and the value of collateral, increasing the cost of external funds relative to internal funds. Since agency problems are likely to be more severe for small firms than large firms, the linkage between internal sources of funds and investment spending should be particularly strong for small firms after monetary contractions. In contrast, agency costs are usually assumed to be smaller for large firms because of the economies of scale in collecting and processing information about their situation. As a result, large firms can more easily finance directly from the financial market and are less dependent on banks. For example, Gertler and Gilchrist (1994) argued that small manufacturing firms in the US economy are more sensitive than large firms in response to the tightening of monetary policy over the business cycle. Small firms account for a highly disproportionate share of declines in sales, inventories and short-term debt following monetary tightening. They argued that the small firms are likely to face larger barriers to outside finance than large firms because asymmetric information creates agency problems between the small firms and banks.

Most of the empirical studies have linked the broad credit channel with the firm financial constraints, which is proxied by cash flow. Fazzari et al. (1988), and several other recent empirical studies of fixed-investment find that smaller firms are more

[59] In the credit markets, the lender delegates to a borrower control over resources. Therefore, the inability to monitor the borrower's actions or to share the borrower's information gives rise to agency costs.

likely to be financially constrained. Therefore the investment by small firms may be sensitive to the cash flow or net worth if the agency cost associated with imperfect information or costly monitoring create a wedge between the cost of internal and external finance. For example, Gertler (1988) and Bernanke and Gertler (1989) have emphasized the role of agency costs, that make external financing sources more expensive for firms than internal sources. Gertler (1988) argued that financial constraints are likely to have more impact on the real decisions of individual borrowers and small firms than large firms. Small firms in particular may have difficulty obtaining funding from non bank sources, so a contraction in bank lending will force these firm to contract their activities, for example investment. In contrast, large firm are likely to be less dependent on bank credit because they will have access to external finance generated from the capital markets. This is because more information is available on large firms and this can often be pooled relatively cheaply, for example by a rating agency that allows dispersed investors in financial markets to access their credit risk. With a greater range of external finance, the large firm may be better able to smooth its investment spending during monetary tightening. Kashyap et al. (1994) find that inventory investment by firm without access to public bond markets appears to be affected by financial constraints. Oliner and Rudebusch (1996) consider the role of financial factors by examining the behaviour of large and small firms in response to changes in monetary policy. They argued that interest rate increases in response to a monetary contraction lower asset values and the value of collateral, which increases the cost of external funds relative to internal funds. In addition, the impact of cash flow on investment increases for small firms, but not for large firms during a monetary policy tightening.

Based on this analysis, in order to examine the relevance of the broad credit channel in transmitting to the firm-level investment in Malaysia, the cash flow to capital stock ratio $\left(\frac{CF_{it}}{K_{i,t-1}}\right)$ has been used as a proxy for the broad credit channel or financial constraints. The cash flow (CF_{it}) has also been scaled by the beginning-of-period capital stock $(K_{i,t-1})$. Therefore, the augmented version of the neoclassical investment model in estimating the firm-level investment functions can be expressed as;

$$\left(\frac{I_{it}}{K_{i,t-1}}\right)=\alpha_1\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right)+\alpha_2\left(\frac{I_{i,t-2}}{K_{i,t-3}}\right)+\theta_0\Delta y_{it}+\theta_1\Delta y_{i,t-1}+\theta_2\Delta y_{i,t-2}+\sigma_0\Delta uc_{it}+\sigma_1\Delta uc_{i,t-1}$$
$$+\sigma_2\Delta uc_{i,t-2}+\varphi_0\left(\frac{CF_{it}}{K_{i,t-1}}\right)+\varphi_1\left(\frac{CF_{i,t-1}}{K_{i,t-2}}\right)+\varphi_2\left(\frac{CF_{i,t-2}}{K_{i,t-3}}\right)+\eta_i+\lambda_t+\upsilon_{it}$$
(4.9)

Where, $\eta_i+\lambda_t+\upsilon_{it}=\varepsilon_{it}$. The error term (ε_{it}) is assumed to follow two-way error components disturbances which is the unobservable firm specific effect (η_i) and unobservable time specific effects (λ_t). υ_{it} is the remainder stochastic disturbance term, which is assumed to be independent and identically distributed with mean zero and variance σ_υ^2.

4.3.5 Interest rates and broad credit channel

The inclusion of the user cost of capital growth (Δuc), and cash flow to capital stock ratio $\left(\frac{CF_{it}}{K_{i,t-1}}\right)$ in equation (4.9) permits both interest rate and broad credit channels for the transmission of monetary policy to be analyzed. The short-run effects of interest rate channel can be tested by checking the signs and significance of the coefficients on the user cost of capital growth that is σ_0, σ_1 and σ_2. The expected sign is negative for their sum of coefficient because an increase in interest rates will increase the user cost of capital, and subsequently decrease firms' investment spending. Similarly, the short-run effects of the broad credit channel can be tested by checking the coefficients φ_0, φ_1 and φ_2. The expected sign is positive for their sum of coefficient and significant for the small firm (constrained firm) relative to the large firm (unconstrained firm). This indicates that the small firm is heavily reliant on internal funds as a cheaper source of funds and has some difficulties in accessing external financing.

In equation (4.9), the long-run elasticity of firm investment with respect to sales growth, user cost of capital growth and cash flow to capital stock can also be identified. The long-run elasticity of investment with respect to sales growth is given by

$\theta = \left(\dfrac{\theta_0 + \theta_1 + \theta_2}{1 - \alpha_1 - \alpha_2} \right)$, the long-run elasticity of investment with respect to user-cost of capital growth is $\sigma = \left(\dfrac{\sigma_0 + \sigma_1 + \sigma_2}{1 - \alpha_1 - \alpha_2} \right)$, and the long-run elasticity of investment with respect to cash flow to capital stock ratio is $\varphi = \left(\dfrac{\varphi_0 + \varphi_1 + \varphi_2}{1 - \alpha_1 - \alpha_2} \right)$.

4.4 Econometric Framework

4.4.1 Data/ Sample Selection

This study uses annual firm balance sheet data spanning from 1990 up to 2008 (19 years). The firms in this study are main board publicly listed companies, which covers an average 650 firms in various sub-sectors of the economy. The data set has been collected from Thompson Datastream. Few firms have been listed continuously since 1990, but many firms are listed in the main board at some later point. Therefore, the data constitute an unbalanced panel. For the estimation analysis, the following sample selections are applied. First, this study just considered non-financial firms. This means that all financial firms are removed from the sample. This is because financial firms have high cash flow but low investment. Therefore, excluding these firms removes the effects of influential outliers on the sample (Agung, 2000). Second, firms were selected that were consecutively present in the sample for at least five years in order to have sufficient number of lags as an explanatory variable. This is important to avoid data reduction due to the data transformation process and for adoption of lagged values in the model estimations (for example, in this study, the maximum lag order is two for all explanatory variables). After refining the data, there are 500 firms to be considered in this study. Third, in order to eliminate outliers, following Nagahata and Sekine (2005), firms with a negative value for the user cost of capital have been dropped from the sample. There are 600 firm-year observations out of 4 828 firm-year observations of the firms user cost of capital have been removed.

Fourth, in order to deal with the influential data, this study uses the DFITS statistics as proposed by Belsley et al. (1980) and the later version extended by Belsley (1991). The DFITS measure is a scaled difference between the in-sample and out-of-sample predicted value for the j_{th} observations (Baum, 2006). By using DFITS statistics, there are 81 firms out of 500 firms or 16.2 percent of the firm observations that have been removed from the sample. Finally, after cleaning the data set, this study has an unbalanced panel of 419 firms, which is equivalent to 2 035 firm-year observations or an average 6.13 annual observations per firm (see Appendix 4.2 for the detailed firm by sub-sector category).

There are two reasons to believe that why using 419 non-financial firms in estimating the determinants of firm-level investment can be representive of the full set of 650 listed companies. First, the 419 non-financial firms have comprised the main sub-sector of economy (see Appendix 4.2), which is sufficient to examine the heterogeneity of monetary policy effects across firm size, and sub-sector of economy. Second, the ratio of total capital expenditure (investment), market capitalization, and asset for 419 non-financial firms as percentage of total capital expenditure, market capitalization, and asset for all listed firms is 87.8 percent, 87.45 percent, and 87.23 percent, respectively. Thus, this ratio indicates that 419 non-financial firms are sufficient to be representative of the total firms listed on the stock market.

4.4.2 Splitting the Sample

4.4.2.1 Small and Large Firm

In order to explore the heterogeneous of monetary policy effects, the sample of firms has been divided into two size categories, that are small and large firms. As mentioned previously, the broad credit channel stated that the small firms are subject to greater informational problems and will be affected more strongly by a monetary policy tightening. Therefore, the small firms rely more heavily on internal financing (for example, cash flow) due to their limited access to external financing. In comparison, the large firms have greater access to external finance and are not heavily dependent on internal financing. For that reason, the firms have been segmented by using their total assets as proposed by Laeven (2002) and Rungsomboon (2005). In order to segment the firms, first, the average (mean) of total assets has been computed for each firm. Second, the grand median of the averages is then computed to segment firms into small and large category. The firm is considered large if their mean assets is greater than the grand median and small if their mean is less than or equal to the grand median. Specifically, there are 210 firms in the large category and 209 firms in small category.

4.4.2.2 By sub-sectors in economy

In addition, this study examines the differential of monetary policy effects by sub-sectors in the economy. However, not all of the sub-sectors can be considered in estimating the dynamic neoclassical investment model due to insufficient observations[60]. Therefore, this study only examines four sub-sectors in the economy, namely, industrial products, consumer products, property, and the services sector.

The differential of monetary policy effects upon firm-level investment spending across sub-sector in economy can be explained by three reasons. First, the interest rate sensitivity of the demand for product differs according to the durability of the goods produced in the particular sector. For example, the demand for product in cyclical industries (durable goods) is more affected by the changes in the interest rates than the demand for non-durables goods (less-cyclical industries). Second, industries that are more capital-intensive are expected to be more sensitive to the changes in the user cost of capital, which itself will depend on changes in interest rates. An increase in interest rates will increase the cost of capital (for example, an increase in cost of holding inventories), and affect their production (capital cost channel) and investment. Third, the effect of monetary policy also depends on the degree of openness of an industry (the ratio of exports and imports over value added). For example, tradable goods industries (export-oriented industries) are likely to be more affected by monetary policy. This is because a monetary policy tightening will generally lead to an exchange rate appreciation, which reduces the competitiveness of the sector and may have negative effect on external demand. As a result the firm will contract their investment spending in response to the deterioration in external demand. Therefore, based on this analysis, the firms in cyclical industries, capital-intensive industries, and industries that are relatively open to trade will be affected more strongly by monetary policy.

[60] The standard rule of thumb to estimate dynamic panel data is large cross-section (N) observation which is at least 50 and short time series observation.

4.4.3 Variable Definitions

In order to estimate the baseline neoclassical investment model in equation (4.9), this section briefly discusses the specific definitions of the variables used in this study.

Investment (I_{it})

This refers to the current-period investment spending for firm i at time t, which includes the capital expenditure on property, plant and equipment taken from firms' uses of funds statement. The capital expenditure is measured in Malaysian Ringgit (RM) in current market prices. Capital expenditure has been used as a proxy for investment by many researchers such as Chirinko et al. (1999), Moyen (2004), Bhagat et al. (2005), and Love and Zicchino (2006).

Capital Stock (K_{it})

The capital stock refers to net firm fixed assets, which excludes depreciation. It includes property, plant and equipment at period t less accumulated reserves for depreciation, depletion and amortization. The capital stock for each firm has calculated by perpetual inventory methods[61] and measured in the Malaysian Ringgit.

Cash Flow $(CF_{i,t})$

Cash flow is defined as operating income after tax earning plus depreciation. The cash flow is also measured in the Malaysian Ringgit. The depreciation includes total depreciation, amortization and depletion. This variable is used as a measurement of the degree of market imperfections caused by financial constraints. Under asymmetric information, the sensitivity of a firm's investment to the cash flow is likely to be different across firms. In fact, the relationship between cash flow (financial constraint) on investment spending can also be relate to the relevance of the broad credit channel in monetary policy transmission mechanism.

---

[61] The perpetual inventory method can be expressed as:

$K_{i,t} = \frac{P_t^K}{P_{t-1}^K} K_{i,t-1}(1-\delta) + I_{i,t}$, where $K_{i,t}$ is the capital stock,, δ is the depreciation rate, P_t^K is capital stock price and $I_{i,t}$ is newly invested capital stock.

Sales (y_{it})

This refers to the net sales or revenue that is calculated at the year-end-period of sales in a particular year, which is measured in the Malaysian Ringgit. The inclusion of this variable is also consistent with the financial accelerator theory, which postulates that there is a positive relationship between sales and investment. For example, an increase in sales growth is associated with more capital expenditure, and increases the rate of investment.

User Cost of Capital (UC)

As mentioned before, the derivation of user cost of capital is based on methodology proposed by Mojon et al. (2002) and Chatelain et al. (2003b). The user cost of capital can help to identify the relevance of interest rate channel of the monetary policy transmission mechanism.

4.4.4 Dynamic Panel GMM Estimation

The inclusion of the lagged dependent variables in the baseline neoclassical investment model in equation (4.9) implies that there is correlation between the regressors and the error term since the lag of the investment ratio $\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right)$ depends on $\varepsilon_{i,t-1}$ which is a function of the firm specific effect (η_i), and time-specific effect (λ_t) [62]. Therefore, due to this correlation, the dynamic panel data estimation in equation (4.9) suffers from Nickell (1981) bias, which disappears only if T is large or approaches infinity. Arellano and Bond (1991), Arellano and Bover (1995) and recently extended by Blundell and Bond (1998) have proposed generalized method of moments (GMM) estimators in order to deal the endogeneity problem (the correlation between the lagged dependent variable and the error term).

In order to remove the firm specific effect (η_i) in equation (4.9), Arellano and Bover (1995) proposed a forward orthogonal deviation transformation or forward Helmert's procedure. This transformation essentially subtracts the mean of future

[62] The lagged dependent variable attempts to capture the effects of delays in expectation building, investment decisions and the installation of capital goods.

observations available in the sample from the first $T-1$ observations. Its main advantage is to preserve sample size in panels with gaps. In contrast, a first-difference transformation has some weakness, which is, if some explanatory variable (x_{it}) is missing, then both $\Delta x_{i,t}$ and $\Delta x_{i,t+1}$ are missing in the transformed data (Roodman, 2009a). However, under orthogonal deviations, the transformed $x_{i,t+1}$ need not go missing. This procedure can be expressed as follows:

$$x_{i,t+1} = c_{it}\left[x_{it} - \frac{1}{T_{it}}\sum_{s>t} x_{is}\right] \tag{4.10}$$

where T_{it} is the number of time-series observations on firm i, c_{it} is the scale factor that is $\sqrt{\frac{T_{it}}{T_{it}+1}}$ and $\sum_{s>t} x_{is} = x_{it} + x_{i,t+1} + ... + x_{iT}$. As noted by Hayakawa (2009), by using a Monte Carlo simulation study, the GMM estimator of the model transformed by the forward orthogonal deviation tends to work better than if transformed by the first difference. Therefore, based on this justification, this study has used forward orthogonal deviation transformation in order to eliminate the firm-specific variable.

