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Essays on the Macroeconomic Impact of Monetary Policy, Fiscal Policy and Financial Development: An Empirical Investigation

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Declaration of Authorship

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Abstract

This thesis includes three self-contained chapters using applied macroeconomics and focusing on the impact of monetary policy, fiscal policy and financial development on real economy in varied context.

The first chapter investigates the monetary policy transmission mechanism and the extent to which exchange rate and oil price shocks exert pressure on macroeconomic variables in Bangladesh. Using a Vector Error Correction model, we find that monetary policy shocks have significant impact on inflation but not on output, while both interest rate and exchange rate channels play active roles in the determination of all other macroeconomic variables. Moreover, external shocks such as oil price and exchange rate shock are also important factors that influence domestic macroeconomic variables in Bangladesh.

The second chapter examines the macroeconomic impact of fiscal policy in Euro-area countries under the same Monetary Union: Austria, Belgium, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Portugal, Spain. Using structural VAR model framework, we show that a positive government spending shock has expansionary macroeconomic effects in Finland and France, a contractionary effect in Austria, Belgium, Germany, Netherlands, Portugal and Spain, but no significant effect is observed in Ireland and Luxembourg. Furthermore, a positive tax shock has a permanent recessionary effect in Belgium, Finland, France and Germany; a non-Keynesian effect in Luxembourg, Ireland, Netherlands and Portugal and almost unresponsive in Spain and Austria. Moreover, the estimated fiscal multipliers range between 0 to 1 on impact and negative for high debt countries. The signs of these multipliers also show a divide between countries, demonstrating both a Keynesian and non-Keynesian nature fiscal policy across these Monetary Union countries.

The third chapter examines the nexus between financial development and economic growth in five countries: Australia, China, South Africa, the UK and the US. We find that in Australia and the US, only market-based financial intermediaries have significant long-run impacts on economic growth, while in China, South Africa and the UK both bank-based and market-based financial indicators have long-run impacts on economic growth. Moreover, in Australia and USA, the financial shock impact the economic growth through stock market only, whereas in South Africa its impact is through banks. However, in China and UK both the banks and stock market play an active role to transmit the shock of financial sector to real economy. Furthermore, we find that economic growth leads to both bank based and market based financial development in Australia, China and South Africa whereas it only leads to market based financial development in UK and USA.

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Chapter 1

Introduction

The fundamental macroeconomic goals are to maximize the standard of living and attain stable economic growth. The goals are achieved by addressing particular objectives such as controlling inflation, increasing productivity, minimizing unemployment. Monetary policy and fiscal policy are valuable tools that the government uses to regulate the performance of the economy and achieve its macroeconomic objectives. Monetary policy is implemented by central banks to influence money supply and interest rates. On the other hand, fiscal policy is implemented by the government through its spending and tax collection mechanisms. These policies can be implemented to stimulate the economy when economic growth becomes stagnant or to restrain growth and economic activities when an economy becomes excessively vibrant. However, there are many challenges that policy makers face in implementing such policies, as it difficult to know the effective magnitude required to attaining the comprehensive goals as well as the particular response of the economy to targeted policy. Economies around the world are repeatedly affected by different shocks (such as oil price jumps, business cycle movements, even pandemic and natural disasters). Depending on the pattern of the shocks, either one of the tools (monetary or fiscal) or both can be used to stabilize the economy. Hence, policymakers need to have a clear understanding of the effectiveness of both monetary and fiscal policy on macroeconomic variables, to regulate economic activity over time. In addition, the effectiveness of

these policies depends on the state of the financial sector of that economy, as they are transmitted via the financial sector to the real economy.

This thesis contributes to our understanding of macroeconomic impact of monetary policy, fiscal policy and financial development based on country characteristics and data availability in varied contexts. Specifically, the thesis gives an insight to the transmission mechanism of monetary policy, fiscal policy and financial development and the channels through which they impact real economic activity. This thesis takes an empirical approach to analyse policy in three different context: a developing country; a subset of European countries under the European Monetary Union; and a set of both emerging and developed countries. Analysing countries with different development structure gives an insight about how the economies in different level of development react with these policies. In addition, the thesis uses three different econometric methodologies: structural VAR models, vector error correction models, and auto-regressive distributed lag models to address the challenges. As such, the thesis is comprised of three self-contained chapters all related to the macroeconomic analysis of monetary and fiscal policies.

The first chapter investigates how monetary policy shocks are transmitted to the real economy during a floating exchange rate regime. The monetary policy authority needs to know how its action will manifest as it is not possible to formulate a good policy without being aware of the transmission channel of monetary policy to the real economy. The thesis uses Bangladesh as an example of a small open developing economy and as a representative of the countries that use the monetary policy framework of monetary aggregates targeting. Hence, the findings and implications are important not just for Bangladesh but for similar countries. The Bangladesh Bank follows the classical quantity theory of money for monetary programming. A significant shift in the policy regime took place with the Bangladesh Bank (Amendment) Act, 2003, when Bangladesh moved into a

flexible exchange rate regime. Step by step the country shifted to more open market operations by introducing the Repurchase Agreement and the Reverse Repurchase Agreement in 2003 to insert and absorb liquidity to and from the money market. The empirical analysis in the first chapter covers the significant policy changes in the financial system during that period.

Therefore, the first chapter examines the monetary policy transmission mechanism considering the modelling equilibrium and long-term relationships between macroeconomic variables. In addition, the chapter investigates the extent to which exchange rate and oil price shocks impact upon macroeconomic variables. A vector error correction model is constructed employing monthly time series data based on the economy wide features of Bangladesh, which incorporates a set of domestic and external shocks. The magnitude of the impact of monetary policy is small in this model compared to a level-based model. The choice of using a vector error correction model allows us to find the cointegrating relationship and to include both the temporary and permanent shocks in the model. The key result in the first chapter is that: the monetary policy shock significantly affects inflation, but does not influence output. In addition, both interest rate and exchange rate channels are effective in transferring the shock in the transmission process. Besides this, external shocks are also playing important role in the movement of Bangladesh's macroeconomic variables.

The second chapter investigates how the changes in fiscal policy affect macroeconomic variables. The macroeconomic impacts of fiscal policy become of central importance to economic policy-makers. This chapter analyses the impact of changes in taxation and government spending on the macroeconomic variables for ten European Union member countries under the same Monetary Union. European economies faced significant adverse economic shocks which started with

the global financial crisis of 2007, and went through a deep recession and an increase in unemployment to the highest levels in 20 years. As a result, the feasibility of the Monetary Union was questioned due to social and economic problems experienced by many Euro-area countries. Indeed, the profound and persistent economic crisis has raised important questions regarding the effective policy tools available to Euro-area economies as they have a single monetary policy. The effectiveness of fiscal policy faces an additional constraint when jurisdiction is part of a monetary union. Against this backdrop, the second chapter seeks to understand how similar or different are the impact of fiscal policy shocks and their domestic transmission channels for Euro-area countries under the same Monetary Union.

In Particular, the second chapter studies the effects of fiscal policy shocks in ten European Monetary Union countries: Austria, Belgium, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Portugal, Spain. The chapter investigates how fiscal policy shocks impact the country real economic variables and estimates the size and sign of fiscal spending and tax multipliers in these countries. Results indicate differences in the transmission of fiscal shocks and fiscal multipliers across these countries. There is limited research on the impact of fiscal policy shocks on the economy of these Euro area countries. The existing studies have focused on the effects of fiscal shocks at the aggregate Euro-area level rather than country level. This study focuses on country-level effects and uses a structural VAR model to capture simultaneous interactions among the variables. Results show that an unexpected positive government spending shock has expansionary macroeconomic effects in Finland and France, but contractionary effects in Austria, Belgium, Germany, Netherlands, Portugal and Spain, while the effect is statistically insignificant in Ireland and Luxembourg. In addition, while a positive government tax revenue shock has a permanent recessionary effect in Belgium, Finland, France and Germany, a non-Keynesian effect is observed in

Luxembourg, Ireland, Netherlands and Portugal and the macroeconomic variables are almost unresponsive in Spain and Austria. Furthermore, heterogeneous magnitudes of responses among these countries is evidenced in the estimated fiscal multipliers, which range between 0 to 1 on impact, and have both positive and negative signs across countries.