However, by transformation using forward orthogonal deviation, a new bias is introduced, that is, the correlation between the transformed error terms, and the transformed lagged dependent variable. Similarly, the transformed explanatory variables, that is the sales growth (Δy_{it}), the growth of user cost of capital (Δuc_{it}), and cash flow to capital stock ratio $\left(\frac{CF_{it}}{K_{i,t-1}}\right)$, are also potentially endogenous because they are related to the transformed error term. Therefore, three assumptions can be made regarding to the explanatory variables. First, an explanatory variable (X_{it}) can be a predetermined variable that is correlated with the past error or $E[X_{it}\varepsilon_{is}] \neq 0$ for $s<t$ but $E[X_{it}\varepsilon_{is}] = 0$ for all $s \geq t$. Second, an explanatory variable (X_{it}) can also be an endogenous variable, which is potentially correlated with the past and present error or $E[X_{it}\varepsilon_{is}] \neq 0$ for $s \leq t$ but $E[X_{it}\varepsilon_{is}] = 0$ for all $s>t$. Third, X_{it} is said to be strictly exogenous if

$E[X_{it}\varepsilon_{is}] = 0$ for all t and s which is uncorrelated with either current, past or future error.

Arellano and Bover (1995) and Arellano and Bond (1991) recommend that the lagged levels or untransformed regressors are used as an instrument for the transformed variable. This refers to the difference GMM. However, Alonso-Borrego and Arellano (1999) and Blundell and Bond (1998) show that if the lagged dependent and the explanatory variables are persistent over time or nearly a random walk, then lagged levels of these variables are weak instruments for the regression equation in differences.

This happens either as the autoregressive parameter (α) approaches unity, or as the variance of the individual effects (η_i) increases relative to the variance of the transient shocks (ε_{it}). Hence, to decrease the potential bias and imprecision associated with the difference estimator, Blundell and Bond (1998) have proposed a system GMM approach by combining both regression in differences and regression in levels. In addition to the regression in differences, the instruments for the regression in levels are the lagged differences of the corresponding instruments.

However, as noted by Roodman (2009), the system GMM can generate moment conditions prolifically. Too many instruments in the system GMM overfits endogenous variable even as it weakens the Hansen test of the instruments' joint validity. Therefore, in order to deal with the instruments proliferation, this study will use two main techniques in limiting the number of instruments – such as using only certain lags instead of all available lags for instruments and combining instruments through addition into smaller sets by collapsing the block of the instrument matrix. This technique has been used by previous researchers, for example Calderon et al. (2002), Beck and Levine (2004), Cardovic and Levine (2005) and Roodman (2009b).

This study has used one-step system GMM estimation. However, for robustness checking, a two-step estimation in the system GMM was also considered. The success of the GMM estimator in producing unbiased, consistent and efficient results is highly dependent on the adoption of the appropriate instruments. Therefore, there are three specifications tests as suggested by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). First, the Hansen test of over-identifying restrictions, which tests the overall validity of the instruments by analysing the sample analogue of the moments conditions used in the estimation process. If the moment condition holds, then the instrument is valid and the model has been correctly specified. Second, it is important to test that there is no serial correlation among the transformed error term. Third, to test the validity of extra moment's conditions on the system GMM, the difference in Hansen test is used. This test measures the difference between the Hansen statistic generated from the system GMM and the difference GMM. Failure to reject the three null hypotheses gives support to the estimated model.

4.5 Estimation Results[63]

This section discusses the empirical results of estimating the baseline augmented dynamic neoclassical investment model in equation (4.9). The main results are from the system GMM in one-step estimation. The focal points are to examine the role of interest rates, and the broad credit channel in transmitting to the firm-level investment spending for the whole sample, and sub-sample analyses according to firm size (small and large firm) and by sub-sector. In addition, the long-run elasticity of firm investment spending with respect to sales growth, user cost of capital growth, and cash flow to capital stock ratio are also discussed.

However, before discussing the effects of monetary policy on firm investment, it is vital to examine the link between monetary policy and firms' interest payable on debt or apparent interest rate (AI), which is the ratio of interest payments to total debt for each firm. This is because the apparent interest rate (AI) is an important variable in constructing the user cost of capital in equation (4.7). The estimation results by using a fixed-effect model (FEM), and a random-effect model (REM) are reported in Table 4.1. The results indicate that monetary policy variables, that is short-term and long-term interest rates, are positively and statistically significant in influencing firms' apparent interest rate (AI).

---

[63] All models are estimated using the Arellano and Bond dynamic panel system GMM estimations by using the Stata xtabond2 syntax written by Roodman (2009a).

4.5.1 The Full Sample

Table 4.2 (Panel A) reports the short run effect of the determinants of firm-level investment spending by using the dynamic neoclassical model in ARDL (2,2) model. As can be seen in Table 4.2, the user cost of capital growth is contemporaneously and highly statistically significance at one percent significant level in influencing the firm-level investment spending. The contemporaneous coefficient of the user cost of capital growth is -0.025, which is indicated that a one percent increase in the user cost of capital growth causes the investment spending (investment ratio or net growth capital stock) to decrease by 0.025 percent. However, the lagged effect of user cost of capital growth is statistically insignificant in influencing firms' investment. In general, the role of user cost of capital growth upon firm investment is relatively smaller than sales growth. The total coefficient of the user cost of capital growth is statistically significant at one percent significance level in influencing investment spending. Investment spending decreases by 0.027 percent in response to a one percent increase in the growth of the user cost of capital. The significant and negative effect of the user cost of capital growth on firm investment in Malaysia supports the relevance of the interest rate channel in monetary transmission. This finding is also consistent with previous studies in the Euro area and Japan as mentioned previously.

The contemporaneous effect of the cash flow to capital stock ratio on firm investment spending is also statistically significant, at least at the 10 percent significance level. For instance, a one percent increase in the contemporaneous cash flow to capital stock ratio leads to an increase in firm investment spending by 0.01 percent. The total effect of cash flow to capital stock ratio on investment is also statistically significant at five percent significance level. For example, the total coefficient is 0.046, which implies that a one percentage point increase in the cash flow to capital stock ratio leads to a 0.046 percentage point rise in firm investment spending. The significance of the cash flow to capital stock ratio supports the relevance of the broad credit channel in the monetary transmission mechanism.

Sales growth has also plays a significant role in influencing the investment spending. For example, a one percent change in sales growth leads to a contemporaneous increase in investment spending by 0.036 percent. The lagged effect of sales growth on firm investment is also statistically significance at a one percent significance level. In addition, the total coefficient of sales growth is 0.079, which is statistically significant at the one percent significance level. This means that a one percent increase in sales growth will generate an increase in firm investment by 0.079 percent. The significant effect of sales growth indicates the relevance of a financial accelerator effect on investment. This means that growth in firms' output (sales growth) will generate more capital expenditure by firms.

The results of the both specification tests, that is AR(2) for testing the serial correlation and the Hansen test for testing the validity of instrument adopted are also valid. As shown in Table 4.2 (Panel A), the p-values for the AR (2) and Hansen tests are higher than 0.10, that is, statistically insignificant at the ten percent significance level. This implies that the empirical model has been correctly specified because there is no serial correlation (autocorrelation) in the transformed residuals, and the instruments (moments conditions) used in the models are valid. The additional moment conditions such as difference in Hansen tests are also statistically insignificant in all models but not reported in order to save space[64].

In summary, the results for the full sample in Table 4.2 (Panel A) suggest that sales growth, user cost of capital growth, and cash flow to capital stock ratio have played an important role in influencing firm-level investment spending. The significant role of the user cost of capital growth and cash flow to capital stock ratio on firm investment illustrate the relevance of interest rates, and the broad credit channel in the monetary policy transmission mechanism.

[64] The detailed results for the difference in Hansen test is not reported in order to save the space. The full results are available upon request.

4.5.2 Sub-Sample Results

It was argued earlier that there may be significant differences in the way that the monetary transmission mechanism affects firms of different sizes and firms operating in different sub-sectors of the economy. This section splits the sample into separate panels in order to investigate these differences.

4.5.2.1 Large and Small Firms

As mentioned before, small firms rely more heavily on internal financing than external financing, because external financing is more costly for small firms than for large firms. Therefore, it is expected that the cash flow to capital stock ratio would play a more significant role in influencing investment by small firms. In addition, the effect of the user cost of capital growth is also expected to be higher in relation to small firms than large firms because small firms face difficulties in accessing external financing.

Table 4.2 summarises the estimation results for large firms (Panel B), and small firms (Panel C). As can be seen, the effect of user cost of capital growth upon firm investment spending are different, namely it is apparent that small firms react more strongly than large firms in responding to monetary policy tightening. Interestingly, the user cost of capital growth has a contemporaneous and significant influence on firms' investment. For example, a one percent increase in the user cost of capital growth leads to a contemporaneous decreases in the small firms' investment by 0.040 percent, whereas large firms' investment spending decreases by 0.016 percent. As expected, the total coefficient of the user cost of capital growth on investment spending is higher for the small firms as compared to large firms. The total coefficient of the user cost of capital growth is -0.060 percent, and -0.022 percent for the small and large firms, respectively. The negative response of investment to the user cost of capital growth supports the importance of the interest rate channel in the monetary transmission mechanism.

The results in Table 4.2 also reveal the different role of the cash flow to capital stock ratio in influencing investment. For the small firms, the first period lagged and two-period lagged of the cash flow to capital stock ratio is statistically significant at 5 percent in influencing investment spending, whereas the contemporaneous effect of the cash flow to capital stock ratio is insignificant. In addition, the total effect of the cash flow to capital stock ratio on investment is statistically significant at the 10 percent significance level for small firms. In contrast, for large firms, the contemporaneous and two-period lagged cash flow to capital stock ratios are statistically significant in influencing the investment. The total coefficient of cash flow to capital stock ratio is relatively high for small compared with large firms, with coefficients of 0.088 for small firm, and 0.058 for large firm. This finding suggests that the small firms are more heavily reliant on internal financing as a cheaper source of finance, and implied that they have experienced a financial constrained. In contrast, large firms may be less dependent on internal financing because they have better access to credit, for example from external financing such as the debt and equity market. Therefore, this finding tends to support the existence of the broad credit channel in monetary transmission in Malaysia.

Besides user cost of capital growth and cash flow to capital ratio, the firm investment (for both small and large firms) has also been significantly influenced by sales growth. The contemporaneous effect of sales growth on investment is 0.032 percent for large firms and 0.025 percent for small firms. The sensitivity of investment to sales growth is also comparatively higher for large firms as compared to small firms, as the total coefficient of sales growth is 0.033 and 0.088 for small and large firms, respectively. This means that a 10 percent increase in sales growth leads to an increase in investment of 0.33 percent, and 0.88 percent for small and large firms, respectively.

In addition, the serial correlation test stated that the GMM estimations are not serially correlated at the second order or AR (2). The Hansen test also shows that the system GMM estimation is well specified and the instruments employed are valid because the p-value is greater than 0.1. The validity of additional moment conditions such as difference in Hansen tests are also statistically insignificant in all models, but not reported in order to save space.

4.5.2.2 Sub-sectors of the economy

Table 4.3 (Panel A-Panel D) reports the estimation results of the neoclassical investment model by sub-sector economy activity, which consists of four sub-sectors, namely consumer products, industrial products, property and services. As can be seen in Table 4.3, the effect of monetary policy varies across the sub-sectors. For example, investment in consumer products, industrial products and services is significantly affected by the user cost of capital growth, whereas investment by firms in the property sector is not significantly affected. This finding suggests that the interest rate channel plays a significant role in influencing investment by firms in the consumer product, industrial product and services sectors. Investment by firms in the industrial product and consumer product sub-sectors is more sensitive to the interest rate channel than other sub-sectors, as the total coefficient of the user cost of capital growth is -0.090 and -0.062, respectively. This indicates that investment spending in industrial firms and consumer product decreases by 0.09 and 0.062 percent, respectively, in response to a one percent increase in the user cost of capital growth.

There are several possible reasons in explaining the differential effect of the interest rate channel across the sub-sectors. First, consumer and industrial product firms are manufacturing industry, which is an export-oriented industry or tradable-goods[65]. In contrast, the property and services firms are domestic-based industry. As mentioned before, tradable goods industries (export-oriented industries) are likely to be more affected by monetary policy because a monetary policy tightening will generally lead to an exchange rate appreciation, which reduces the competitiveness of the sector and may have negative effect on external demand. As a result the firms will contract their investment spending in response to the deterioration in external demand. Second, the investment by firms in consumer and industrial products rely heavily on bank loans as a source of financing. This is because the ratio of the interest payment to the total debt (apparent interest rate) for consumer and industrial product firms is higher than other sub-sectors[66]. As a result, monetary policy contraction through an increase in interest

[65] From year 2000 until 2008, on average, the manufacturing industry has contributed 70 percent of the total Malaysian export. Therefore, it is expected that manufacturing industry will be vulnerable to the exchange rate risk in response to the monetary policy.

[66] Based on author calculation, on average, from 1990 until 2008, the ratio of interest payment to total debt for consumer product firms is 0.178, industrial products is 0.203, property is 0.144 and services

rate will increase the firm's apparent interest rate, and subsequently the firm will downsize its investment spending. Third, industrial products are capital intensive industry[67], and should be more sensitive to changes in the user cost of capital. Thus, an increase in interest rates will increase the cost of capital, and subsequently the firm will shrink their investment spending. Fourth, the consumer products are durable goods industry and more cyclical industry, therefore the investment spending will be more affected by a rise in the interest rates.

The effect of the cash flow to capital stock ratio also varies across the sub-sectors. For example, investment spending by firms in the services sector is not significantly affected by the cash flow ratio, whereas investment in the other sub-sectors is statistically significantly affected by the cash flow to capital stock ratio. This finding indicates the relevance of the broad credit channel in these three sub-sectors of the economy. In addition, the firms in consumer product are seen to be more responsive to the broad-credit channel, as investment spending increases by 0.064 percent in response to a one percent increase in the cash flow to capital stock ratio.

The differential effect of the cash flow to capital stock ratio (the broad credit channel) across sub-sectors can be explained by the balance sheet condition, in particular the borrowing capacity of the firm (Peersman and Smets (2002) and Dedola and Lippi (2005)). The borrowing capacity of the firm can be related to the degree of financial leverage (measured by the ratio of total debt to total asset or to total shareholders' capital), and the incidence of interest rates expenditures on cash flows, called the interest rate burden (measured by the ratio of interest rate payments to operating profits). Dedola and Lippi (2005) interpret the leverage ratio as an indicator of borrowing capacity, which indicates that more leveraged firms tend to get loans at better terms. Therefore, highly-leveraged firms could be less sensitive to monetary policy changes (less sensitive to the broad credit channel or less sensitive to cash flow to capital stock ratio). Similarly, highly interest rate burden firms could be less sensitive to

---

0.137. This indicates that consumer and industrial product firms are heavily relied on bank loan as source of financing.

[67] The capital intensity is the ratio of fixed asset to total sales. Based on author calculation, on average, the capital intensity in industrial product is 1.435, services is 1.223, property 1.201 and consumer product is 0.562.

the cash flow to the capital stock ratio, whereas less interest rate burden firms will be more sensitive to the cash flow to the capital stock ratio. Since the consumer products sector has a smaller leverage ratio than other sub-sectors, therefore the effect of cash flow to capital stock ratio (broad credit channel) is higher for consumer products as compared to other sub-sector[68]. In addition, the ratio of the interest rate payments to operating profits is also low for consumer products firms as compared to other sub-sectors, therefore the investment spending by firms in consumer product is more sensitive to the cash flow to capital stock ratio[69].

Contemporaneous sales growth significantly affects investment spending in consumer product and services firms, whereas the other sub-sectors are not significantly affected. The total effect of sales growth is also statistically significant in influencing firms' investment in the consumer product and services sub-sectors. For example, investment increases by 0.10 percent and 0.06 percent in consumer product and services firms, respectively, in response to a one percent increase in sales growth. However, the total coefficient of cash flow is not significant in influencing firms' investment in the industrial product and property sectors.

The serial correlation test shows that the system GMM estimations are not serially correlated at the second order or AR (2). In fact, the Hansen test shows that the system GMM estimation is well specified and the instruments employed are valid because the p-value is greater than 0.1. The validity of additional moment conditions such as difference in Hansen tests are also statistically insignificant in all models, but not reported in order to save space.

[68] Based on author calculation, on average, from year 1990 until 2008, the leverage ratio for consumer product is 0.193, industrial product is 0.236, property is 0.218 and services 0.238.
[69] On average, from year 1990 until 2008, the ratio of the interest rate payments to operating profits is 0.210 for consumer products, 0.536 for industrial product, 0.681 for property and 0.356 for services.

Table 4.1: The Link between Monetary Policy and Firms' Apparent Interest Rates

Independent variable	Fixed-Effect Model (FEM)			Random-Effect Model (REM)		
	Coeff.	Std. error	p-value	Coeff.	Std. error	p-value
Panel A : Short term interest rates (inter bank overnight rate)						
AI_{t-1}	-0.671	0.015	0.000***	-0.574	0.014	0.000***
Δr_t	0.017	0.011	0.099*	0.020	0.010	0.054***
r_{t-1}	0.063	0.008	0.000***	0.058	0.007	0.000***
constant	-2.154	0.056	0.000***	-1.871	0.053	0.000***
R-square	0.277			0.278		
Number of observations	3914			3914		
Number of group	415			415		
Panel B : Long term interest rates (10 years government bond)						
AI_{t-1}	-0.677	0.015	0.000***	-0.575	0.014	0.000***
Δr_t	0.044	0.017	0.010	0.046	0.017	0.008***
r_{t-1}	0.055	0.012	0.000***	0.051	0.011	0.000***
constant	-2.239	0.077	0.000***	-1.921	0.072	0.000***
R-square	0.278			0.278		
Number of observations	3823			3823		
Number of group	415			415		

Note: The dependent variable is the firm apparent interest rates (AI), which is the ratio of interest expense to total debt for each firm. *** significant at 1 percent significance level; ** significant at 5 percent significance level; * significant at 10 percent significance level.

Table 4.2: System GMM Estimation – One step estimation (Forward Orthogonal Deviation Transformation)

Independent Variables	Panel A-Whole sample			Panel B-Large Firm			Panel C-Small firm		
	coef.	robust std. error	p-value	coef.	robust std. error	p-value	coef.	robust std. error	p-value
$\left(I_{t-1} / K_{t-2}\right)$	0.232	0.108	0.031**	0.374	0.117	0.001***	0.086	0.092	0.352
$\left(I_{t-2} / K_{t-3}\right)$	0.057	0.031	0.062	0.006	0.008	0.462	0.091	0.027	0.001
$\sum\left(I_{i,t-n} / K_{i,t-n-1}\right)$	**0.289**	**0.139**	**0.000*****	**0.380**	**0.125**	**0.000**	**0.177**	**0.119**	**0.001**
$\Delta \log UCC_{i,t}$	-0.025	0.004	0.000	-0.016	0.005	0.001	-0.040	0.010	0.000
$\Delta \log UCC_{i,t-1}$	-0.001	0.006	0.816	-0.005	0.004	0.200	-0.019	0.011	0.098
$\Delta \log UCC_{i,t-2}$	-0.001	0.003	0.809	-0.001	0.004	0.737	-0.001	0.008	0.898
$\sum \Delta \log UCC_{i,t-n}$	**-0.027**	**0.013**	**0.000*****	**-0.022**	**0.013**	**0.002**	**-0.060**	**0.029**	**0.001**
$\left(CF_{it} / K_{i,t-1}\right)$	0.010	0.006	0.078	0.021	0.010	0.033	0.026	0.018	0.133
$\left(CF_{i,t-1} / K_{i,t-2}\right)$	0.015	0.017	0.379	0.017	0.021	0.426	0.035	0.014	0.014
$\left(CF_{i,t-2} / K_{i,t-3}\right)$	0.021	0.010	0.040	0.020	0.009	0.036	0.027	0.009	0.044
$\sum\left(CF_{i,t-n} / K_{i,t-n-1}\right)$	**0.046**	**0.023**	**0.025****	**0.058**	**0.040**	**0.004**	**0.088**	**0.041**	**0.067**
$\Delta \log Sale_{i,t}$	0.036	0.009	0.000	0.032	0.012	0.007	0.025	0.013	0.048
$\Delta \log Sale_{i,t-1}$	0.016	0.010	0.114	0.021	0.014	0.118	0.005	0.015	0.727
$\Delta \log Sale_{i,t-2}$	0.027	0.008	0.001	0.035	0.012	0.003	0.003	0.012	0.799
$\sum \Delta \log Sale_{i,t-n}$	**0.079**	**0.027**	**0.000*****	**0.088**	**0.038**	**0.011**	**0.033**	**0.040**	**0.171**
Number of observations	2286			1340			1004		
Observations per group	6.02			6.91			5.23		
Number of instruments	94			66			56		
no. of firms	380			194			192		
AR(1)- *p-value*	0.001			0.001			0.001		
AR(2)- *p-value*	0.729			0.203			0.127		
Hansen test - *p-value*	0.218			0.247			0.274		

(Continued Table 4.2)

Note:
The dependent variable is the firm-level investment spending measured by the ratio of capital expenditure to lagged capital stock $\left(I_{it} / K_{i,t-1}\right)$. The independent variables are the user cost of capital growth $\left(\Delta \log UCC\right)$, cash flow to lagged capital stock ratio $\left(CF / K_{i,t-1}\right)$ and sales growth $\left(\Delta \log Sale\right)$.

** Significant at 5% percent level; *** significant at 1% level. The *p-value* of the total coefficient was tested by using a Wald statistic.

Year dummies and constant are not included in order to save space. All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets have also been rejected at least at 10 percent significance level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:

Lags 2 to all available lags for all endogenous variables (lagged dependent variable), lags 1 to all available lags for all predetermined variables (cash flow to capital stock ratio and sales growth) and all lags for strictly exogenous variable (user cost of capital growth).

Table 4.3: System GMM Estimation – One step estimation (Forward Orthogonal Deviation Transformation) by sectoral

Independent Variables	Panel A - consumer product			Panel B - Industrial product			Panel C - Property			Panel D - Services		
	coef.	robust std. error	p-value	coef.	robust std. error	p-value	coef.	robust std. error	p-value	coef.	robust std. error	p-value
$\left(I_{t-1}/K_{t-2}\right)$	0.543	0.184	0.003	0.292	0.116	0.012	0.003	0.005	0.585	0.208	0.113	0.066
$\left(I_{t-2}/K_{t-3}\right)$	0.059	0.057	0.308	0.020	0.030	0.499	0.002	0.003	0.549	0.009	0.006	0.119
$\sum\left(I_{i,t-n}/K_{i,t-n-1}\right)$	**0.602**	**0.241**	**0.001**	**0.312**	**0.146**	**0.000**	**0.005**	**0.008**	**0.947**	**0.217**	**0.119**	**0.001**
$\Delta \log UCC_{i,t}$	-0.052	0.016	0.002	-0.058	0.012	0.000	-0.009	0.008	0.298	-0.020	0.008	0.014
$\Delta \log UCC_{i,t-1}$	-0.007	0.013	0.573	-0.016	0.011	0.152	-0.017	0.014	0.200	-0.001	0.008	0.894
$\Delta \log UCC_{i,t-2}$	-0.003	0.012	0.783	-0.016	0.007	0.016	-0.013	0.012	0.269	-0.001	0.006	0.930
$\sum \Delta \log UCC_{i,t-n}$	**-0.062**	**0.041**	**0.018**	**-0.090**	**0.030**	**0.000**	**-0.039**	**0.034**	**0.619**	**-0.022**	**0.022**	**0.086**
$\left(CF_{it}/K_{i,t-1}\right)$	0.044	0.020	0.028	0.002	0.005	0.620	0.030	0.011	0.007	0.016	0.011	0.117
$\left(CF_{i,t-1}/K_{i,t-2}\right)$	0.012	0.018	0.509	0.007	0.003	0.046	0.004	0.010	0.720	0.013	0.016	0.433
$\left(CF_{i,t-2}/K_{i,t-3}\right)$	0.008	0.030	0.783	0.001	0.002	0.684	0.005	0.006	0.448	0.004	0.012	0.752
$\sum\left(CF_{i,t-n}/K_{i,t-n-1}\right)$	**0.064**	**0.068**	**0.062**	**0.010**	**0.010**	**0.024**	**0.039**	**0.027**	**0.022**	**0.033**	**0.039**	**0.135**
$\Delta \log Sale_{i,t}$	0.048	0.017	0.004	0.032	0.024	0.175	0.009	0.013	0.518	0.038	0.018	0.034
$\Delta \log Sale_{i,t-1}$	0.023	0.018	0.208	0.011	0.022	0.615	0.005	0.012	0.672	0.007	0.020	0.743
$\Delta \log Sale_{i,t-2}$	0.028	0.015	0.057	0.007	0.015	0.641	0.022	0.009	0.021	0.012	0.018	0.508
$\sum \Delta \log Sale_{i,t-n}$	**0.099**	**0.050**	**0.019**	**0.050**	**0.061**	**0.607**	**0.036**	**0.034**	**0.110**	**0.057**	**0.056**	**0.069**
Number of observations	444			695			431			590		
Observations per group	6.94			6.21			7.56			6.28		
Number of instruments	61			59			25			60		
no. of firms	64			112			57			94		
AR(2)- *p-value*	0.871			0.988			0.267			0.348		
Hansen test - *p-value*	0.501			0.259			0.205			0.283		

(Continued Table 4.3)

Note:

The dependent variable is the firm-level investment spending measured by the ratio of capital expenditure to lagged capital stock $\left(I_{it} / K_{i,t-1}\right)$. The independent variables are the user cost of capital growth $\left(\Delta \log UCC\right)$, cash flow to lagged capital stock ratio $\left(CF / K_{i,t-1}\right)$ and sales growth $\left(\Delta \log Sale\right)$.

** Significant at 5% percent level; *** significant at 1% level. The *p-value* of the total coefficient was tested by using Wald statistic.

Year dummies and constant are not included in order to save space. All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets have also been rejected at least at 10 percent significant level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:

Lags 2 to all available lags for endogenous variables (lagged dependent variable), lags 1 to all available lags for all predetermined variables (cash flow to capital stock ratio and sales growth) for all sectors except property sector and all lags for strictly exogenous variable (user cost of capital growth) for all sectors. For property sector, lag 2 to 3 for lagged dependent variable and lag 1 to 2 for cash flow to capital ratio and sales growth.

The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002), and Roodman (2009b).

4.5.3 Long-run Effects

Table 4.4 and Table 4.5 report the long-run elasticity of firm investment with respect to user cost of capital growth, cash flow to capital stock ratio, and sales growth for the whole sample and sub-sample analysis. In Table 4.4, for the whole sample and sub-sample (small and large firm), the long-run coefficient of user cost of capital growth, cash flow to capital stock ratio and sales growth is relatively higher than the effect in the short run (Table 4.2). The effect of the interest rate channel (user cost of capital) is also relatively higher for small firms as compared to large firms. For example, the long-run coefficient of user cost of capital growth for small firms is -0.073, whereas for large firm it is -0.035. This means that, in the long-run, investment spending declines by 0.073 percent and 0.035 percent for the small firms and large firms, respectively, in response to a one percent increase in the user cost of capital growth. This finding indicates that small firms have been more affected by the interest rate channel as compared to large firms.

In Table 4.5, the long-run coefficient of user cost of capital growth is also statistically significant for firms in the consumer product, industrial product and services sectors. However, the investment spending in property firms is not significantly affected by the user cost of capital growth. Interestingly, the investment in consumer product and industrial product are more sensitive to the user cost of capital growth than other sub-sectors, which suggest that the important role of the interest rate channel. For example, the long run coefficient of user cost of capital is -0.140 and -0.131 for firms in the consumer products and industrial products sub-sectors, respectively.

In addition, in the long-run, the cash flow to capital stock ratio is also statistically significant in influencing investment spending by small and large firms. The long run coefficient of the cash flow to capital stock ratio is higher for small firms than large firms. The long-run coefficient of the cash flow to capital stock ratio is 0.107 and 0.093 for small and large firms, respectively. This finding points to the relevance of the broad credit channel in the monetary transmission mechanism in Malaysia. The effect of the cash flow to capital stock ratio on investment spending is also different across sub-sectors, being statistically significant for consumer products, property and services but not for firms in the industrial products sector. Investment by consumer products firms has a stronger effect of the cash flow to capital stock ratio, with a long run coefficient of 0.120 percent.

In the long run, investment by small firms is not statistically significantly influenced by sales growth, whereas investment by large firms is, with a long run coefficient of 0.141. Investment by firms in the consumer products and property sectors is also significantly affected by sales growth, whereas investment by firms in the industrial products and services sectors are not significantly affected. Investment by consumer products firms reveals a more substantial effect than other sub-sectors, as investment increases by 0.251 percent in response to a one percent change in sales growth.

Table 4.4: Long run coefficients of the user cost of capital growth, cash flow to capital stock ratio and sales growth on firm investment – Whole Sample, Small and Large Firms

	Whole sample	Small firms	Large Firms
User cost of capital growth	-0.038 (0.013)***	-0.073 (0.020)***	-0.035 (0.016)**
Cash flow to capital stock ratio	0.065 (0.024)***	0.107 (0.037)***	0.093 (0.055)*
Sales growth	0.110 (0.032)***	0.040 (0.039)	0.141 (0.042)***

Table 4.5: Long run coefficients of the user cost of capital growth, cash flow to capital stock ratio and sales growth on firm investment – by sub-sector

	Consumer products	Industrial products	Property	Services
User cost of capital growth	-0.140 (0.078)*	-0.131 (0.037)***	-0.040 (0.033)	-0.028 (0.016)*
Cash flow to capital stock ratio	0.120 (0.063)**	0.012 (0.010)	0.039 (0.021)*	0.042 (0.022)*
Sales growth	0.251 (0.142)*	0.074 (0.066)	0.036 (0.016)**	0.072 (0.044)

Note: number in parenthesis is standard error computed by delta method[70].