The third chapter examines the nexus between financial development and economic growth. The economic recession which began in late 2007 showed the importance of financial systems in stimulating the real economy. As such, it is of paramount importance for policy makers to know the numerous channels through which financial development transmits to the real economy and vice versa. There is a lack of consensus regarding whether the development of financial sector actually leads the real sector development or the opposite. So far, there has been no general consensus on the causal relationship between financial development and economic growth in both developed and developing economies. Existing literature tend to use different time periods, statistical methods and proxies for financial development, with most employing cross-country analysis.

The third chapter of this thesis extends the analysis by investigating the dynamic relationship between financial development and economic growth in terms of bank-based and market-based systems for Australia, China, South Africa, the UK and the USA. Both the short-run and long-run relationship between financial development and economic growth are covered for all countries. As such, the roles that financial intermediaries (bank-based system) and financial markets (market-based system) play in promoting growth in the economies can be assessed. Using auto-regressive distributed lag models for estimation and Bound testing approach, we find that there exists significant long-run relationships between real GDP and the financial development variables. In Australia and USA only market based financial intermediaries have significant long-run

impact on economic growth, whereas in China, South Africa and UK both bank-based and market-based financial indicators have long-run impacts on economic growth. In addition, we find that in Australia and the USA, the financial shock impacts the economic growth through stock market only, whereas in South Africa the financial shock impacts the economic growth through banks only. In China and the UK both the banks and stock market play an active role in transmitting the financial sector shock to real economy. Finally, we find that the economic growth leads to both bank based and market based financial development in Australia, China and South Africa whereas it only leads to market based financial development in the UK and the USA.

The remainder of this thesis is organised as follows. Chapter 2 focuses in Bangladesh as a case study of a small open economy and analyse the monetary policy transmission mechanism under the floating exchange rate regime. Chapter 3 examines the macroeconomic impacts of fiscal policy under monetary union in a subset of Euro-area countries. Chapter 4 investigates the nexus between financial development and economic growth in both developed and emerging economies. Finally, Chapter 5 provides general concluding remarks.

Chapter 2

Monetary Policy Transmission, External Shocks, and the Economy: Evidence from Bangladesh

Abstract

This paper investigates the monetary policy transmission mechanism and the extent to which exchange rate and oil price shocks exert pressure on macroeconomic variables in Bangladesh. Using a Vector Error Correction model, we find that monetary policy shocks have significant impact on inflation but not on output, while both interest rate and exchange rate channels play active roles in the determination of all other macroeconomic variables. Moreover, external shocks such as oil price and exchange rate shock are also important factors that influence domestic macroeconomic variables in Bangladesh.

Key Words: Monetary policy, Bangladesh, VECM, Exchange rate, Oil price.

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By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);
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2.1 Introduction

Monetary policy is a key tool used to influence the economic growth of a country. Monetary policy measures can be transferred to the real economy through different channels. Hence, to understand the effect of monetary policy it is essential to identify the channels through which monetary policy action influences the real economy and the time it takes for the policy action to affect economic activities. The monetary policy transmission mechanism may differ from country to country depending on their economic and financial situation. Monetary policy transmission mechanism is the main focus or specific concern from the central bank's point of view. It is not possible to formulate a good policy without being aware of the transmission of monetary policy to the real economy. Achieving high and robust economic growth in the long run is the main target of economic policy. From the central bank's point of view, this target can only be attained, by controlling inflation level and securing financial stability through the conduct of a consistent and vibrant monetary policy. The monetary policy transmission mechanism works through different channels such as- interest rate channel, the asset prices channel, the exchange rate channel, the credit channel and the expectation channel. Using these channels, monetary policy actions transmitted to real economy and influence output and inflation.

Considerable research has been conducted on monetary transmission mechanisms in developed economies, but similar quantitative and qualitative research for developing economies is scarce. Notwithstanding, monetary policy is as equally important for developing economies as for developed economies. This paper aims to analyse the monetary policy transmission mechanism in a small open developing economy. Specifically, we focus on Bangladesh as a case study to address three research questions. First, how do monetary policy shocks affect price level and other real macro variables in Bangladesh? Second, how do exchange rate shocks affect price level and other real macro variables in

Bangladesh? Finally, how do central bank and the real economic variables respond to oil price shocks?

There is a lack of empirical evidence on how monetary policy shocks affect the economy in Bangladesh. Existing studies often use different identification methods to identify and quantify the impact of monetary policy shocks on different macroeconomic variables in Bangladesh. Most of these studies used data from different policy regimes. To interpret the impact of policy shocks it is necessary to look at different policy regimes independently. In addition, these studies either do not include data from the floating exchange rate period or include a small portion of the floating regime. Changes in the exchange rate arrangement can modify the channels of transmission mechanism, and therefore including data from more recent periods can produce very different results. This paper advances on prior analysis of the Bangladesh economy by considering the significant policy changes implemented in 2003. Earlier studies also suffered from the various puzzles identified in the literature.

Against this backdrop, this study contributes to the existing literature by revisiting the monetary policy transmission mechanism in Bangladesh using vector error correction framework (thus enabling to model long-term and short-term relationships between the country macroeconomic variables). The identification method used in the model is robust to all price, liquidity and exchange rate puzzles, and the study covers significant policy changes in the financial system of Bangladesh, the flexible exchange rate regime. From the policy stand-view, the study aims to formulate recommendations to help monetary authorities to design and implement robust monetary and financial policies for the Bangladesh economy.

The main contributions of the study is threefold. First, we find that monetary policy shock has significant impact on inflation, but a very small effect on output. So, monetary policy shock is not the dominant source of the fluctuations of output

in Bangladesh. Our findings differ from Cushman and Zha (1997) and Kim and Roubini (2000) regarding the response horizon of both output and inflation. Second, both interest rate and exchange rate channels play an important role in the transmission of monetary policy shock in the real economy. This is supported by the New Open Economy Macroeconomics literature pioneered by Obstfeld and Rogoff (1995) and Cushman and Zha (1997). And third, external shocks such as oil price shocks play a crucial role in both the long-run and short-run fluctuations of Bangladesh's macroeconomic variables. As a small open economy, one of the most important sources of macroeconomic fluctuations in Bangladesh is the rise in global oil price. It is considered as proxy for the global shock (Blanchard and Gali, 2007) and is commonly used variable in the monetary policy literature as a negative and inflationary supply shock. It also encapsulates important business cycle information.

The rest of this chapter is organized as follows. Section 2 contains a brief overview of Monetary Policy in Bangladesh. Literature review is discussed in Section 3. Empirical model is discussed in Section 4. Data is presented in Section 5. Section 6 contains the empirical analysis. Section 7 contains some concluding remarks.

2.2 Overview of Monetary Policy in Bangladesh

Bangladesh gained independence from Pakistan in 1971. Over the following 10 years the country's economy grew by on average 6.3 percent mainly due to robust domestic demand and financial inclusion initiatives of the Government. After gaining independence, Bangladesh only achieves USD 1544.27 per capita income in 2017.

At the time of independence, the agriculture sector accounted for almost 38.6 percent of GDP while in 2017 it accounted for only 14.7 percent (see Figure 2.1).