*** significant at 1 percent significance level, ** significant at 5 percent significance level and * significant at 10 percent significance level ,

The long-run effects of the explanatory variables are defined as the sum of the coefficients on the explanatory variable divided by one minus the sum of the coefficient on the lagged dependent variable.

[70] The delta method is estimated by using nlcom syntax in Stata.

4.5.4 Robustness Checking[71]

For robustness checking, the baseline neoclassical investment model in equation (4.9) has been re-estimated with various strategies such as by using two-step system GMM estimation, difference GMM (one-step and two-step estimation), various instrumental strategies (for example, using different assumptions about endogenous and pre-determined variables), different lag-length criteria, and the combination of instrument with level and differences equations. In general, the main results are robust, which are that the interest rate and broad credit channels are relevant in transmitting the effects of monetary policy to firm-level investment. This section briefly discusses the results of two-step system GMM estimation and difference GMM (one-step and two-step estimation).

4.5.4.1 System GMM: two-step estimation

In general, the results of the two-step system GMM estimation are similar to the one-step estimation. The user cost of capital growth is statistically significant in influencing the small and large firm investment spending. The investment by small firms is relatively more affected by the user cost of capital growth as compared to large firms. Investment in small firms is contemporaneously significantly affected by the cash flow to capital stock ratio. However, the total effect of the cash flow to capital stock ratio on investment spending is insignificant for small and large firms. Sales growth is also contemporaneously significant in influencing the investment spending for small and large firms; however, the total effect is not significant. In the long-run, for the whole sample, all explanatory variables are statistically significant in influencing firms' investment. However, in the long run the investment by large firms is only significantly affected by sales growth. In contrast, in the long-run, investment by small firms is significantly affected by the user cost of capital growth and cash flow to capital stock ratio.

The effect of monetary policy also varies by sub-sector. For example, in the short-run, investment spending by firms in the consumer products, industrial products and services sectors is significantly affected by the user cost of capital growth. In

[71] The full results of robustness checking are available upon request.

addition, the investment by firms in consumer and industrial products is statistically significantly influenced by the cash flow to capital stock ratio in the short-run. In the long-run, all explanatory variables are statistically significant in influencing firms' investment in the consumer products sector. However, in the long-run the investment by firms in the industrial products sector is only significantly influenced by the user cost of capital. In contrast, investment by firms in the property and services sectors is insignificantly affected by all explanatory variables in the long-run.

4.5.4.2 Difference GMM

For the difference GMM, the number of instrument is not collapsed as compared with the system GMM. In general, similarly with system GMM, the empirical results have supported the existence of interest rates and the broad credit channel in monetary policy transmission in Malaysia.

The effect of the interest rate channel also varies with firm size. The total effect of the user cost of capital growth on firm investment spending is statistically and negatively significant, at least at the one percent significance level. The investment spending by small firms has decreased more than for large firms in response to monetary policy tightening (an increase in the user cost of capital). For example, the total effect of the user cost of capital growth for small firms is -0.053 (one-step estimation) and -0.037 (two-step estimation), whereas the total effect for large firms is -0.036 in one-step and -0.028 in two-step estimation. In the long-run, for the whole sample, firm investment spending is significantly influenced by user cost of capital growth and sales growth in one-step and two-step estimations. For large firms, in the long-run investment spending is statistically significantly influenced by the user cost of capital growth and cash flow to capital stock ratio in one-step estimation, but in two-step estimation, large firms' investment is only significant influenced by the user cost of capital growth. However, for small firms, in one-step estimation the investment spending is statistically influenced by the user cost of capital growth, but in the two-step estimation no explanatory variables are significant in influencing firms' investment in the long-run.

The effect of monetary policy variables also varies by sub-sectors. For example, in the short-run, the investment by firms in the consumer products, industrial products and property sectors is significantly affected by the user cost of capital growth (in both one-step estimation and two-step estimation). Firms in the industrial products and consumer products sectors are more sensitive to the interest rate channel. The cash flow to capital stock ratio also significantly influences firms' investment in all sub-sectors except consumer products. The services sector is more sensitive to the cash flow to capital stock ratio. In the long run, investment spending by industrial products firms is significantly influenced by the user cost of capital and sales growth in one-step estimation, however in two-steps estimation investment is only significantly influenced by sales growth.

In one-step and two-step estimation, the short-run and long-run effects of the cash flow to capital ratio upon investment spending is statistically insignificant for both firm sizes. Therefore, by using difference GMM, this finding tends to reject the significance of financial constraints and the broad credit channel in the monetary policy transmission mechanism in Malaysia, at least insofar as it affects investment by firms. In long run, there is no significant effect of cash flow on firm investment in the consumer products, industrial products and property sectors; however, there is a significant effect of cash flow on firm investment in the services sector.

Investment by small and large firms is also significantly influenced by sales growth. However, the response of investment by small firms is greater than for large firms. For example, the total coefficient of sales growth by small firm is 0.320 in one-step and 0.306 in two-step estimation, whereas for large firms it is 0.280 (one-step) and 0.141 (two-step). However, there is no significant effect of sales growth upon firm investment in large and small firms in the long run. In the long run, the investment by firms in the consumer products and services sectors is significantly affected by sales growth in the one-step and two-step estimation; whereas investment by firms in the industrial products and property sectors are not affected.

4.6. Summary and Conclusions

The channels of monetary policy transmission mechanism using macro level evidence have been studied extensively by prior studies, but little attention has been given to investigating the micro level evidence of the monetary transmission mechanism. Therefore, to fill this gap in the previous literature, this study focuses on two main channels of monetary policy, namely the interest rate channel (derived from the user cost of capital), and the broad credit channel (cash flow to capital stock ratio) in affecting firm-level investment in a small open economy (i.e. Malaysia). In addition, the heterogeneous of monetary policy effects by firm size (large and small firms), and by sub-sectors of the economy have also been investigated in this study.

By estimating the dynamic version of an augmented neoclassical investment model in ARDL model using system GMM estimation, this study tends to support the relevance of interest rates and the broad credit channel in transmitting to firm-level investment spending. Specifically, the firm-level investment spending is seen to be significantly influenced by the user cost of capital, and cash flow to capital ratio. In addition, monetary policy has heterogeneous effects, in that small firms are affected more strongly by the interest rate channel as compared to large firms. Investment by small and large firms is also statistically significantly influenced by internal funds (the cash flow to capital stock ratio). However, the effect of the cash flow to capital stock ratio on firm investment is relatively higher for small firms as compared to large firms. As mentioned before, the higher response of small firm investment to the cash flow to capital stock ratio suggests that small firms are heavily relied upon internal financing as a source of financing, which indicates that the small firms have experienced financial constraints under imperfect financial markets. In contrast, large firms have not heavily relied upon the cash flow to capital ratio, which indicates that they are not subject to liquidity constraints and can gain access to external financing such as short-term credit markets, bonds and financial instruments in the capital market. The effect of monetary policy on firm investment is also heterogeneous across sub-sectors of economy activity. For example, in the long-run, the firm investment in the consumer products and services sectors are significantly affected by the interest rate and broad credit channels. However, the firm investment in the industrial products and property sectors has only been significantly affected by interest rates channel.

This study has several implications for the implementation of monetary policy. First, since the interest rate channel plays a significant role in influencing firms' investment, the monetary authority has a greater chance to stabilise investment by altering the monetary policy variables such as short-term interest rates or the interbank overnight rate. This is because the interbank overnight rate has a significant effect upon firm apparent interest rates. For example, monetary authority can fine-tune the investment cycle by implementing an easing monetary policy during a slowdown in economic activity. Second, the existence of the broad credit-channel implies that monetary policy is likely to be more effective when firms face tighter financial constraints, in particular for small firms. Therefore, small firms have to monitor closely their financial condition, in particular the cash flow as a cheaper source of financing. Third, the empirical finding indicated that the response of the real sector economy to monetary policy shocks, in particular investment, depends on the degree of financial constraint, the segmentation of firm (by firm size and by sub-sector), and the firm balance sheet conditions. Therefore, the monetary authority has to monitor the microeconomic indicators of the firm in formulating their monetary policy. In addition, the monetary authority has also to observe the credit market conditions and liquidity in the financial market in order to ensure that the domestic liquidity is reasonable to support the business agenda.

Finally, since firm investment is less sensitive to the interest rate channel, several conclusions can be drawn on the macroeconomic consequences of a monetary policy change from the micro level results. First, the effect of monetary policy is relatively small in influencing aggregate expenditure (in particular investment spending); therefore monetary policy via the interest rate channel does not have much effect in stimulating national income. Second, this finding also indicates that monetary policy is less effective to fine-tune investment demand from the business cycle conditions. Third, the low sensitivity of investment demand to interest rates seems to support the Keynesian hypothesis, which postulated that monetary policy is less effective because investment demand is less sensitive to interest rates. According to Keynesian views, investment demand is mainly influenced by business cycle conditions such as volatile expectations about expected future sales and profit. For example, any changes in expected future sales and profit changes the demand for new capital and hence the level of investment in the domestic economy.

5. CONCLUSIONS

This dissertation is composed of three empirical essays that relate to the effectiveness of monetary policy implementation by using macro and disaggregated firm-level studies. Specifically, it provides new empirical evidence about the role of monetary policy as a stabilization policy at the macro level, and how relevant is monetary policy in influencing firm-level equity returns, and firm-level investment spending in a small open economy (i.e. Malaysia). In general, the finding of the study has revealed a significant role of monetary policy variables (in particular, the inter bank overnight rate) in the Malaysian economy. This is because a change in the inter bank overnight rate has an important effect on macroeconomic variables (in particular economic growth, inflation, and the exchange rate), firm-level equity returns, and firm-level investment spending.

The first essay (chapter 2) focuses on the effectiveness of monetary policy (interest rates and money supply) as a stabilization policy in a small open economy by using an open-economy SVAR study. It examines the role of monetary policy on macroeconomic variables (economic growth, inflation, and the exchange rate), and evaluates the effectiveness of monetary policy in mitigating the negative effects of foreign shocks upon domestic macroeconomic variables. In addition, the effects of foreign shocks, namely oil price, foreign income, and foreign monetary policy, upon domestic macroeconomic variables (domestic income and inflation), and domestic monetary policy variables (money supply, and interest rates) have also been examined. As monetary policy operating procedure in Malaysia has changed from monetary targeting towards interest rates targeting, this study also investigates the different role of monetary policy variables during two monetary policy regimes.

The results of the first essay provide four significant directions for monetary policy analysis in a small open economy at the macroeconomic level. First, it supports the relevance of monetary policy as a stabilization policy. For example, economic growth is shown to respond positively to a positive innovation in money supply, and negatively to a positive innovation in the interest rates. The inflation rate has also responded positively to the positive innovation in money supply, and negatively to positive innovations in the interest rates. The effects of money supply and interest rate shocks on the exchange rate and stock prices are also shown to be consistent with standard economic theory. Second, monetary policy also plays a vital role in mitigating the negative effects of foreign shocks (adverse supply shocks) on domestic macroeconomic variables (economic growth and inflation). This finding indicates an important role of monetary policy in stabilizing domestic economy following an adverse supply shock (for example, an increase in world oil price). Third, the effects of foreign shocks on domestic macroeconomic variables are also shown to be consistent with economic theory. Output growth decreases, and the inflation rate rises in response to an adverse supply shock (positive innovation in the world oil price). Fourth, there is no evidence for the output puzzle, price puzzle (after three months), or exchange rate puzzle. However, there is a liquidity puzzle, which is that interest rates respond positively to the positive innovation in money supply after 4 months.

The policy implications in the first essay highlight five significant indications for monetary policy implementation in a small open economy. First, the monetary authority has to monitor closely the external environment, such as shocks resulting from the world oil price, and foreign monetary policy and foreign income in formulating their monetary policy. This is because the foreign shocks have a significant effect on domestic macroeconomic variables. Therefore, by considering the external events in the monetary policy strategy, the monetary authority can implement an appropriate policy for achieving their ultimate target in terms of economic growth and price stability. Second, the monetary authority can also use monetary policy as a stabilization policy in mitigating the negative effects of external shocks on the domestic economy. Third, since interest rates and narrow money supply play a significant role in stimulating economic growth and controlling inflation in Malaysian economy, the monetary authority (in particular, the BNM) has to monitor the developments in narrow money and interest rates[72]. Fourth, the negative response of output growth and inflation to interest rates

[72] In Malaysia, since April 2004, the Monetary Policy Committee (MPC) at the BNM has monitored the stability in the domestic interest rates by controlling the overnight policy rate (OPR). The MPC will decide either to change or not the current level of OPR after observing the current and future domestic and external developments.

indicates that the monetary authority (in particular, the BNM) has a greater opportunity to stimulate economic activity, and maintaining price stability by controlling the inter bank overnight interest rates. Fifth, the monetary authority can also amplify the macroeconomic effects of monetary policy through exchange rate and the stock market effects. This is because the exchange rate can affect the external sector (that is exports and imports) and the stock market can influence investment spending and consumption.

Chapter 3 provides new empirical evidence about the effects of monetary policy shocks (domestic and international monetary policy) upon firm-level equity returns. This study is the first step in examining the relevance of the stock market channel of the monetary transmission mechanism. Monetary policy shocks are generated through an identified VAR (SVAR) by using monthly data. Then, monthly structural shocks have been cumulated within year in order to compute the annual monetary policy shocks. This study also examines the heterogeneous effects of monetary policy shocks by firm size (large and small firm), by financially constrained and less-constrained firms, and by sub-sectors of economic activity. The yearly determinants of firm-level equity returns have been estimated by using an augmented Fama and French (1992, 1996) multifactor model in a dynamic panel GMM framework.

In general, the findings in the second essay have supported economic theory, that is that firm-level equity returns have responded negatively to the monetary policy shocks (domestic and international monetary policy). This finding gives four new directions on the importance of stock market effects in monetary policy analysis. First, the negative response of firm-level equity returns indicates that the monetary authority has a greater chance to influence economic activity through the stock market effects. Second, the significant effect of international monetary policy shock on firm-level equity return indicates the relevance of international risk factors (in particular international monetary policy) in influencing the firm-level stock returns. Third, the effect of domestic monetary policy shocks on stock returns is also heterogeneous, in the sense that small firms' equity is significantly affected by monetary policy, whereas large firms' equity is not significantly affected. In addition, the equity return of financially constrained firms is also significantly more affected by domestic monetary policy than less-constrained firms. These findings show that the small and financially constrained firms are more severely affected by monetary policy tightening, and therefore more likely to downsize investment activity during monetary tightening. Therefore, financial assistance (or capital injection) from the monetary authority may be necessary for helping firms during a monetary contraction. Fourth, the effect of domestic monetary policy is also differential by firm's nature of business, in that only the industrial products sector is significantly affected by monetary policy, whereas other sub-sectors of the economy are not affected. This finding is very important to the monetary authority in assessing the overall effects of monetary policy across sub-sectors of economic activity, and for the firms in formulating their business plans.