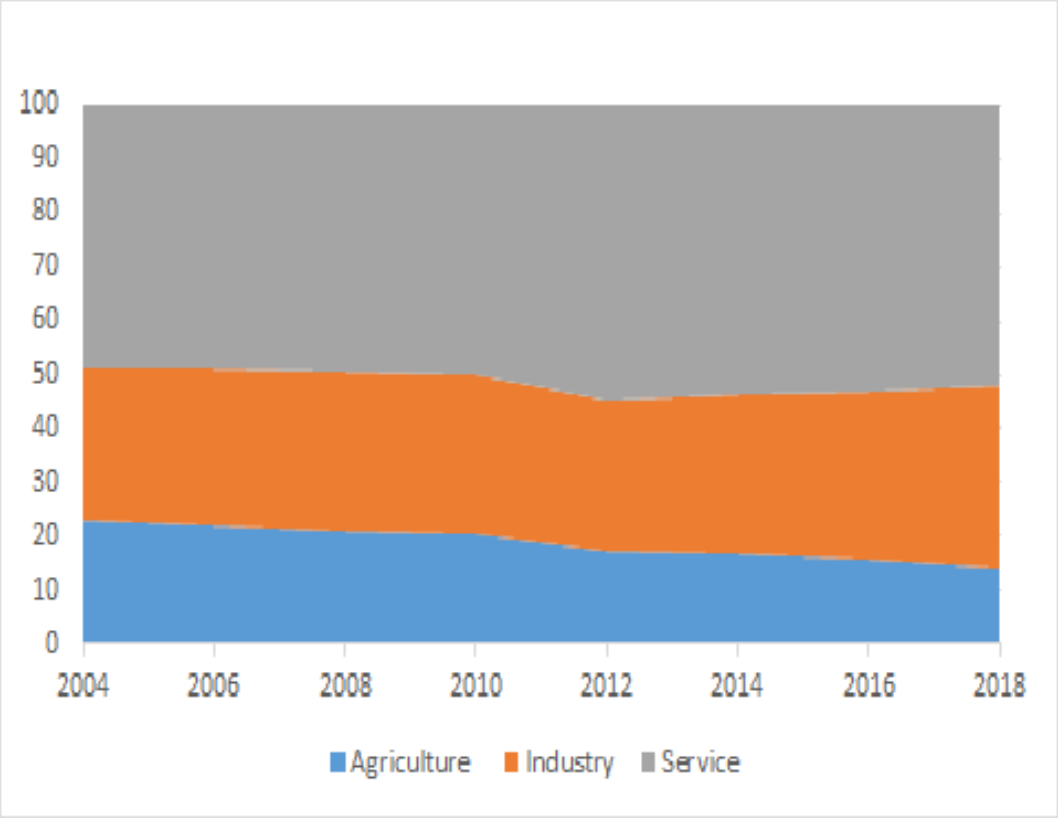


FIGURE 2.1: Sectoral Decomposition of GDP

The industry and service sectors accounted for 15.5 percent and 45.9 percent (see Figure 2.1) respectively during the same periods. In 2017, the share of industry and service sectors increased significantly and reached 32.4 percent and 52.9 percent (see Figure 2.1) of GDP respectively in Bangladesh. Besides this, the industrial sector is showing highest growth over time (see Figure 2.2) compared to the other sectors. Bangladesh has progressively moved toward a market-oriented strategy of development since late the 1970s, after carrying out trials with a socialist model of development during the early 1970s. Since independence, Bangladesh has tried diverse policy measures to achieve some socio-economic objectives. At the same time the monetary and banking sectors in Bangladesh have experienced a continuing transformation. Bangladesh economy has gone

under significant economic reforms since the late 1980s and gained macroeconomic stability with a persistent economic growth.

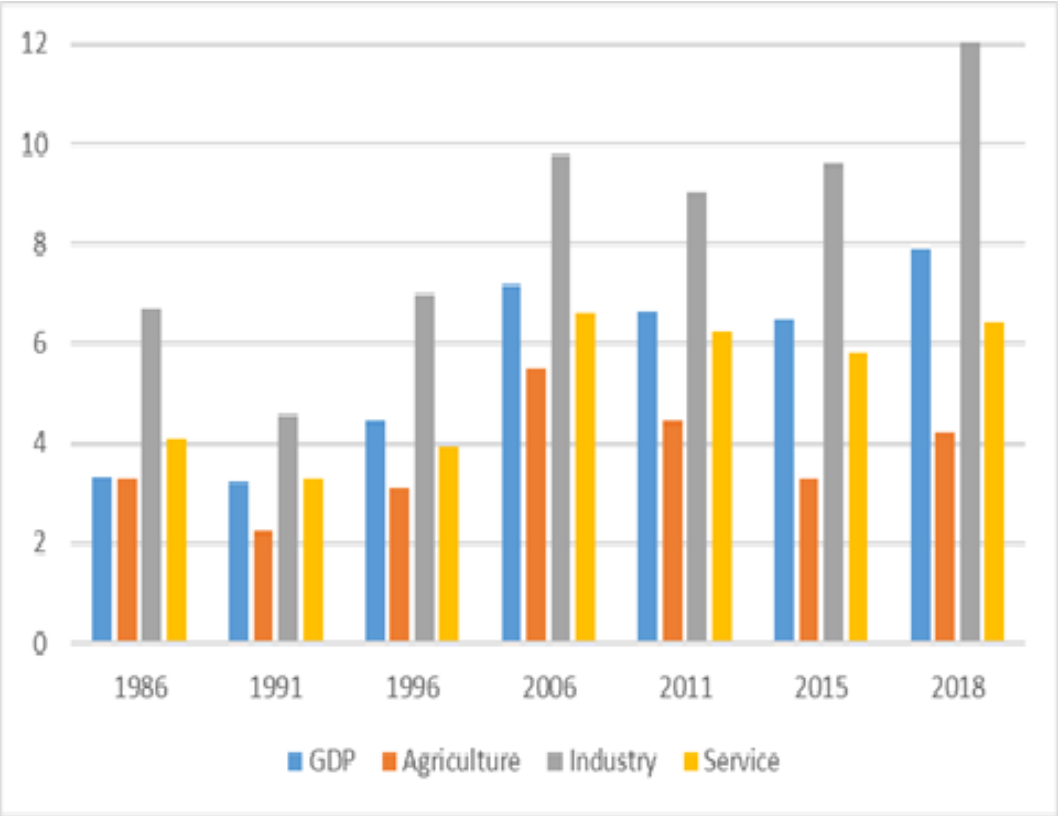


FIGURE 2.2: GDP and the Broad Sectors

Before 1983, all the financial institutions in Bangladesh operated under a strict regime of regulations and directives by the government and the central bank. This in turn led to inefficiency of financial intermediation and misutilisation of scarce resources. In 1984 a "National Commission on Money, Banking and Credit" was designed to find a remedy for the disruptions to the financial sector. To remove the disruptions from the financial sector, a widespread "Financial Sector Reform Programs (FSRP)" was set-up in the early 1990s. The main objectives of the FSRP were liberalization of interest rates, indirect control in monetary management, and privatization of commercial banks and denationalization of government banks. Macroeconomic performance in Bangladesh has displayed

substantial stability. At the same time, Bangladesh was displaying comparatively stable environment in the real GDP growth with the 0.54 and 0.30 percent volatility during the periods from 1980 to 2017. Since the 1980s with acceleration in the 1990s, Bangladesh has introduced different types of economic and financial sector modifications which have developed monetary policy transmission and its effectiveness extensively.

According to the Bangladesh Bank order, 1972, the Central Bank of Bangladesh was established in order to stabilize domestic monetary value and the exchange rate of the country vis-a-vis foreign currencies, boosting employment, boosting a high level of production and real income and boosting and supporting the full development of the productive resources of the country. Bangladesh Bank was authorized to manage the monetary and credit system of Bangladesh according to the Bangladesh Bank order, 1972, with a view to maintaining domestic monetary value and sustaining an economical external par value of the Bangladeshi Taka towards raising growth.

In May 2003, a significant shift in the policy regime took place by the Bangladesh Bank (Amendment) Act, 2003, when Bangladesh moved into the flexible exchange rate regime. Step by step the country relocated to more open market operations by introducing the Repurchase (Repo) agreement and the reverse repurchase agreement in 2003 to insert and absorb liquidity from the money market. However, Bangladesh occasionally intervene the foreign exchange market. Central Bank of Bangladesh implements a separate foreign exchange intervention policy. The Bangladesh Bank performs a variety of functions. Central banks have control over the monetary management. They control the supply of money and credit and can effectively influence the interest rate. However, Bangladesh Bank performs the supervisory role over the financial system and try to keep the system stable. They take deposits from other commercial banks and serve as the lender of last resort. They are the government's bankers and agents. The

Bangladesh Bank follows the classical quantity theory of money for monetary programming, i.e.,

$$MV = PY \ , \tag{2.2.1}$$

where M, V, P, and Y are money demand, velocity of money, price level, and real output. Writing equation in terms of growth rate gives:

$$g_m \ = \ g_p + g_y - g_v \ , \tag{2.2.2}$$

where g_m, g_p, g_y, and g_v are the growth rates of money demand, expected inflation, anticipated growth of real output, and expected growth of income velocity of money respectively. Bangladesh Bank follows a different form of the quantity theory of money. According to this simple approach, Bangladesh Bank estimates inflation and GDP forecast to manage liquidity in the private credit market. Bangladesh Bank emphases on reserve money as the operating target and broad money (M_2) as the intermediate target. Reserve money can stimulus the growth path of M_2 through the money multiplier. This type of monetary programming can be considered as a variant of the monetary policy rule offered by Taylor (1993). Bangladesh Bank has various instruments at its disposal to achieve the estimated target growth of M_2. These instruments include bank rate, the rate at which commercial banks can borrow from Bangladesh Bank; statutory liquidity requirement (SLR), the mandatory reserve requirement; and open market operation (OMO). Bank rate and SLR are rarely adjusted. The last times these rates changed were in November 2003 and June 2014. Bangladesh Bank uses OMO through repo (repurchase agreement), reverse repo (the counterpart of repo), and the weekly auction of treasury bills and Bangladesh Bank bills for regular liquidity management. This adjustment of liquidity finally affects the inter-bank call money rate (overnight rate) and subsequently deposit and lending rates.

Bangladesh Bank has been declaring half-yearly Monetary Policy Statements (MPS) since 2006. In MPS, the central bank usually announce inflation expectations of economic agents and the general public. Nowadays, the formulation of Monetary Policy Stance is based on wide-ranging stakeholder discussions from the common people level up to the level of expert professionals including think tanks, past Finance Ministers, Advisers, Governors and trade bodies. Bangladesh Bank outlines the monetary policy stance through the Monetary Policy Statement founded on an evaluation of international and national macroeconomic situation and outlook.

2.3 Literature Review

There has been a considerable number of empirical studies investigating different channels of monetary policy. Most of the studies emphasise the consequence of monetary policy shocks on diverse macroeconomic variables such as economic growth, inflation, employment, export, exchange rate, import, balance of payment, interest rate, gross domestic product etc. To reveal the monetary policy transmission mechanism Vector Auto Regression (VAR), Structural VAR (SVAR), Vector Error Correction (VECM) and Dynamic Stochastic General Equilibrium (DSGE) models are the most used and most popular models.

Vector auto-regression (VAR) has been introduced as a useful tool to analyse monetary policy effects. The pioneering works by Sims (1992), Bernanke (1990), Bernanke and Blinder (1992) and Christiano, Eichenbaum, and Evans (1999) have presented how did the US real economy responded to the monetary policy shocks by using the VAR model. Angeloni et al. (2003) conducted an extensive study on the Euro area. They used structural models and VAR and for several of the countries in the Euro area they were achieved an indication of active lending channels in the monetary transmission process (Aleem, 2010). On the other hand, although

the banks are the main source of finance for businesses in Thailand, the credit channel is not strong there Disyatat and Vongsinsirikul (2003). To determine the effect of monetary policy in Ghana, Abradu-Otoo, Amoah, and Bawumia (2003) applied the recursive VAR approach using quarterly data from 1969 to 2002. Using both T-bill rate and broad money (M2) as their monetary policy variable, they did not find any significant effect of monetary policy on price or output. Taking policy interest rate as the monetary policy variable, Cheng Kevin (2006) applied both the recursive and structural VAR approach in the Kenyan economy and found that interest rate shock significantly affects exchange rate and price level in Kenya, but the policy rate does not affect output. On the other hand, in the Czech Republic, Romania, Slovenia and Slovakia the interest rate channel is the most influential channel. Popescu et al. (2012) measured the effect of monetary policy shocks on GDP, prices, the nominal exchange rate and monetary aggregate (M3) using a VAR model of Romanian economy and found a positive effect on GDP, the nominal exchange rate and monetary aggregate (M3) and a negative effect on prices. Christiano, Eichenbaum, and Evans (1994) consider the effects of a contractionary monetary policy shock on various other economic activity using recursive VAR. Eichenbaum and Evans (1995) have investigated how exchange rate responds to monetary policy shocks in the VAR model framework. They used the Federal Fund Rate as a tool of monetary policy and their results revealed statistically significant perpetual reaction of policy shocks on the exchange rates. Fisher (1997) examines how different components of aggregate investment respond to a contractionary monetary policy shock. Christiano, Eichenbaum, and Evans (1997) analyse several measures of aggregate real wages, manufacturing real wages, aggregate profits and before tax profits in five sectors of the economy: manufacturing, durables, non-durables, retail and transportation and utilities. They found that a contractionary monetary policy shock led to a sharp persistent decline in profits in all but two cases. Bonser-Neal, Roley, and Sellon (1998) re-inspected

the relationship and got an identical result. Karim, Lee, and Gan (2007) found that both nominal and real effective exchange rate were reduced by the contractionary monetary policy shocks in the economy. These results were substantiated by Bhuiyan (2012) who confirmed the same result for Bangladeshi data. Furthermore, Mondal (2014) ascertained that a smaller amount of the unpredictability of exchange rate is affected by past policy shock than past unpredictability of the exchange rate itself.

Since the recursive VAR approach fails to capture the dynamic interactions among the macroeconomic variables in the model, it can generate misleading or puzzling impacts of monetary policy shocks on major economic aggregates. In order to identify monetary policy shock more precisely and solve the puzzles, a vast number of literatures use structural VAR methodology which allows simultaneous interaction among the variables in the model. One leading study in monetary policy literature using SVAR methodology is by Kim and Roubini (2000). They estimated SVAR model for six manufacturing countries to solve theoretical discrepancies such as the price puzzle, liquidity puzzle and exchange rate puzzle, all found in previous VAR studies. Dungey and Pagan (2000) developed an eleven-variable block recursive SVAR model for the Australian economy and Dungey and Pagan (2009) extend it giving special priority on monetary policy impacts. In order to explore the transmission channel of the monetary policy in the real economy of the Czech Republic, Hungary, Poland, Romania, Slovenia and Slovakia, Oros, Romocea-Turcu, et al. (2009) used the SVAR model and revealed that in Hungary and Poland the exchange rate is the strongest channel. Other studies have found opposite results. Sek (2008) applied the structural Vector Auto-regressive model and Generalized Methods of Moment to discover the relationship between monetary policy and exchange rate in three East-Asian countries which have very recently introduced an inflation targeting system to their monetary policy formulation process. Separating the control period as pre-

and post-financial crisis of 1997-98 the outcome illustrates trivial influence of policy shocks on exchange rate in both time periods.

In the last two decades, a new method for estimating SVAR has been emerged in monetary policy literature which employs sign restrictions upon the impulse responses to identify monetary policy shock. The impacts of monetary policy shocks are obtained this way are necessarily influenced by a priori theorizing to avoid puzzling results. Faust (1998) only imposes sign restrictions on impact and Canova and De Nicolo (2002) impose sign restrictions on the cross-correlations of the aggregate variables' responses to particular shocks. Uhlig (2005) identifies the effects of monetary policy by directly imposing sign restrictions on the impulse responses. Mountford (2005) follows Uhlig's (2005) sign restriction identification approach exactly to examine the effects of monetary policy in UK using SVAR model. Rafiq and Mallick (2008) examines the effects of monetary policy shocks on output in the three largest euro area economies by applying sign restricted VAR identification procedure. By applying Uhlig's (Uhlig (2005)) identification approach, Scholl and Uhlig (2008) revisit the effects of monetary policy on exchange rates imposing sign restrictions on the impulse responses of selected macroeconomic variables.

In the last few years, VECM model has been using in monetary policy literature to cover both the short term and long term impact of monetary policy shock. Sun, Gan, and Hu (2010) explore the existence of bank lending channel in China using VECM model and find that short-run deviation in the loan supply are corrected through changes in the lending rate. On the other hand, Cocriş and Nucu (2013) witness monetary policy transmission mechanism in Romania via interest rate channel. However, Fuddin (2014) represent that in Indonesia the monetary policy shock transmitted to economic growth via credit channel and to inflation via interest rate channel. Rifat (2015) using VECM model found that there is no significant relationship between monetary policy instruments and stock market

in Bangladesh. In addition, Obeid, Awad, et al. (2017) showed the existence of positive long term and short term effects of monetary policy instruments on the growth of real GDP.