The policy implications from the second essay suggest that the monetary authority in a small open economy (in particular the BNM) has to monitor developments in the domestic stock market, which is can be influenced by monetary policy, in order to take advantage of the stock market channel in economic activity. As argued by Mishkin (2007), the fluctuations in the equity market, which are influenced by monetary policy, have an important effect on the aggregate economy. The monetary authority should also monitor the external environment such as international stock markets, and international monetary policy in formulating their monetary policy. This is vital because the foreign variables are a risk factor in domestic equity markets, and can influence the domestic economy through financial market variables. The differential of monetary policy effects on equity returns by firm size, sub-sector of economic activity, and financially constrained and less-constrained firms, have suggested three implications for the monetary authority, market participants, and firms. First, the monetary authority has to make an accurate assessment about the overall effect of monetary policy on economic activity. Second, from the perspective of practitioners or market participants, in particular investors, they should observe all relevant information in the market (internal or external information), in particular monetary policy changes in order to formulating an effective investment strategy, and minimizing their business risk. Third, from the firms' point of view, they should maintain sound financial performance and observe the international and domestic environment in order to stabilize their share prices.

Chapter 4 examines the relevance of two monetary policy channels, namely the interest rate and broad credit channels in transmitting to the disaggregated firm-level investment spending. The relevance of the interest rate and broad-credit channels has been investigated by checking the expected signs of the user cost of capital growth, and the cash-flow to capital stock ratio on firm-level investment, respectively. In addition, this study also examines the heterogeneous effects of monetary policy upon firm-level investment spending by firm size (large and small firms), and by sub-sectors of the economy.

The empirical results provide new evidence on the microeconomic effects of monetary policy in a small open economy (i.e. Malaysia) in four dimensions. First, the user cost of capital growth (which is indirectly affected by policy-controlled interest rates) plays a significant role in affecting firm-level fixed investment expenditures. Second, firm liquidity (cash flow to capital stock ratio) and sales growth are also significant. The significant effect of the user cost of capital growth and cash-flow to capital stock ratio on firm investment spending have supported the relevance of interest rates and broad credit channel of monetary transmission in a small open economy. Third, the results also reveal that the effects of monetary policy channels on the firms' investment are heterogeneous, as the small firms who faced financial constraints responded more to monetary tightening as compared to the large firms (less constrained firms). Fourth, monetary policy effects are also heterogeneous by sub-sectors of the economy, as some sectors (for example, consumer products, industrial products, and services) are significantly affected by monetary policy, and other sub-sectors (for example, property) are not affected. Thus, the monetary authority has to consider the microeconomic aspects of the firm in formulating their monetary policy.

The policy implications suggest that the monetary authority has to monitor the microeconomic aspects of firms' behaviour in designing their monetary policy. This is because the response of the real sector of the economy (in particular, firm-level investment spending) to monetary policy shocks depends on the degree of financial constraint, and the segmentation of firms (by firm size and by sub-sector). Since the interest rate channel plays a significant role in influencing firms' investment, the BNM has a greater opportunity to stabilize investment spending by altering the monetary policy variables, that is the inter bank overnight rate. In addition, the significant role of the broad credit channel indicates that the BNM should monitor the private sector cash flow in order to ensure that they have sufficient liquidity for operating their business (in particular, for investment activity). The heterogeneous nature of monetary policy effects by firm size (small and large firm), and by sub-sector of economic activity indicates that the BNM has to give some financial assistance to the most affected firms during the periods of tight monetary policy. The monetary authority has also to observe the credit market conditions and liquidity in the financial market in order to ensure that the domestic liquidity is reasonable to support the business agenda. In addition, the small firms have to monitor closely their financial condition, in particular the cash flow as a cheaper source of financing.

Future research in the context of this study is proposed in the following directions: First, at the macro level it would be valuable for future research to examine the effectiveness of monetary policy upon the components of interest-sensitive expenditure such as fixed-investment, durable consumption (private consumption), and the trade sector. Second, the relative importance of different channels of monetary transmission should also be considered in evaluating the different roles in the economy. Third, since monetary policy significantly affects the firm-level stock returns (the first step of the monetary transmission mechanism via the stock market channel), the future research should extend to the mechanism by which the stock market channel transmits to the economy. As noted by Mishkin (2007), the transmission mechanisms involving the stock market channel have four types; (i)stock market effects on investment (Tobin's q theory), (ii)firm balance-sheet effects (credit view), (iii)household liquidity effects, and (iv)household wealth effects[73].

Fourth, in the third essay, there are three possible extensions for further study. First, the firm investment model can be estimated by using an alternative investment model such as Tobin-q, Euler equation, and dynamic model in error correction model (ECM). Second, further study should also consider examining the heterogeneous effects

[73] The detailed discussion about the role of the asset price channel in monetary policy transmission can be found in Mishkin (2007).

of monetary policy on different components of investment (not just fixed-investment) such as residential investment, equipment and inventories, structures, and consumer durables. Third, further research could test another channel of the monetary transmission mechanism namely the trade credit and exchange rate channel on firm-level investment spending.

Appendix 2.1 : SVAR with combinations of $I(1)$ and $I(0)$ variable

Following Zivot (2000), consider two observed series y_{1t} and y_{2t}, which is y_{1t} is $I(1)$ and y_{2t} is $I(0)$. By defining $y_t = (\Delta y_{1t}, y_{2t})'$, so that y_t is $I(0)$. Suppose y_t has the structural representations as ;

$$\begin{aligned} By_t &= \gamma_0 + \Gamma_1 y_{t-1} + \varepsilon_t \\ y_t &= \mu + \Phi(L)\varepsilon_t \end{aligned} \tag{2.5}$$

and reduced form representations as;

$$\begin{aligned} y_t &= a_0 + A_1 y_{t-1} + u_t \\ &= \mu + \Psi(L)u_t \end{aligned} \tag{2.6}$$

Where, $E[\varepsilon_t \varepsilon_t'] = D$, D is diagonal, $E[u_t u_t'] = \Omega = B^{-1} D B^{-1'}$, $\Psi(L) = (I_2 - A_1 L)^{-1}$, and $\Phi(L) = \Psi(L) B^{-1}$.

The impulse-response functions are given by;

$$\frac{\delta \Delta y_{1t+s}}{\delta \varepsilon_{1t}} = \phi_{11}^{(s)} \ , \ \frac{\delta \Delta y_{1t+s}}{\delta \varepsilon_{2t}} = \phi_{12}^{(s)} \tag{2.7}$$

$$\frac{\delta y_{2t+s}}{\delta \varepsilon_{1t}} = \phi_{21}^{(s)} \ , \ \frac{\delta y_{2t+s}}{\delta \varepsilon_{2t}} = \phi_{22}^{(s)} \tag{2.8}$$

Since y_{1t} is $I(1)$, and using the fact that

$$y_{it+s} = y_{it-1} + \Delta y_{it} + \Delta y_{it+1} + ... + \Delta y_{it+s} \ , \ i = 1,2 \tag{2.9}$$

the long-run impacts on the level of y_1 of shocks to ε_1 and ε_2 are

$$\lim_{s \to \infty} \frac{\delta y_{1t+s}}{\delta \varepsilon_{1t}} = \theta_{11}(1) = \sum_{s=0}^{\infty} \theta_{11}^{(s)} \tag{2.10}$$

$$\lim_{s \to \infty} \frac{\delta y_{1t+s}}{\delta \varepsilon_{2t}} = \theta_{12}(1) = \sum_{s=0}^{\infty} \theta_{12}^{(s)} \tag{2.11}$$

Equation (2.10) and (2.11) stated that by accumulating the response of the first difference variable (y_{1t}), we can interpret the impact of the structural shocks $(\varepsilon_{1t}, \varepsilon_{2t})$ on the level of level y_{1t}.

Since y_{2t} is $I(0)$, the long-run impacts on the level of y_2 of shocks to ε_1 and ε_2 are zero;

$$\lim_{s \to \infty} \frac{\delta y_{2t+s}}{\delta \varepsilon_{jt}} = \lim_{s \to \infty} \theta_{ij}^{(s)} = 0 \tag{2.12}$$

Appendix 3.1: Number of Firm by Categorised

By sector	Before Detecting Outliers	After Detecting Outliers
Construction	33	24
Consumer Product	66	57
Hotel	04	03
Industrial Product	114	88
Infrastructure	06	06
Mining	01	01
Plantation	30	22
Property	76	61
REITS	01	01
Services	106	88
Technology	12	10
Total Firms	**449**	**361**

Appendix 3.2: Augmented Fama-French Multifactor Model: System GMM Estimation (two step estimation)

Explanatory variable	whole sample coeff.	whole sample corrected std. error	whole sample p-value	large coeff.	large corrected std. error	large p-value	small coeff.	small corrected std. error	small p-value
Lagged Dependent Variable									
$r_{i,t-1}$	0.031	0.041	0.444	0.080	0.040	0.049**	0.093	0.043	0.029**
$r_{i,t-2}$	0.044	0.017	0.011**	0.077	0.027	0.005***	0.156	0.041	0.000***
Domestic Market Return	1.097	0.050	0.000***	1.175	0.145	0.000***	1.266	0.127	0.000***
Small Minus Big (SMB)	0.961	0.076	0.000***	0.595	0.221	0.007***	0.154	0.107	0.151
High Minus Low (HML)	0.064	0.112	0.569	-0.046	0.284	0.873	1.701	0.254	0.034**
International Market Return	0.292	0.046	0.094*	0.138	0.063	0.030**	-0.539	0.253	0.034**
Domestic Monetary Policy Shocks	-0.042	0.024	0.111	-0.005	0.011	0.666	-0.080	0.042	0.060*
International Monetary Policy Shocks	-0.080	0.013	0.000***	-0.067	0.026	0.009***	-0.046	0.023	0.046**
Book-Value-Market Value	0.135	0.022	0.000***	-0.008	0.038	0.833	0.105	0.041	0.011**
Lagged of Real sales growth	0.007	0.009	0.468	0.035	0.010	0.001***	0.0004	0.005	0.930
Financial leverage	0.010	0.009	0.240	0.010	0.029	0.728	-0.018	0.018	0.333
Liquidity	0.034	0.015	0.000***	0.014	0.045	0.751	-0.044	0.035	0.198
Number of observations		2695			1297			952	
Observations per group		7.86			7.67			5.50	
Number of firms		343			169			173	
Number of instrument		274			105			97	
AR(2) –p-value		0.616			0.848			0.416	
Hansen test-p-value		0.203			0.153			0.318	

Note: *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Constant not included in order to save space.

The dependent variable is firm-level equity return (r_{it}) in terms of excess returns. All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at 10 percent significant level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:

Lags 2 to 4 for all endogenous variables and all lags for strictly exogenous variable (whole sample). Lags 2 to all available lags for all endogenous variables and all lags for strictly exogenous variable (large firm and small firm).

The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009) except for the whole sample. The two-step estimations are based on Windmeijer (2005).

Appendix 3.3: Augmented Fama-French Multifactor Model by sub-sector economy: System GMM Estimation (two step estimation)

Explanatory variable	Consumer product			Industrial product			property			services		
	coeff.	corrected std. error	p-value	coeff.	corrected std. error	p-value	coeff.	corrected std. error	p-value	coeff.	corrected std. error	p-value
Lagged Dependent Variable												
$r_{i,t-1}$	0.086	0.067	0.198	0.043	0.044	0.327	0.138	0.063	0.029**	0.048	0.073	0.513
$r_{i,t-2}$	-	-	-	-	-	-	0.197	0.063	0.002***	0.104	0.052	0.046**
Domestic Market Return	1.182	0.224	0.000***	1.249	0.128	0.000***	1.346	0.292	0.000***	1.152	0.211	0.000***
Small Minus Big (SMB)	1.143	0.374	0.002***	0.688	0.336	0.041**	1.769	0.456	0.000***	0.988	0.478	0.039**
High Minus Low (HML)	0.360	0.333	0.280	-1.212	0.373	0.001***	0.686	0.529	0.194	-0.215	0.406	0.597
International Market Return	0.015	0.108	0.887	0.156	0.141	0.267	0.371	0.136	0.006***	0.071	0.138	0.606
Domestic Monetary Policy Shocks	-0.115	0.089	0.195	-0.034	0.016	0.037**	-0.079	0.092	0.395	-0.002	0.022	0.934
International Monetary Policy Shocks	-0.005	0.029	0.857	-0.107	0.025	0.000***	-0.078	0.041	0.062*	-0.004	0.007	0.591
Book-Value-Market Value	-0.026	0.040	0.525	0.022	0.041	0.587	0.004	0.048	0.941	0.050	0.060	0.401
Lagged of Real sales growth	0.323	0.256	0.208	-0.086	0.094	0.359	0.006	0.047	0.902	0.046	0.037	0.214
Financial leverage	-0.058	0.066	0.382	0.022	0.050	0.661	0.011	0.050	0.802	0.071	0.043	0.101
Liquidity	-0.039	0.105	0.715	-0.042	0.070	0.547	0.059	0.073	0.418	0.050	0.053	0.346
Number of observations		362			546			398			567	
Observations per group		6.70			6.66			6.86			6.83	
Number of firms		54			82			58			83	
Number of instrument		28			44			28			36	
AR(2) –p-value		0.895			0.787			0.251			0.253	
Hansen test-p-value		0.610			0.135			0.125			0.520	

Note: *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Constant not included in order to save space.
The dependent variable is firm-level equity return (r_{it}) in terms of excess returns. All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at 10 percent significant level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:

Lags 2 to 3 for all endogenous variables and all lags for strictly exogenous variable (for consumer product and property), lags 2 to 5 for all endogenous variables and all lags for strictly exogenous variable (for industrial product) and lags 2 to 4 for all endogenous variables and all lags for strictly exogenous variable (for services).
The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009) for all sub-sector economy activity. The two-step estimations are based on Windmeijer (2005).

Appendix 3.4: Augmented Fama-French Multifactor Model by financially constrained and less-constrained: System GMM Estimation (two step estimation)

Explanatory variable	Financial constraint firm			Financial less-constraint firm		
	coeff.	corrected std. error	p-value	coeff.	corrected std. error	p-value
Lagged Dependent Variable						
$r_{i,t-1}$	0.151	0.053	0.004***	0.043	0.037	0.248
$r_{i,t-2}$	0.211	0.044	0.000***	0.039	0.039	0.303
Domestic Market Return	1.654	0.249	0.000***	1.479	0.161	0.000***
Small Minus Big (SMB)	2.679	0.597	0.000***	1.552	0.268	0.000***
High Minus Low (HML)	-0.181	0.272	0.507	0.004	0.229	0.984
International Market Return	0.146	0.131	0.265	0.160	0.080	0.045**
Domestic Monetary Policy Shocks	-0.118	0.060	0.049**	-0.039	0.012	0.001***
International Monetary Policy Shocks	-0.007	0.007	0.315	-0.038	0.015	0.013**
Book-Value-Market Value	-0.012	0.042	0.775	-0.014	0.028	0.620
Lagged of Real sales growth	0.084	0.124	0.498	-0.107	0.119	0.370
Financial leverage	0.008	0.024	0.746	0.013	0.018	0.484
Liquidity	0.045	0.043	0.294	0.109	0.042	0.009***
Number of observations		1001			1169	
Observations per group		5.82			6.96	
Number of firms		172			168	
Number of instrument		28			28	
AR(2) –p-value		0.786			0.280	
Hansen test-p-value		0.672			0.500	

Note: *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Constant not included in order to save space.
The dependent variable is firm-level equity return (r_{it}) in terms of excess returns. All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at 10 percent significant level, but not reported here. The full results are available upon request.
Instrument for orthogonal deviation equation:
Lags 2 to 3 for all endogenous variables and all lags for strictly exogenous variable for financially constrainted and less-constrained firm.