There are some monetary policy literature available in Bangladesh context. Chowdhury, Dao, and Wahid (1995) used the recursive VAR model for Bangladesh and identified no causality between inflation and monetary policy but discovered that the most important part of the variations of exchange rate can be characterized by inflation and monetary policy together. In reaction to monetary policy shocks they did not identified the same result that the inflation reacts vigorously but this reaction remain for a short time-span. Younus (2004) uses the monetary base as the central bank's policy variable and observes the bank lending channel of Bangladesh over the period of 1975 to 2000, and concludes that due to excess reserve in the banking sector, the the bank lending channel in Bangladesh does not exist. Ahmed and Islam (2004) analyse the monetary transmission channels of Bangladesh employing the unrestricted VAR approach for the period 1979 to 2005 and found weak evidence of lending and exchange rate channels. But in their study period, Bangladesh was in a fixed exchange rate system. Besides this, all the above studies use recursive VAR approach which is not appropriate to capture the dynamic relations between variables. Later on, Bhuiyan (2012) answered the question of by what method the macroeconomic variables react to monetary policy shock. Using the Bayesian Structural VAR model for Bangladeshi monthly time series macroeconomic data he concluded that interest rate and exchange rate respond sharply with the monetary policy shock whereas the other two significant variables, industrial production's and inflation's reaction, delayed for around six months and one year correspondingly. However, the time span of this study is from 1994 to 2009. Alam (2015) examined the effectiveness of the monetary policy in Bangladesh using SVAR approach. He used quarterly data on CPI, industrial production index, M2, nominal exchange rate, reserve money, and

three month T-bill rate, from 1995 to 2011. The paper can't solve the price puzzle or the exchange rate puzzle and concludes that monetary policy is not effective in controlling short-run economic fluctuations in Bangladesh. Both of them fails to cover the significant policy changes in the financial system during that period. Afrin (2017) explores the lending and exchange rate channels of monetary policy using recursive SVAR methodology. Against this backdrop, this study contributes to the existing literatures by constructing a Vector Error Correction model for Bangladesh's economy over the period of 2003M6 to 2017M12 in order to determine the effects of monetary policy shocks on various macroeconomic variables.

2.4 Empirical Specification

We consider the following vector autoregressive (VAR) framework:

$$Y_t = \mu + A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + \varepsilon_t, \tag{2.4.1}$$

where $Y_t = [ir_t, rm_t, er_t, im_t, ip_t, cpi_t, op_t]\prime : n \times 1$ is a column vector of endogenous variables ($n = 7$), $A_1, \ldots, A_p : n \times n$ are matrices of parameters, p is the lag length, and $\varepsilon_t : K \times 1$ is a vector of disturbances such that $\varepsilon_t \overset{i.i.d.}{\sim} N(0, \Sigma_\varepsilon)$ with $\Sigma > 0$. Within Y_t, ir_t is the three month Treasury bills rate as the short-term nominal interest rate, rm_t is the reserve money, er_t is the real effective exchange rate, im_t is the imports payments in units of Bangladeshi currency, ip_t is the industrial production, cpi_t is the consumer price index and op_t is the global oil price index. We are interested in the setting where Y_t combine both $I(0)$ and $I(1)$ variables.

We can write (2.4.1) in the following vector error correction (VEC) form:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t, \tag{2.4.2}$$

where Δ is the first difference operator, Π=$\sum_{i=1}^{p} A_i - I_n$ and Γ_i=$\sum_{j=i+1}^{p} A_j$. Model (2.4.2) nests three important cases. First, if the variables in Y_t are cointegrated of rank r, then there exist the matrices $\alpha : n \times r$ and $\beta : n \times r$ such that $\Pi = \alpha\beta'$ and $\Pi Y_{t-1} \sim I(0)$. As such, (2.4.2) can be written as:

$$\Delta Y_t = \alpha\beta' Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t, \tag{2.4.3}$$

where $\beta' Y_{t-1}$ is the error correction term which reflects the long term trend (equilibrium relationships) between variables, and α measures the speed of adjustment of the variables towards the long-run trend (equilibrium). The coefficient matrices Γ_i's capture the short-run dynamics in the cointegrated system. Second, if the variables in Y_t are $I(1)$ but not cointegrated, Π is zero and thus has rank 0. And third, if all the variables are $I(0)$, Π has full rank n. It is often the case that the cointegrating VECM (2.4.3) exhibits deterministic trends. These trends can stem from two distinct sources– the mean of the cointegrating relationship (i.e., the mean of $\beta' Y_{t-1}$) and the mean of the differenced series (i.e., the mean of ΔY_t). By allowing for a constant and a linear trend in ΔY_t, and assuming that there are r cointegrating relations, (2.4.3) can be rewritten as:

$$\Delta Y_t = \alpha\beta' Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \mu + \delta t + \varepsilon_t, \tag{2.4.4}$$

where δ and μ are $n \times 1$ parameter vectors. Because (2.4.4) models the differences of the data, the constant implies a linear time trend in the levels, and the time trend t implies a quadratic time trend in the levels of the data. Often we may want to include a constant or a linear time trend for the differences without allowing for the higher-order trend that is implied for the levels of the data. The VEC setting exploits the properties of the matrix α to achieve the flexibility of including a constant or a linear time trend for the differenced data. Because α is a $n \times r$ rank

matrix of rank r, we can rewrite the deterministic components in (2.4.4) as:

$$\mu = \alpha\mu_0 + \gamma, \delta t = \alpha\rho t + \tau t. \tag{2.4.5}$$

where μ_0 and ρ are $r \times 1$ vectors; γ and τt are $n \times 1$ vectors; γ is orthogonal to $\alpha\mu_0$ and τ is orthogonal to $\alpha\rho$. So, (2.4.4) can be rewritten as:

$$\Delta Y_t = \alpha(\beta' Y_{t-1} + \mu_0 + \rho t) + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \gamma + \tau t + \varepsilon_t. \tag{2.4.6}$$

Cointegration tests such as the one in Johansen (1988) places restrictions on the trend and constant terms in (2.4.6), thus yielding five different cases in the VEC relationships:

CASE 1. Unrestricted trend. If no restrictions are placed on the trend parameters, (2.4.6) implies that there are quadratic trends in the levels of the variables and that the cointegrating equations are stationary around time trends (trend stationary)

CASE 2. Restricted trend, i.e., $\tau = 0$. By setting $\tau = 0$, we assume that the trends in the levels of the data are linear but not quadratic. This specification allows the cointegrating equations to be trend stationary.

CASE 3. Unrestricted constant, i.e., $\tau = 0$ and $\rho = 0$. By setting $\tau = 0$ and $\rho = 0$, we exclude the possibility that the level series have quadratic trends, and we restrict the cointegrating equations to be stationary around constant means. Because γ is not restricted to zero, this specification still puts a linear time trend in levels series.

CASE 4. Restricted constant, i.e., $\tau = 0$, $\rho = 0$ and $\gamma = 0$. By setting $\gamma = 0$, we assume there are no linear time trends in level series. This specification allows

the cointegrating equations to be stationary around a constant mean, but it does not allow no other trends or constant terms.

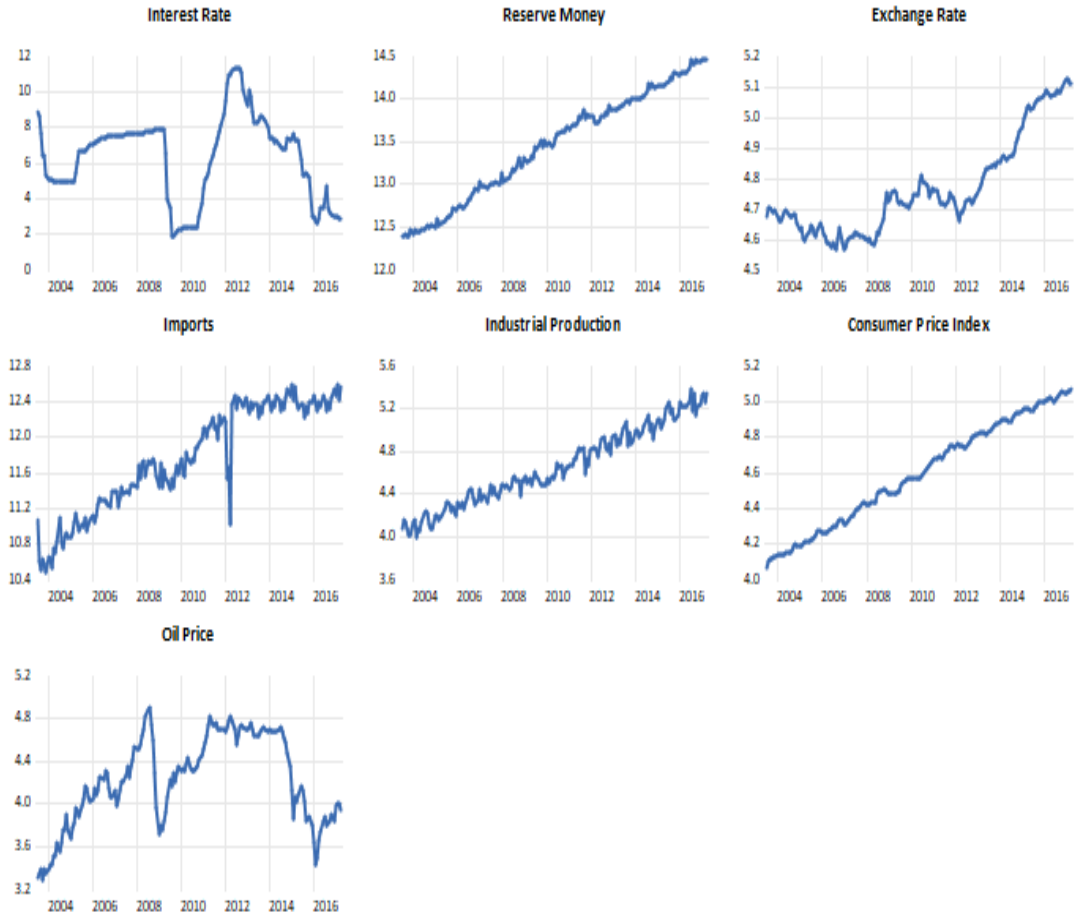
CASE 4. No trend and mean, i.e., $\tau = 0$, $\rho = 0$, $\gamma = 0$ and $\mu_0 = 0$. This specification assumes that there are no nonzero means or trends. It also assumes that the cointegrating equations are stationary with means 0 and that the differences and the level series have means 0.

2.5 Data

Given, the short period of study, deciding which variables to include is a balance between degrees of freedom and correct model specification. The commonly used variables such as short term interest rate, reserve money, exchange rate, the Consumer Price Index and output are all included in the model. Other important candidates, such as import prices and oil prices are also included. However, the model also does not include any variable relating to the asset price channel, such as the share price index or house price index. The stock market index appear less important for Bangladesh, and the economy-wide house price index is not available for the entire period in the required frequency. However, We use monthly data from Bangladesh over the period of $2003M6$ to $2017M12$. The seasonally adjusted data for the reserve money (rm), the consumer price index (cpi), the industrial production index (ip), FOB imports (im) were collected from the International Financial Statistics (IFS). The real effective exchange rate (er) is computed using the nominal exchange rate and consumer price indices of major trading partner countries which was collected from Bruegel. For the short term interest rate (ir) we use the 91 day T-bill rate from the Monetary Policy Department of Bangladesh Bank. We collect international oil price (op) data from Index Mundi. The GDP data for Bangladesh is not available in monthly frequency. For this reason Industrial production index is used as a proxy, as there is no data for any other

suitable proxy for output. All variables except the interest rate are transformed in logarithmic.

FIGURE 2.3: Plots of the data



The descriptive statistics of the variables are presented in Table A1 in the appendix. The plots of the time series are shown in Figure 2.3. While the reserve money, imports, industrial production, consumer price index, and some extent the exchange rate variables trend upwards during the study period, both interest rate and oil price variables show little evidence of a deterministic trend. Evidence of a stochastic trend (unit root) is apparent in these graphical representation for all variables.

Table 2.1 reports the unit root test results for all variables. The first and second columns of the table show the order of integration of the time series when the Augmented Dickey Fuller (ADF) and the Phillip-Perron (PP) tests are employed.

TABLE 2.1: Unit root test

Variables	ADF	PP
$log(rm)$	$I(1)$	$I(1)$
$log(cpi)$	$I(1)$	$I(1)$
ir	$I(1)$	$I(1)$
$log(er)$	$I(1)$	$I(1)$
$log(ip)$	$I(1)$	$I(1)$
$log(im)$	$I(1)$	$I(1)$
$log(op)$	$I(1)$	$I(1)$

As seen, both the ADF and PP tests yield a similar conclusion that all variables are integrated of order 1 (i.e., $I(1)$). This means that the Π matrix in the VECM representation (2.4.2) has a reduced rank, i.e., $0 \leq r = rank[\Pi] < 7$. If the variables in Table 2.1 cointegrate, $r = rank[\Pi] > 0$ (i.e., $\Pi \neq 0$) and (2.4.2) shows that a VAR in first differences is misspecified because it omits the lagged level term ΠY_{t-1}. Because of this, it is important to emphasise on cointegration analysis as we do.

2.6 Main Results

2.6.1 Cointegrating Relationships

We first check if there is evidence of cointegrating relationships between the seven variables in Table 2.1. Johansen's cointegration test results are reported in Table 2.2 with both the trace and maximum eigenvalue statistics. The test is carried out with three lags as suggested by the AIC criterion.[1]

We see that both the trace statistic (first part of Table 2.2) and the maximum eigenvalue statistic (second part of Table 2.2) indicates evidence of 3 cointegrating

[1] The SBC, HQ, FPE, LR criteria suggest 1, 2, 2, and 5 lags respectively. Due to the relatively small sample size, we choose 3 lags to estimate the model rather than 5 lags.

TABLE 2.2: Cointegration test

Unrestricted cointegration rank test (Trace)				
Hypothesised No. of CE(s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob.**
None*	0.4522	232.71	125.62	0.0000
At most 1*	0.306	134.60	95.75	0.0005
At most 2*	0.191	75.11	69.82	0.0178
At most 3	0.128	40.49	47.86	0.2052
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesised No. of CE(s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob.**
None*	0.4522	98.102	46.231	0.0000
At most 1*	0.306	59.497	40.077	0.0001
At most 2*	0.191	34.609	33.877	0.0409
At most 3	0.128	22.367	27.584	0.2021

equations at 5% nominal level. This means that there exists 4 long run equilibrium relationships among the variables in Table 2.1. The existence of 3 cointegrating vectors among the seven variables means that there are four independent permanent shochs among the seven shocks. The first cointegrating system relates the log of industrial production index (proxy for GDP) to the log of real exchange rate (ler), log of import (lim), log of reserve money (lrm) and real interest rate (ir). The second cointegrating system associates the log of consumer price index (cpi) to the log of real exchange rate (ler), log of import (lim), log of reserve money (lrm) and real interest rate (ir). Finally, the third cointegrating system relates the log of oil price (op) to the log of real exchange rate (ler), log of import (lim), log of reserve money (lrm) and real interest rate (ir). The estimate of the cointegrating parameter matrix β is given by:

$$\hat{\beta} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1.02 & -0.39 & 3.06 \\ 0.3 & -019 & -3.34 \\ -0.62 & -0.21 & 2.07 \\ -0.04 & -0.01 & 0.11 \end{pmatrix}, \tag{2.6.1}$$

where the identity matrix of order 3 at the upper block of $\hat{\beta}$ results from Johansen's restrictions necessary to identify the cointegrating relationships. The estimated 3 cointegrating relationships are explicitly at the equilibrium given by:

$$\hat{lip}_{t-1} = 1.02ler_{t-1} - 0.30lim_{t-1} + 0.62lrm_{t-1} + 0.04ir_{t-1} - 5.23 \quad (2.6.2)$$

$$\hat{lcpi}_{t-1} = 0.39ler_{t-1} + 0.19lim_{t-1} + 0.21lrm_{t-1} + 0.01ir_{t-1} - 2.47 \quad (2.6.3)$$

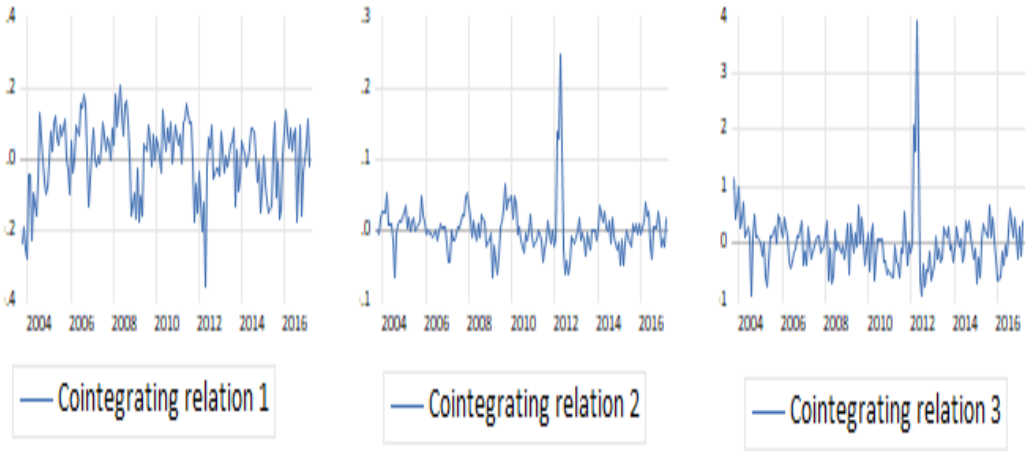
$$\hat{lop}_{t-1} = -3.06ler_{t-1} + 3.34lim_{t-1} - 2.07lrm_{t-1} - 0.11ir_{t-1} + 8.25, \quad (2.6.4)$$

where (2.6.2)-(2.6.4) are obtained by setting $\hat{\beta}'Y_{t-1} + \hat{\mu}_0 = 0$, $Y_t = [lip_t, lcpi_t, lop_t, ler_t, lim_t, lrm_t, ir_t]'$.