The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009).
The two-step estimations are based on Windmeijer (2005).

Appendix 3.5: Augmented Fama-French Multifactor Model: Difference GMM Estimation (one step estimation)

Explanatory variable	whole sample coeff.	whole sample Robust std. error	whole sample p-value	large coeff.	large Robust std. error	large p-value	small coeff.	small Robust std. error	small p-value
Lagged Dependent Variable									
$r_{i,t-1}$	0.101	0.022	0.000***	0.132	0.042	0.002***	0.126	0.042	0.003***
$r_{i,t-2}$	0.073	0.017	0.000***	0.069	0.032	0.029**	0.156	0.038	0.000***
Domestic Market Return	1.122	0.044	0.000***	1.181	0.157	0.000***	1.113	0.156	0.000***
Small Minus Big (SMB)	1.016	0.077	0.000***	0.791	0.222	0.000***	1.719	0.338	0.000***
High Minus Low (HML)	-0.007	0.129	0.958	0.159	0.343	0.644	-0.445	0.233	0.056*
International Market Return	0.301	0.055	0.000***	0.186	0.100	0.062*	0.349	0.129	0.007***
Domestic Monetary Policy Shocks	-0.079	0.020	0.000***	-0.016	0.010	0.120	-0.051	0.052	0.327
International Monetary Policy Shocks	-0.083	0.013	0.000***	-0.056	0.028	0.044**	-0.044	0.024	0.070*
Book-Value-Market Value	0.170	0.028	0.000***	0.086	0.061	0.157	0.192	0.048	0.000***
Lagged of Real sales growth	0.001	0.007	0.841	0.025	0.010	0.011**	0.017	0.027	0.528
Financial leverage	-0.005	0.029	0.869	-0.027	0.044	0.540	0.035	0.034	0.304
Liquidity	0.015	0.021	0.487	-0.017	0.053	0.747	0.020	0.043	0.639
Number of observations		2290			1093			758	
Observations per group		6.82			6.79			4.51	
Number of firms		336			161			168	
Number of instrument		246			96			88	
AR(2) –p-value		0.386			0.339			0.432	
Hansen test-p-value		0.352			0.159			0.588	

Note: *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Constant not included in order to save space.
The dependent variable is firm-level equity return (r_{it}) in terms of excess returns. All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at 10 percent significant level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:

Lags 2 to 5 for all endogenous variables and all lags for strictly exogenous variable (whole sample). Lags 2 to all available lags for all endogenous variables and all lags for strictly exogenous variable (large firm and small firm).

The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009) except for the whole sample.

Appendix 3.6: Augmented Fama-French Multifactor Model: Difference GMM Estimation (two step estimation)

Explanatory variable	whole sample coeff.	whole sample corrected std. error	whole sample p-value	large coeff.	large corrected std. error	large p-value	small coeff.	small corrected std. error	small p-value
Lagged Dependent Variable									
$r_{i,t-1}$	0.1001	0.022	0.000***	0.137	0.040	0.001***	0.110	0.046	0.017**
$r_{i,t-2}$	0.073	0.019	0.000***	0.085	0.029	0.003***	0.162	0.039	0.000***
Domestic Market Return	1.124	0.046	0.000***	1.139	0.136	0.000***	1.125	0.126	0.000***
Small Minus Big (SMB)	1.013	0.078	0.000***	0.710	0.215	0.001***	1.583	0.305	0.000***
High Minus Low (HML)	-0.011	0.124	0.927	0.092	0.297	0.756	-0.706	0.249	0.005***
International Market Return	0.294	0.054	0.000***	0.170	0.099	0.087*	0.375	0.125	0.003***
Domestic Monetary Policy Shocks	-0.080	0.023	0.000***	-0.013	0.010	0.209	-0.065	0.049	0.188
International Monetary Policy Shocks	-0.085	0.013	0.000***	-0.058	0.028	0.037**	-0.064	0.024	0.009***
Book-Value-Market Value	0.168	0.029	0.000***	0.069	0.058	0.234	0.172	0.047	0.000***
Lagged of Real sales growth	-0.0003	0.008	0.962	0.026	0.103	0.013**	0.026	0.031	0.405
Financial leverage	-0.005	0.028	0.867	-0.008	0.057	0.893	0.013	0.039	0.746
Liquidity	0.015	0.022	0.490	-0.011	0.051	0.835	0.006	0.038	0.876
Number of observations		2290			1093			758	
Observations per group		6.82			6.79			4.51	
Number of firms		336			161			168	
Number of instrument		246			96			88	
AR(2) –p-value		0.539			0.339			0.411	
Hansen test-p-value		0.352			0.159			0.588	

Note: *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Constant not included in order to save space.

The dependent variable is firm-level equity return (r_{it}) in terms of excess returns. All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at 10 percent significant level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:

Lags 2 to 3 for all endogenous variables and all lags for strictly exogenous variable (for consumer product and property), lags 2 to 5 for all endogenous variables and all lags for strictly exogenous variable (for industrial product) and lags 2 to 4 for all endogenous variables and all lags for strictly exogenous variable (for services).

The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009) for all sub-sector economy activity.

The two-step estimations are based on Windmeijer (2005).

Appendix 3.7: Augmented Fama-French Multifactor Model: Difference GMM Estimation (one step estimation)

Explanatory variable	Consumer product			Industrial product			property			services		
	coeff.	Robust std. error	p-value	coeff.	Robust std. error	p-value	coeff.	Robust std. error	p-value	coeff.	Robust std. error	p-value
Lagged Dependent Variable												
$r_{i,t-1}$	0.119	0.052	0.023**	0.122	0.038	0.001***	0.282	0.079	0.000***	0.138	0.103	0.180
$r_{i,t-2}$	-	-	-	-	-	-	0.273	0.058	0.000***	0.147	0.092	0.111
Domestic Market Return	1.207	0.225	0.000***	1.084	0.141	0.000***	0.752	0.467	0.107	0.920	0.212	0.000***
Small Minus Big (SMB)	0.922	0.329	0.005***	0.730	0.201	0.000***	1.761	0.346	0.000***	1.067	0.272	0.000***
High Minus Low (HML)	0.245	0.381	0.520	-1.211	0.344	0.000***	1.083	0.891	0.224	0.981	1.219	0.421
International Market Return	0.020	0.155	0.896	0.297	0.156	0.057*	0.626	0.228	0.006***	0.183	0.182	0.316
Domestic Monetary Policy Shocks	-0.165	0.064	0.009***	-0.013	0.012	0.280	-0.015	0.079	0.851	-0.002	0.017	0.917
International Monetary Policy Shocks	-0.002	0.023	0.923	-0.085	0.024	0.000***	-0.023	0.071	0.743	-0.002	0.012	0.890
Book-Value-Market Value	0.061	0.079	0.439	0.269	0.058	0.000***	0.280	0.105	0.008***	0.234	0.134	0.080*
Lagged of Real sales growth	0.043	0.147	0.771	0.016	0.083	0.842	0.025	0.010	0.014**	0.050	0.044	0.251
Financial leverage	-0.056	0.050	0.256	0.090	0.043	0.037**	0.046	0.073	0.528	0.117	0.063	0.063*
Liquidity	-0.026	0.085	0.764	0.027	0.051	0.592	-0.002	0.207	0.992	0.088	0.075	0.241
Number of observations		303			453			328			469	
Observations per group		5.94			5.66			5.86			5.72	
Number of firms		51			80			56			82	
Number of instrument		19			50			19			27	
AR(2) –p-value		0.297			0.775			0.830			0.140	
Hansen test-p-value		0.446			0.146			0.283			0.729	

Note: *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Constant not included in order to save space.
The dependent variable is firm-level equity return (r_{it}) in terms of excess returns. All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at 10 percent significant level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:
Lags 2 to 3 for all endogenous variables and all lags for strictly exogenous variable (for consumer product and property), lags 2 to 5 for all endogenous variables and all lags for strictly exogenous variable (for industrial product) and lags 2 to 4 for all endogenous variables and all lags for strictly exogenous variable (for services).

The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009) for all sub-sector economy activity.

Appendix 3.8: Augmented Fama-French Multifactor Model: Difference GMM Estimation (two step estimation)

Explanatory variable	Consumer product			Industrial product			property			services		
	coeff.	corrected std. error	p-value	coeff.	corrected std. error	p-value	coeff.	corrected std. error	p-value	coeff.	corrected std. error	p-value
Lagged Dependent Variable												
$r_{i,t-1}$	0.122	0.050	0.014^{**}	0.138	0.043	0.001^{***}	0.260	0.124	0.036^{**}	0.112	0.075	0.138
$r_{i,t-2}$	-	-	-	-	-	-	0.265	0.066	0.000^{***}	0.100	0.061	0.101
Domestic Market Return	1.263	0.248	0.000^{***}	1.146	0.154	0.000^{***}	0.885	0.602	0.142	1.054	0.163	0.000^{***}
Small Minus Big (SMB)	1.020	0.303	0.001^{***}	0.726	0.218	0.001^{***}	1.939	0.512	0.000^{***}	1.113	0.313	0.000^{***}
High Minus Low (HML)	0.277	0.359	0.441	-1.185	0.397	0.003^{***}	1.019	1.282	0.426	-0.068	0.432	0.875
International Market Return	0.041	0.158	0.793	0.207	0.161	0.197	0.536	0.272	0.049^{**}	0.235	0.188	0.212
Domestic Monetary Policy Shocks	-0.198	0.070	0.005^{***}	-0.017	0.013	0.186	-0.032	0.067	0.628	-0.016	0.014	0.272
International Monetary Policy Shocks	-0.014	0.022	0.517	-0.096	0.024	0.000^{***}	-0.015	0.090	0.867	-0.005	0.007	0.504
Book-Value-Market Value	0.079	0.086	0.359	0.241	0.072	0.001^{***}	0.267	0.186	0.150	0.323	0.088	0.000^{***}
Lagged of Real sales growth	-0.002	0.165	0.992	-0.013	0.088	0.880	0.025	0.015	0.113	0.011	0.047	0.810
Financial leverage	-0.062	0.076	0.413	0.094	0.045	0.034^{**}	0.062	0.010	0.535	0.069	0.045	0.125
Liquidity	-0.029	0.14	0.801	0.020	0.056	0.729	-0.095	0.223	0.669	0.098	0.059	0.099
Number of observations		303			453			328			469	
Observations per group		5.94			5.66			5.86			5.72	
Number of firms		51			50			56			82	
Number of instrument		19			50			19			27	
AR(2) –p-value		0.236			0.971			0.956			0.163	
Hansen test-p-value		0.446			0.146			0.283			0.729	

Note: *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Constant not included in order to save space.
The dependent variable is firm-level equity return (r_{it}) in terms of excess returns. All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at 10 percent significant level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:

Lags 2 to 3 for all endogenous variables and all lags for strictly exogenous variable (for consumer product and property), lags 2 to 5 for all endogenous variables and all lags for strictly exogenous variable (for industrial product) and lags 2 to 4 for all endogenous variables and all lags for strictly exogenous variable (for services).
The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009) for all sub-sector economy activity. The two-step estimations are based on Windmeijer (2005).The two-step estimations are based on Windmeijer (2005).

Appendix 3.9: Augmented Fama-French Multifactor Model: Difference GMM Estimation (one step estimation)

	Financial constraint firm			Financial less-constraint firm		
Explanatory variable	coeff.	Robust std. error	p-value	coeff.	Robust std. error	p-value
Lagged Dependent Variable						
$r_{i,t-1}$	0.171	0.040	0.000***	0.098	0.045	0.029**
$r_{i,t-2}$	0.168	0.039	0.000***	0.074	0.040	0.064*
Domestic Market Return	1.186	0.228	0.000***	1.279	0.195	0.000***
Small Minus Big (SMB)	1.320	0.257	0.000***	1.645	0.267	0.000***
High Minus Low (HML)	-0.139	0.337	0.678	0.145	0.295	0.621
International Market Return	0.335	0.154	0.030**	0.306	0.101	0.002***
Domestic Monetary Policy Shocks	-0.118	0.065	0.069*	-0.035	0.018	0.071*
International Monetary Policy Shocks	-0.015	0.006	0.006***	-0.032	0.018	0.071*
Book-Value-Market Value	0.162	0.059	0.007***	0.185	0.087	0.035
Lagged of Real sales growth	0.123	0.110	0.267	0.049	0.118	0.678
Financial leverage	-0.007	0.069	0.914	-0.038	0.058	0.503
Liquidity	0.110	0.080	0.171	0.000	0.073	0.999
Number of observations		809			973	
Observations per group		4.90			6.01	
Number of firms		165			162	
Number of instrument		35			19	
AR(2) –p-value		0.839			0.294	
Hansen test-p-value		0.132			0.557	

Note: *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Constant not included in order to save space.
The dependent variable is firm-level equity return (r_{it}) in terms of excess returns. All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at 10 percent significant level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:

Lags 2 to 3 for all endogenous variables and all lags for strictly exogenous variable for financially constrained and less-constrained firm.

The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009).

Appendix 3.10: Augmented Fama-French Multifactor Model: Difference GMM Estimation (two step estimation)

Explanatory variable	Financial constraint firm coeff.	Financial constraint firm corrected std. error	Financial constraint firm p-value	Financial less-constraint firm coeff.	Financial less-constraint firm corrected std. error	Financial less-constraint firm p-value
Lagged Dependent Variable						
$r_{i,t-1}$	0.182	0.051	0.000^{***}	0.119	0.043	0.005^{***}
$r_{i,t-2}$	0.178	0.041	0.000^{***}	0.064	0.039	0.098^{*}
Domestic Market Return	1.182	0.306	0.000^{***}	1.251	0.158	0.000^{***}
Small Minus Big (SMB)	1.282	0.347	0.000^{***}	1.547	0.217	0.000^{***}
High Minus Low (HML)	-0.282	0.364	0.439	0.123	0.277	0.656
International Market Return	0.378	0.485	0.041^{**}	0.306	0.088	0.000^{***}
Domestic Monetary Policy Shocks	-0.136	0.079	0.087^{*}	-0.037	0.014	0.011^{**}
International Monetary Policy Shocks	-0.020	0.007	0.002^{***}	-0.036	0.017	0.041^{**}
Book-Value-Market Value	0.182	0.081	0.025^{**}	0.200	0.091	0.029
Lagged of Real sales growth	0.167	0.165	0.309	-0.066	0.125	0.599
Financial leverage	0.015	0.064	0.814	-0.053	0.056	0.942
Liquidity	0.059	0.068	0.379	-0.006	0.085	0.942
Number of observations		809			973	
Observations per group		4.90			6.01	
Number of firms		165			162	
Number of instrument		35			19	
AR(2) –p-value		0.820			0.341	
Hansen test-p-value		0.112			0.557	

Note: *** significant at 1 percent; ** significant at 5 percent; * significant at 10 percent. Constant not included in order to save space.
The dependent variable is firm-level equity return (r_{it}) in terms of excess returns. All *p-value* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at 10 percent significant level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:
Lags 2 to 3 for all endogenous variables and all lags for strictly exogenous variable for financially constrained and less-constrained firm.