The model exhibits a long term positive relationship between output and interest rate, signaling that a contractionary monetary policy will boost output in the long-run. The coefficient of reserve money is 0.62, meaning that reserve money and industrial production index (thus output) are positively related, and that on average one percent increase in reserve money increases the growth of industrial production index 0.62 percent. Although we cannot infer this elasticity directly to the real output growth, the high correlation between the industrial production index and real GDP means the reserve money has a similar large long-run effect on real output growth. Also, the coefficient of exchange rate which is 1.02 reveals that exchange rate and industrial production index (thus real output) are directly related, and that on average one percent increase in exchange rate increases the growth of industrial production index by 1.02 percent. Besides this, from the second equation we can say that there is also a long-run positive relationship between consumer price index and interest rate. So, a contractionary monetary policy increase the consumer price index in the long-run. The coefficient of reserve money is 0.21. This positive estimate indicates that reserve money and consumer price index are directly related, and that one percent increase in reserve money increases consumer price index by 0.21 percent. Also, the estimated coefficient of exchange rate is 0.39, thus revealing that exchange rate and consumer price index are directly related, and that on average one percent increase in exchange rate increases consumer price index by 0.39 percent.

Given the data, we filtering the vector of errors $\hat{\beta}'Y_{t-1} + \hat{\mu}_0$ at any time t, which yields

FIGURE 2.4: Plots of cointegrating systems from the VECM estimation



the evolution of the three cointegrating systems over times. Values of zero in these prediction indicate that the given system is at the long-run equilibrium (the zero horizontal line), while positive values indicate the system is above the long-run equilibrium and negative values depict a system is below the long-run equilibrium. We can then plot the dynamic of the three cointegrating systems over time. Figure 2.4 shows these graphical representations where the long-run equilibrium relationship among the variables are depicted by the zero horizontal line. Interestingly, all cointegrating system indicate large short-run deviations from the long-run equilibrium in 2012. In the first half of 2012, Bangladesh economy witnessed significant balance of payments pressures due to high global oil prices and low aid disbursements, forcing significant depreciation of the Taka and some foreign reserve depletion. Besides these, government's borrowing from the banking sector also rose sharply during that period and inflation rose to double-digits levels.

The estimates of the full VECM are summarised in the following system of equations:

$$\begin{pmatrix} \Delta\hat{lip}_t \\ \Delta\hat{lcpi}_t \\ \Delta\hat{lop}_t \\ \Delta\hat{ler}_t \\ \Delta\hat{lim}_t \\ \Delta\hat{lrm}_t \\ \Delta\hat{ir}_t \end{pmatrix} = \begin{pmatrix} -0.36 \\ 0.05 \\ -0.31 \\ 0.05 \\ -0.001 \\ 0.21 \\ 1.11 \end{pmatrix} ect_{1(t-1)} + \begin{pmatrix} 0.90 \\ -0.19 \\ 0.95 \\ -0.02 \\ 2.25 \\ -0.29 \\ 4.59 \end{pmatrix} ect_{2(t-1)} + \begin{pmatrix} -0.11 \\ 0.01 \\ -0.11 \\ 0.003 \\ 0.06 \\ 0.02 \\ -0.16 \end{pmatrix} ect_{3(t-1)} + \begin{pmatrix} 0.02 \\ 0.005 \\ 0.005 \\ 0.004 \\ 0.006 \\ 0.02 \\ 0.01 \end{pmatrix}$$

$$+ \begin{pmatrix} -0.19 & -0.02 & 0.15 & -0.03 & -0.47 & -0.05 & 0.27 \\ -3.29 & 0.38 & 2.22 & -0.28 & 0.88 & -0.83 & 2.31 \\ 0.10 & -0.01 & 0.27 & -0.03 & 0.10 & -0.001 & -0.59 \\ 0.46 & -0.01 & -1.27 & 0.34 & 0.71 & 0.03 & 0.82 \\ -0.09 & -0.01 & -0.11 & 0.002 & -0.02 & -0.03 & 0.25 \\ -0.09 & -0.02 & 0.04 & -0.01 & 1.22 & -0.56 & -0.08 \\ -0.002 & -0.001 & -0.02 & 0.004 & -0.01 & -0.004 & 0.29 \end{pmatrix} \begin{pmatrix} \Delta lip_{t-1} \\ \Delta lcpi_{t-1} \\ \Delta lop_{t-1} \\ \Delta ler_{t-1} \\ \Delta lim_{t-1} \\ \Delta lrm_{t-1} \\ \Delta ir_{t-1} \end{pmatrix} \quad (2.6.5)$$

$$+ \begin{pmatrix} 0.04 & -0.01 & 0.16 & -0.01 & -0.17 & -0.09 & -0.13 \\ -0.37 & -0.04 & -2.75 & 0.15 & -3.24 & 0.47 & -4.87 \\ 0.19 & 0.004 & 0.127 & -0.01 & 0.04 & -0.03 & -0.11 \\ 0.59 & -0.11 & 0.46 & -0.20 & 2.44 & -0.06 & -0.87 \\ 0.01 & -0.004 & -0.07 & -0.003 & 0.12 & -0.001 & 0.23 \\ 0.41 & -0.02 & 0.19 & -0.04 & 0.01 & -0.12 & -0.61 \\ 0.004 & -0.002 & 0.04 & -0.01 & 0.01 & -0.01 & 0.15 \end{pmatrix} \begin{pmatrix} \Delta lip_{t-2} \\ \Delta lcpi_{t-2} \\ \Delta lop_{t-2} \\ \Delta ler_{t-2} \\ \Delta lim_{t-2} \\ \Delta lrm_{t-2} \\ \Delta ir_{t-2} \end{pmatrix},$$

where $\hat{\beta}' Y_{t-1} \equiv \begin{pmatrix} ect_{1(t-1)} & ect_{2(t-1)} & ect_{3(t-1)} \end{pmatrix}$. The VEC system is stable and the residuals from the estimation show little evidence of autocorrelation, as shown in Table 2.3.

TABLE 2.3: Autocorrelation test of the Variables

Null Hypothesis : No serial correlation up to lag h					
Lags	Q-Stat	Prob.*	Adj Q-stat	Prob.*	df
1	15.16	–	15.25	–	–
2	61.16	0.9069	61.82	0.8962	77
3	139.21	0.1986	141.33	0.1659	126

2.6.2 Shocks Transmission

In this section, we examine how the shocks propagate in the VEC system. Unlike the traditional VAR, the computation of the impulse response functions is based on the VECM representation where the estimated long-run restrictions are taken into account. This allows us to examine the effect of a variable-specific shock on the individual variables as well as on the estimated cointegrating relationships (Pesaran, Shin, et al. (1995)). The impulse responses derived from VECM model do not provide confidence bands. However, The identification method used to identify the shocks (the monetary policy shock, the exchange rate shocks and the oil price shock) is Cholesky decomposition to the errors of the VECM. The ordering of the variables are crucial for this method. The variables are ordered as follows: real interest rate, reserve money, real exchange rate, imports, industrial production index, consumer price index and oil price.

Monetary Policy Shock

The fundamental theory of open-economy monetary transmission mechanism needs to discuss before presenting impulse responses of monetary policy shock. Plenty of open-economy monetary transmission models, such as Obstfeld and Rogoff (1995), Adolfson (2001), Smets and Wouters (2002), Monacelli (2005) and Ito and Sato (2008), contributed to new open-economy macroeconomics literature. These models suggest that monetary policy affects the real economy through the interest rate and exchange rate channels. For instance, a contractionary monetary policy shock increases the interest rate, which increases the capital inflow into a country from rest of the world, leading to a domestic currency appreciation. The appreciation of home currency increases prices of domestic

products relative to foreign products, leading to a decline in net exports. Hence, the contractionary monetary policy shock leads to a drop in aggregate demand. So according to theory, monetary policy shock affects the level of output with a lag, and the price level with a further lag.