The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009). The two-step estimations are based on Windmeijer (2005)

Appendix 4.1: The Derivation of Neoclassical Demand for Capital

Assume that the firm production function can be represented as CES function as follows;

$$F\left(L_{it,}K_{it}\right)=TFP_iA_t\left[\beta_iL_{it}^{\frac{\sigma-1}{\sigma}}+\alpha_iK_{it}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}\upsilon} \quad (4.11)$$

By taking the first order condition of capital (K) yields;

$$F_K=TFP_iA_t\frac{\sigma}{\sigma-1}\upsilon\left[\beta_iL_{it}^{\frac{\sigma-1}{\sigma}}+\alpha_iK_{it}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}\upsilon-1}\alpha_i\frac{\sigma-1}{\sigma}K_{it}^{\frac{\sigma-1}{\sigma}-1} \quad (4.12)$$

According to the neoclassical model, the firm will demand the capital stock until the marginal product of capital (F_K) and the user cost of capital (UC_{it}) are equal as follows;

$$F_K=TFP_iA_t\frac{\sigma}{\sigma-1}\upsilon\left[\beta_iL_{it}^{\frac{\sigma-1}{\sigma}}+\alpha_iK_{it}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}\upsilon-1}\alpha_i\frac{\sigma-1}{\sigma}K_{it}^{\frac{\sigma-1}{\sigma}-1}=UC_{it} \quad (4.13)$$

Equation [4.13] can be rewritten as;

$$F_K=TFP_iA_t\left[\beta_iL_{it}^{\frac{\sigma-1}{\sigma}}+\alpha_iK_{it}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}\upsilon}[\varphi]^{-1}\upsilon\alpha_iK_{it}^{-1/\sigma}=UCC_{it} \quad (4.14)$$

Where, $Y_{it}=TFP_iA_t\varphi^{\frac{\sigma}{\sigma-1}\upsilon}$ and $\varphi=\left[\frac{Y_{it}}{TFP_iA_t}\right]^{\frac{\sigma-1}{\upsilon\sigma}}$

By rearranging equation [4.14],

$$Y_{it}\left(\frac{Y_{it}}{TFP_iA_t}\right)^{-\frac{\sigma-1}{\upsilon\sigma}}\upsilon\alpha_iK_{it}^{-\frac{1}{\sigma}}=UCC_{it} \quad (4.15)$$

By transforming equation [4.15] into log function, it yields;

$$1-\frac{\sigma-1}{\upsilon\sigma}\log Y_{it}+\log\left(TFP_t^{\frac{\sigma-1}{\upsilon\sigma}}\upsilon\alpha_i\right)-\frac{1}{\sigma}\log K_{it}=\log UCC_{it} \tag{4.16}$$

Equation [4.16] can be simplified as;

$$\frac{\upsilon\sigma-\sigma+1}{\upsilon}y_{it}+\log\left(TFP_t^{\frac{\sigma-1}{\upsilon}}(\upsilon\alpha_i)^{\sigma}\right)-k_{it}=\sigma uc_{it} \tag{4.17}$$

Since, $\frac{\upsilon\sigma-\sigma+1}{\upsilon}=\sigma-\frac{\sigma-1}{\upsilon}=\sigma+\frac{1-\sigma}{\upsilon}=\theta$ and $\log\left(TFP_t^{\frac{\sigma-1}{\upsilon}}(\upsilon\alpha_i)^{\sigma}\right)=h_{it}$, therefore the demand for capital stock according to the neoclassical theory is represented as;

$$k_{it}=\theta y_{it}-\sigma uc_{it}+h_{it} \tag{4.18}$$

Appendix 4.2 : Number of Firm by Categorised

By sector	Before Detecting Outliers	After Detecting Outliers
Construction	38	29
Consumer Product	75	66
Hotel	04	04
Industrial Product	127	116
Infrastructure	06	04
Plantation	34	26
Property	84	58
Services	118	103
Technology	14	13
Total Firms	**500**	**419**

REFERENCES

ACEMOGLU, D., S.JOHNSON, ROBINSON, J. A. & P.YARED 2005. From education to democracy? *American Economic Review,* 95**,** 44-49.

AGUNG, J. 2000. Financial constraint, firms' investments and the channel of monetary policy in Indonesia. *Applied Economics,* 32**,** 1637-1646.

ALLEN, D. E. & CLEARY, F. 1998. Determinants of cross-section of stock returns in the Malaysian stock market. *International Review of Financial Analysis,* 7**,** 253-275.

ALONSO-BORREGO, C. & ARELLANO, M. 1999. Symmetrically normalized instrumental variable estimation using panel data. *Journal of Business & Economic Statistics,* 17**,** 36-49.

AMISANO, G. & GIANNINI, C. 1996. *Topics in structural VAR econometrics,* Berlin, Springer.

ANDERSON, T. W. & HSIAO, C. 1982. Formulation and estimation of dynamics models using panel data. *Journal of Econometric,* 18**,** 570-606.

ANG, J. B. 2009. Private Investment and Financial Sector Policies in India and Malaysia. *World Development,* 37**,** 1261-1273.

ANGELONI, I., KASHYAP, A. & MOJON, B. 2001. *Monetary policy transmission in the Euro area,* Edinburgh, Cambridge University Press.

ARELLANO, M. & BOND, S. 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies,* 58**,** 277-297.

ARELLANO, M. & BOVER, O. 1995. Another look at the instrumental-variable estimation of error-components models. *Journal of Econometric,* 68**,** 29-52.

AZALI, M. 1998. The roles of money and credit in the monetary policy transmission mechanism : Preliminary evidence using Malaysian quarterly data. *Asian Economic Review***,** 395-405.

AZALI, M. & MATTHEWS, K. 1999. Money-Income and Credit-Income Relationships during the Pre-and the Post-Liberalization Periods: Evidence from Malaysia. *Applied Economics,* 31**,** 1161-1170.

BALTAGI, B. H. 2008. *Econometric Analysis of Panel Data,* UK, John Wiley & Sons, Ltd.

BARTH, M. J. & RAMEY, V. A. 2000. The cost channel of monetary transmission. *NBER Working Paper Series.* Cambridge: National Bureau of Economic Research.

BASISTHA, A. & KUROV, A. 2008. Macroeconomic cycles and stock market's reaction to monetary policy. *Journal of Banking & Finance,* 32**,** 2606-2616.

BAUM, C. F. 2006. *An introduction to modern econometric using stata,* College Station, Texas, A Stata Press Publication, StataCorp LP.

BECK, T. & LEVINE, R. 2004. Stock markets,banks, and growth: panel evidence. *Journal of Banking and Finance,* 58.

BELSLEY, D. A. 1991. *Conditioning diagnostics: Collinearity and weak data in regression,* New York, Wiley.

BELSLEY, D. A., KUH, E. & WELSCH, R. E. 1980. *Regressions Diagnostics : Identifying influential data and sources of collinearity,* New York, Wiley.

BERNANKE, B., GERTLER, M. & GILCHRIST, S. 1996. The financial accelerator and flight to quality. *The Review of Economics and Statistics,* 78**,** 1-15.

BERNANKE, B. S. 1986. Alternative explanations of the money-income correlation. *Carnegie-Rochester Conference Series on Public Policy,* 25**,** 49-100.

BERNANKE, B. S. & BLINDER, A. S. 1992. The federal funds rate and the channel of monetary transmission. *The American Economic Review,* 82**,** 901-921.

BERNANKE, B. S. & GERTLER, M. 1989. Agency cost, net worth, and business fluctuations. *American Economic Review,* 79**,** 14-31.

BERNANKE, B. S. & GERTLER, M. 1995. Inside the black box: The credit channel of monetary policy transmission. *Journal of Economic Perspectives,* 9**,** 27-48.

BERNANKE, B. S., GERTLER, M. & WATSON, M. 1997. Systematic monetary policy and the effects of oil shocks. *Brookings papers on Economic Activity,* 1**,** 91-157.

BERNANKE, B. S. & KUTTNER, K. N. 2005. What explains the stock market's reaction to the Federal Reserve policy? *The Journal of Finance,* 60**,** 1221-1257.

BERNANKE, B. S. & MIHOV, I. 1998. Measuring monetary policy. *The Quarterly Journal of Economics,* 113**,** 869-902.

BHAGAT, S., MOYEN, N. & SUH, I. 2005. Investment and internal funds of distressed firms. *Journal of Corporate Finance,* 11**,** 449-472.

BJØRNLAND, H. C. & LEITEMO, K. 2009. Identifying the interdependence between US monetary policy and the stock market. *Journal of Monetary Economics,* 56**,** 275-282.

BLANCHARD, J. B. & GALI, J. 2007. The macroeconomics effects of oil price shocks: Why are the 2000s so different from the 1970s? *NBER, Working papers.*

BLANCHARD, O. & QUAH, D. 1989. The dynamic effects of aggregate demand and supply disturbances. *American Economic Review,* 79**,** 655-673.

BLUNDELL, R. & BOND, S. 1998. Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics,* 87**,** 115-143.

BOND, S., ELSTON, J. A., MAIRESSE, J. & MULKAY, B. 2003. Financial factors and investment in Belgium, France, Germany, and the United Kingdom: A comparison using company panel data. *The Review of Economics and Statistics,* 85**,** 153-165.

BOND, S. & REENEN, J. V. 1999. Microeconometric models of investment and employment. London: Institute of Fiscal Studies.

BOND, S. R. 2002. Dynamic panel data: a guide to micro data methods and practice. *Portuguese Economic Journal,* 1**,** 141-162.

BREDIN, D., HYDE, S., NITZSCHE, D. & O'REILLY, G. 2007. UK stock returns and the impact of domestic monetary policy shocks. *Journal of Business Finance & Accounting,* 34**,** 872-888.

BREDIN, D., HYDE, S., NITZSCHE, D. & O'REILLY, G. 2009. European monetary policy surprises: The aggregate and sectoral stock market response. *International Journal of Finance and Economics,* 14**,** 156-171.

BRISCHETTO, A. & VOSS, G. 1999. A structural vector auto regression model of monetary policy in Australia. *Research Discussion Paper, Reserve Bank of Australia.*

BUCKLE, R. A., KIM, K., KIRKHAM, H., H., M. & SHARMA, J. 2007. A Structural VAR business cycle model for a volatile small open economy. *Economic Modeling,* 24**,** 990-1017.

BUTZEN, P., FUSS, C. & VERMEULEN, P. 2003. Business investment and monetary transmission in Belgium. *In:* ANGELONI, I., KASHYAP, A. & MOJON, B.

(eds.) *Monetary policy transmission in the Euro area.* United Kingdom: Cambridge University Press.

CALDERON, C. A., CHONG, A. & LOAYZA, N. V. 2002. Determinants of current account deficits in developing countries. *Contribution to Macroeconomics,* 2**,** 1-31.

CANOVA, F. 2005. The transmission of US shocks to Latin America. *Journal of Applied Econometrics,* 20**,** 229-251.

CAPORALE, G. M., CIPOLLINI, A. & DEMETRIADES, P. O. 2005. Monetary policy and the exchange rate during the Asian crisis: identification through heteroscedasticity. *Journal of International Money and Finance,* 24**,** 39-53.

CARDOVIC, C. A. & LEVINE, R. 2005. Does foreign direct investment accelerate economic growth? *In:* MORAN, T., GRAHAM, E. & BLOMSTROM, M. (eds.) *Does foreign direct investment promote development.* Washington, DC: Institute for International Economics and Center for Global Development.

CASSOLA, N. & MORANA, C. 2004. Monetary policy and the stock market in the euro area. *Journal of Policy Modeling,* 26**,** 387-399.

CHATELAIN, J.-B., EHRMANN, M., GENERALE, A., MARTINEZ-PAGES, J., VERMUELEN, P. & WORMS, A. 2003a. Monetary policy transmission in the Euro area : new evidence from micro data on firms and banks. *European Economic Association,* 1**,** 731-742.

CHATELAIN, J.-B., GENERALE, A., HERNANDO, I., KALCKREUTH, U. V. & VERMEULEN, P. 2003b. New findings on firm investment and monetary transmission in the Euro area. *Oxford Review of Economic Policy,* 19**,** 73-82.

CHATELAIN, J. B. & TIOMO, A. 2003. Monetary policy and corporate investment in France. *In:* ANGELONI, I., KASHYAP, A. & MOJON, B. (eds.) *Monetary Policy tranmission in the Euro area.* United Kingdom: Cambridge University Press.

CHIRINKO, R. S. 1993. Business fixed investment spending: modelling strategies, empirical results, and policy implications. *Journal of Economic Literature,* 31**,** 1875-1911.

CHIRINKO, R. S., FAZZARI, S. M. & MEYER, A. P. 1999. How responsive is business capital formation to its user cost?: An exploration with micro data. *Journal of Public Economics,* 74**,** 53-80.

CHRISTIANO, L. J., EICHENBAUM, M. & EVANS, C. 1996. The effects of monetary policy shocks: Evidence from the flow of funds. *Review of Economics and Statistics,* 78**,** 16-34.

CLARE, A. D. & PRIESTLEY, R. 1998. Risk factors in the Malaysian stock market. *Pacific-Basin Finance Journal,* 6**,** 103-114.

CONOVER, C. M., JENSEN, G. R. & JOHNSON, R. R. 1999. Monetary environments and international stock returns. *Journal of Banking & Finance,* 23**,** 1357-1381.

COOLEY, T. F. & LEROY, S. F. 1985. Atheoretical macroeconomics: a critique. *Journal of Monetary Economics,* 16**,** 283-308.

CUSHMAN, D. O. & ZHA, T. 1997. Identifying monetary policy in a small open economy under flexible exchange rates. *Journal of Monetary Economics,* 39**,** 433-448.

DANIEL, K. & TITMAN, S. 1997. Evidence on the characteristics of cross sectional variation in stock returns. *Journal of Finance,* 52**,** 1-33.

DAVIS, J. L. 1994. The cross-section of realized stock returns. *The Journal of Finance,* 49**,** 1579-1593.

DEDOLA, L. & LIPPI, F. 2005. The monetary transmission mechanism: Evidence from the industries of five OECD countries. *European Economic Review,* 49**,** 1543-1569.

DOMAC, I. 1999. The Distributional Consequences of Monetary Policy : Evidence from Malaysia. *Policy Research Working Paper the World Bank, East Asia and Pacific Region.*

DUNGEY, M. & PAGAN, A. 2000. A Structural VAR Model of the Australian Economy. *The Economic Record,* 76**,** 321-342.

EGERT, B. & MACDONALD, R. 2009. Monetary transmission mechanism in central and eastern Europe: surveying the surveyable *Journal of Economic Survey,* 23**,** 277-327.

EHRMANN, M. & FRATZSCHER, M. 2004. Taking Stock: Monetary policy transmission to equity markets. *Journal of Money, Credit, and Banking,* 36**,** 719-737.

EHRMANN, M. & FRATZSCHER, M. 2006. Global financial transmission of monetary policy shocks. *European Central Bank (ECB) Working Paper No. 616.* Franfurt, Germany: European Central Bank (ECB).

EHRMANN, M., FRATZSCHER, M. & RIGOBON, R. 2005. Stock, bonds, money markets and exchange rate:Measuring international financial transmission. *NBER Working Paper Series.* Massachusetts Avenue, Cambridge: National Bureau of Economic Research.

FAMA, E. F. & FRENCH, K. R. 1992. The cross-section of expected stock returns *The Journal of Finance,* XLVII**,** 427-465.

FAMA, E. F. & FRENCH, K. R. 1996. Multifactor explanations of asset pricing anomalies. *The Journal of Finance,* 51**,** 55-84.

FAUST, J. 1998. The robustness of identified VAR conclusion about money. *Carnegie-Rochester Conference Series on Public Policy,* 49**,** 207-244.

FAZZARI, S., HUBBARD, R. G. & PETERSON, B. 1988. Financing constraints and corporate investment. *Brookings Papers on Economic Activity,* 1**,** 141-195.

FULLER, W. A. 1976. *Introduction to statistical time series,* New York, John Wiley.

GAIOTTI, E. & GENERALE, A. 2003. Monetary policy and firms' investment in Italy. *In:* ANGELONI, I., KASHYAP, A. & MOJON, B. (eds.) *Monetary policy tranmission in the Euro area.* United Kingdom: Cambridge University Press.

GALI, J. 1992. How well does the IS-LM model fit postwar U.S data? *The Quarterly Journal of Economics,* 107**,** 709-738.

GANLEY, J. & SALMON, C. 1997. The industrial impact of monetary policy shocks: some stylised facts. *Bank of England 1997, Working Paper.* London: Bank of England.

GERTLER, M. 1988. Financial structure and aggregate activity. *Journal of Money, Credit, and Banking,* 20**,** 559-588.

GERTLER, M. & GILCHRIST, S. 1994. Monetary policy, business cycles, and the behavior of small manufacturing firms. *The Quarterly Journal of Economics,* CIX**,** 309-340.

GORDON, D. B. & LEEPER, E. M. 1994. The dynamic impacts of monetary policy: An exercise in tentative identification. *Journal of Political Economy,* 102**,** 1228-1247.

GREGORIOU, A., KONTONIKAS, A., MACDONALD, R. & MONTAGNOLI, A. 2009. Monetary policy shocks and stock returns: Evidence from the British market. *Financial Market and Portfolio Management (forthcoming)*.

GRILLI, V. & ROUBINI, N. 1995. Liquidity and exchange rates: puzzling evidence from the G-7 countries. *Working paper.* Yale University.

GRINBLATT, M. & MOSKOWITZ, T. J. 2004. Predicting stock price movements from past returns: the role of consistency and tax-loss selling. *Journal of Financial Economics,* 71**,** 541-579.

GUARIGLIA, A. & MATEUT, S. 2006. Credit channel, trade credit channel, and inventory investment: Evidence from a panel of UK firms. *Journal of Banking & Finance,* 30**,** 2835-2856.

HABIBULLAH, M. S. & BAHARUMSHAH, A. Z. 1996. Money, output and stock prices in Malaysia:an application of cointegration tests. *International Economic Journal,* 10**,** 317-333.

HALL, R. E. & JORGENSON, D. W. 1967. Tax policy and investment behaviour *American Economics Review,* 57 391-414.

HAMILTON, J. 1983. Oil and the Macro economy since World War II. *Journal of Political Economy***,** 228-248.

HAMILTON, J. 1996. This is what happened to the oil price macro economy relationship. *Journal of Monetary Economics,* 38**,** 215-220.

HANDA, J. 2000. *Monetary Economics,* London, Routledge.

HANDA, J. 2009. *Monetary Economics,* London and New York, Routledge, Taylor & Francis Group.

HAYAKAWA, K. 2009. First difference or forward orthogonal deviations- which transformation should be used in dynamic panel data models?: a simulation study. *Economics Bulletin,* 29**,** 1-9.

HAYO, B. & UHLENBROCK, B. 2000. Industry effects of monetary policy in Germany. *In:* HAGEN, J. V. & WALLER, C. (eds.) *Regional Aspects of Monetary Policy in Europe.* Boston: Kluwer.

IBRAHIM, M. 2005. Sectoral effect of monetary policy: Evidence from Malaysia. *Asian Economic Journal,* 19**,** 83-102.

IBRAHIM, M. H. 1999. Macroeconomics variables and stock prices in Malaysia: an empirical analysis. *Asian Economic Journal,* 13**,** 219-231.

IBRAHIM, M. H. & AZIZ, H. 2003. Macroeconomics variables and the Malaysian equity market. *Journal of Economic Studies,* 30**,** 6-27.

IOANNIDIS, C. & KONTONIKAS, A. 2008. The impact of monetary policy on stock prices *Journal of Policy Modelling,* 30**,** 33-53.

JEGADEESH, N. 1990. Evidence of predictable behavior of security returns. *The Journal of Finance,* 45**,** 881-898.

JEGADEESH, N. & TITMAN, S. 1993. Returns to buying winners and selling losers: implications for stock market efficiency. *The Journal of Finance,* XLVIII**,** 65-91.

JENSEN, G. R. & JOHNSON, R. R. 1995. Discount rate changes and security returns in the U.S., 1962-1991. *Journal of Banking & Finance,* 19**,** 79-95.

JENSEN, G. R. & MERCER, J. M. 2002. Monetary policy and the cross-section of expected stock return. *The Journal of Financial Research,* XXV**,** 125-139.

KALCKREUTH, U. V. 2003. Investment and monetary transmission in Germany: a microeconometric investigation. *In:* ANGELONI, I., KASHYAP, A. & MOJON,

B. (eds.) *Monetary policy transmission in the Euro area.* United Kingdom: Cambridge University Press.
KAPLAN, S. N. & ZINGALES, L. 1997. Do investment cash flow sensitivities provide useful measures of financing constraints. *Quarterly Journal of Economics*, 213-237.
KASHYAP, A. K., LAMONT, O. A. & STEIN, J. C. 1994. Credit conditions and the cyclical behaviour of inventories. *The Quarterly Journal of Economics,* 109, 565-592.
KASHYAP, A. K., STEIN, J. C. & WILCOX, D. W. 1993. Monetary policy and credit conditions:evidence from the composition of external finance. *American Economic Review,* 83, 78-98.
KHOLODILIN, K., MONTAGNOLI, A., NAPOLITANO, O. & SILIVERSTOVS, B. 2009. Assessing the impact of the ECB's monetary policy on the stock markets: A sectoral view. *Economics Letters,* 105, 211-213.
KIM, S. 2001. International transmission of U.S monetary policy shocks: evidence from VAR's. *Journal of Monetary Economics,* 48, 339-372.
KIM, S. & ROUBINI, N. 2000. Exchange rate anomalies in the industrial countries: A solution with a structural VAR approach. *Journal of Monetary Economics,* 45, 561-586.
KUTTNER, K. N. 2001. Monetary policy surprises and interest rates: Evidence from the Fed funds futures market. *Journal of Monetary Economics,* 47, 523-544.
LAEVEN, L. 2002. Financial constraints on investments and credit policy in Korea. *Journal of Asian Economics,* 13, 251-269.
LAKONISHOK, J., SHLEIFER, A. & VISHNY, R. W. 1993. Contrarian investment, extrapolation, and risk. *NBER Working Paper Series.* Cambridge: National Bureau of Economic Research.
LAMONT, O., POLK, C. & SAA-REQUEJO, J. 2001. Financial constrainst and stock returns. *The Review of Financial Studies,* 14, 529-554.
LASTRAPES, W. D. 1998. International evidence on equity prices, interest rates and money. *Journal of International Money and Finance,* 17, 377-406.
LAU, S. T., LEE, C. T. & MCINISH, T. H. 2002. Stock returns and beta, firms size, E/P, CF/P, book-to-market, and sales growth: evidence from Singapore and Malaysia. *Journal of Multinational Financial Management,* 12, 207-222.
LEEPER, E. M. & GORDON, D. B. 1991. In search of the liquidity effect. *Journal of Monetary Economics,* 29, 341-369.
LEVTCHENKOVA, S., PAGAN, A. R. & ROBERTSON, J. C. 1998. Shocking stories. *Journal of Economic Survey,* 12, 507-532.
LEVY, J. & HALIKIAS, I. 1997. Aspects of monetary transmission mechanism under exchange rate targeting: the case of France. *IMF Working Paper Series.*
LOVE, I. & ZICCHINO, L. 2006. Financial development and dynamic investment behavior: Evidence from panel VAR. *The Quarterly Review of Economics and Finance,* 46, 190-210.
LUDVIGSON, S., STEINDEL, C. & LETTAU, M. 2002. Monetary policy transmission through the consumption-wealth channel. *FRBNY Economic Policy Review*, 117-133.
LUNNEMANN, P. & MATHA, T. 2003. Monetary transmission: empirical evidence in Luxembourg firm-level data. *In:* ANGELONI, I., KASHYAP, A. & MOJON, B.

(eds.) *Monetary policy transmission in the Euro area.* United Kingdom: Cambridge University Press.

LUTKEPOHL, H. & KRATZIG, M. (eds.) 2004. *Applied Time Series Econometrics,* New York: Cambridge University Press.

MACKOWIAK, B. 2007. External shocks, U.S monetary policy and macroeconomics fluctuations in emerging markets. *Journal of Monetary Economics,* 54**,** 2512-2520.

MAIRESSE, J., HALL, B. H. & MULKAY, B. 1999. Firm-level investment in France and the United States: An exploration of what we have learned in twenty years. *NBER Working Paper Series.* Massachusetts Avenue, Cambridge.

MISHKIN, F. S. 2007. *Monetary policy strategy,* London, England, The MIT Press, Cambridge, Massachusetts.

MOJON, B., SMETS, F. & VERMEULEN, P. 2002. Investment and monetary policy in the euro area. *Journal of Banking & Finance,* 26**,** 2111-2129.

MOYEN, N. 2004. Investment-cash flow sensitivities: constrained versus unconstrained firms. *The Journal of Finance,* LIX**,** 2061-2092.

NAGAHATA, T. & SEKINE, T. 2005. Firm investment, monetary transmission and balance-sheet problems in Japan: an investigation using micro data. *Japan and the World Economy,* 17**,** 345-369.

NICKELL, S. 1981. Biases in dynamic models with fixed effects. *Econometrica,* 49**,** 1417-1426.

OLINER, S. D. & RUDEBUSCH, G. D. 1996. Monetary policy and credit conditions: evidence from the composition of external finance: comment. *The American Economic Review,* 86**,** 300-309.

PARRADO, E. 2001. Effects of foreign and domestic monetary policy in a small open economy : The case of Chile. *Working papers, No 108.*: Central Bank of Chile.

PATELIS, A. D. 1997. Stock return predictability and the role of monetary policy. *The Journal of Finance,* 52**,** 1951-1972.

PEERSMAN, G. & SMETS, F. 2002. The industry effects of monetary policy in the Euro area. *European Central Bank, Working Paper Series.* Germany: European Central Bank.

PEERSMAN, G. & SMETS, F. 2005. The industry effects of monetary policy in the Euro area. *The Economic Journal,* 115**,** 319-342.

PEREZ-QUIROS, G. & TIMMERMANN, A. 2000. Firm size and cyclical variations in stock returns. *Journal of Finance,* 55.

POOLE, W. 1970. Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model *The Quarterly Journal of Economics,* 84**,** 197-216.

RAMASWAMY, R. & SLOEK, T. 1997. The real effects of monetary policy in the European Union: What are the differences? . *IMF Working Paper, 97/160.*

RAMEY, V. A. 1993. How important is the credit channel in the transmission of monetary policy? *NBER Working Paper Series.* Massachusetts Avenue, Cambridge.

RAPACH, D. E. 2001. Macro shocks and real stock prices. *Journal of Economics and Business,* 53**,** 5-26.

REICHENSTEIN, W. 1987. The impact of money on short-term interest rates. *Economic Inquiry,* 25**,** 67-82.

RIGOBON, R. 2003. Identification through heteroscedasticity. *The Review of Economics and Statistics,* 4**,** 777-792.

RIGOBON, R. & SACK, B. 2003. Measuring the response of monetary policy to the stock market. *Quarterly Journal of Economics,* 118**,** 639-669.

RIGOBON, R. & SACK, B. 2004. The impact of monetary policy on asset prices. *Journal of Monetary Economics,* 51**,** 1553-1575.

ROODMAN, D. 2009a. How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal,* 9**,** 86-136.

ROODMAN, D. 2009b. Practitioners' Corner: A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics,* 71**,** 135-158.

RUNGSOMBOON, S. 2005. Deterioration of firm balance sheet and investment behaviour: Evidence from panel data on Thai firms. *Asian Economic Journal,* 19**,** 335-355.

SELLIN, P. 2001. Monetary policy and the stock market: theory and empirical evidence. *Journal of Economic Surveys,* 15**,** 491-541.

SHAHARUDIN, R. S. & FUNG, H. S. 2009. Does size matter? A study of size effect and macroeconomic factors in Malaysian stock returns. *International Research Journal of Finance and Economics***,** 101-16.

SIMS, C. A. 1986. Are forecasting models usable for policy analysis? . *Quarterly Review of the Federal Reserve Bank of Minneapolis,* winter**,** 2-16.

SIMS, C. A. & ZHA, T. 1999. Error bands for impulse responses. *Econometrica,* 67**,** 1113-1155.

SIMS, C. A. & ZHA, T. 2006. Does monetary policy generate recessions? . *Macroeconomic Dynamics,* 10**,** 231-272.

TANG, H. C. 2006. The relative important of monetary policy transmission channels in Malaysia. *CAMA Working Paper Series.* The Australian National University.

TAYLOR, J. B. 1997. A core of practical macroeconomics. *American Economic Review,* 87**,** 233-235.

THORBECKE, W. 1997. On stock market return and monetary policy. *The Journal of Finance,* 52**,** 635-654.

TOBIN, J. 1969. A general equilibrium approach to monetary theory. *Journal of Money, Credit and Banking,* 1**,** 15-29.

TOBIN, J. 1978. Monetary policy and the economy: the transmission mechanism. *Southern Economic Journal,* 44**,** 421-431.

UMIZAKI, S. 2007. Monetary policy in a small open economy: The case of Malaysia. *The Developing Economics,* XLV(4)**,** 437-464.

VALDERRAMA, M. T. 2003. The role of trade credit and bank lending relationships in the transmisssion mechanism in Austria. *In:* ANGELONI, I., KASHYAP, A. & MOJON, B. (eds.) *Monetary policy transmission in the Euro area.* United Kingdom: Cambridge University Press.

WALSH, C. E. 2003. *Monetary theory and policy* London, England, The MIT Press.

WANG, J., MERIC, G., LIU, Z. & MERIC, I. 2009. Stock market crashes, firm characteristics, and stock returns. *Journal of Banking & Finance,* 33**,** 1563-1574.

WINDMEIJER, F. 2005. A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics,* 126**,** 25-51.

ZIVOT, E. 2000. Notes on Structural VAR Modeling.