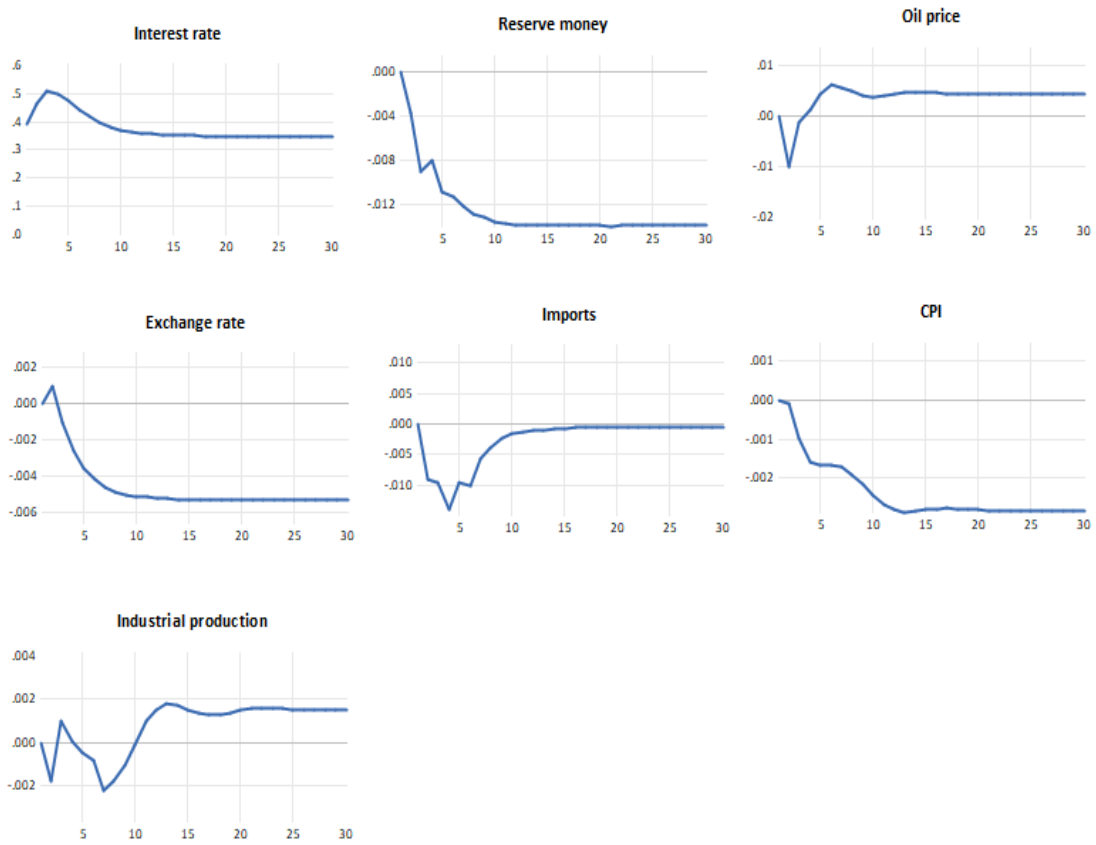


FIGURE 2.5: Monetary Policy Shock

The impulse-response functions to a shock in monetary policy are shown in Figure 2.5. Monetary policy shock represented by the shocks to the short term interest rate. Bangladesh Bank focuses on reserve money as the operating target and money supply as the intermediate target. Therefore, it uses short term interest as instrument that can affect the goals through the target variables. That's why we use interest rate as a shock of monetary policy. We notice from the impulse-response function that interest rate reacts positively immediately after a contractionary monetary policy shock and continue

to increase till three months, then decreases slowly till fifteenth month. Reserve money shows an anticipated decreases in response to a contractionary monetary policy shock. Bangladeshi currency appreciates immediately after a contractionary monetary policy shock, then depreciates after one month and persists then. This result is theoretically consistent and opposite to previous findings of (Afrin (2017), Bhuiyan (2012)). Imports respond negatively with a contractionary monetary policy shock until four months and start increasing after that until almost one year and persists after that. The response of industrial production is volatile and initially moves negatively according to the theoretical prediction. Industrial production is not much responsive in longer time horizon to a positive innovations in interest rate. Inflation does not respond immediately with monetary policy shock, but starts to decrease after first month. The response of inflation to interest rate shock is negative persistently over the all response horizons. Response of inflation is also theoretically consistent. This finding differs with the findings of Cushman and Zha (1997) and Kim and Roubini (2000). They find that a contractionary monetary policy shock lower output with a lag and inflation with a further lag. The impulse responses of monetary policy shock are free from all three puzzles such as- liquidity puzzle, exchange rate puzzle and price puzzle. The impact magnitude of monetary policy shock is smaller in this paper compared to the paper of Bhuiyan (2012)) and much higher compared to Afrin (2017). Both of that paper used structural VAR as this paper is using error correction mechanism.

Exchange Rate Shock

The impulse-response functions to a shock in exchange rate are shown in Figure 2.6. Exchange rate appreciates immediately due to its own shock. After 2 months, exchange rate starts to depreciate and remain stable. The appreciation of domestic currency increases the price of domestic products compared to foreign products, leading to an increase in imports. The response of imports to exchange rate shock shows immediate increase, reach the pick in third month and then decline and become negative after four months. Due to a deterioration in net exports, aggregate demand should decrease and both output and

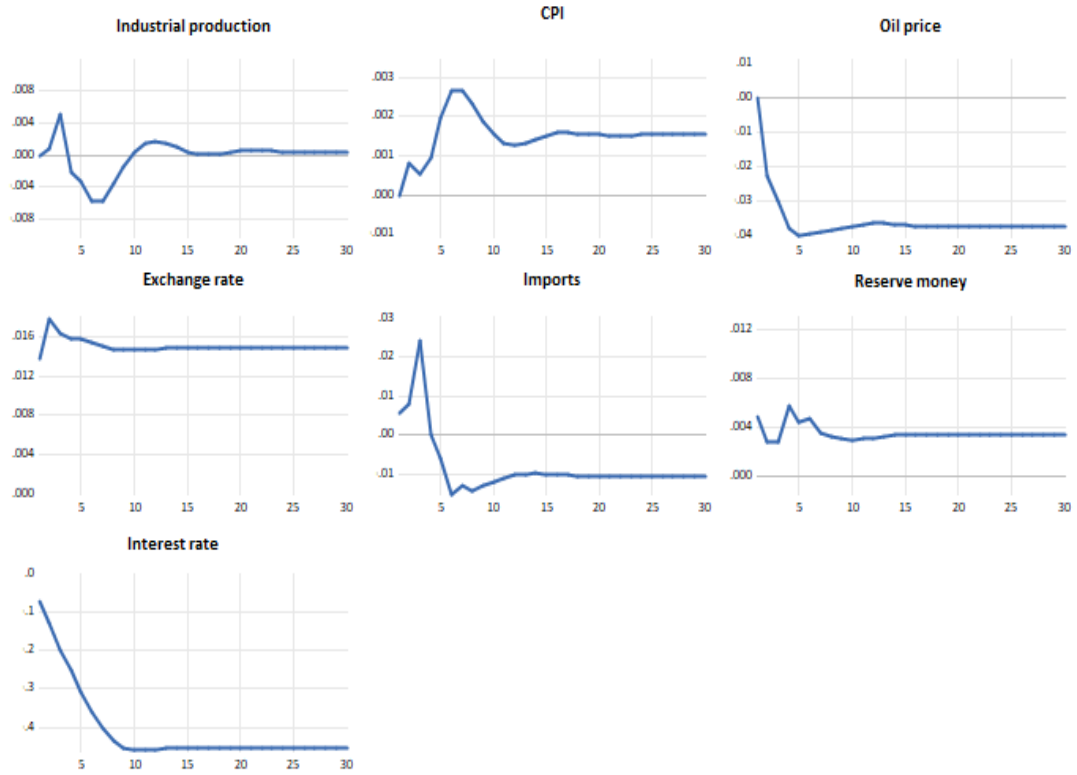


FIGURE 2.6: Exchange Rate Shock

inflation should decrease according to theory. But, industrial production responds positively with positive innovations in exchange rate. Industrial production responds negatively due to exchange rate shock with a lag of four months and the shock dies out within fifteen month. On the other hand, inflation tend to increase with the exchange rate shock for first half year and after that decreases persistently.

Oil Price Shock

One of the most important sources of macroeconomic fluctuations is rise in global oil price. It is considered as the global shock by the economists as it can affect many economies concurrently (Blanchard and Gali (2007)). A positive shock in oil price raises

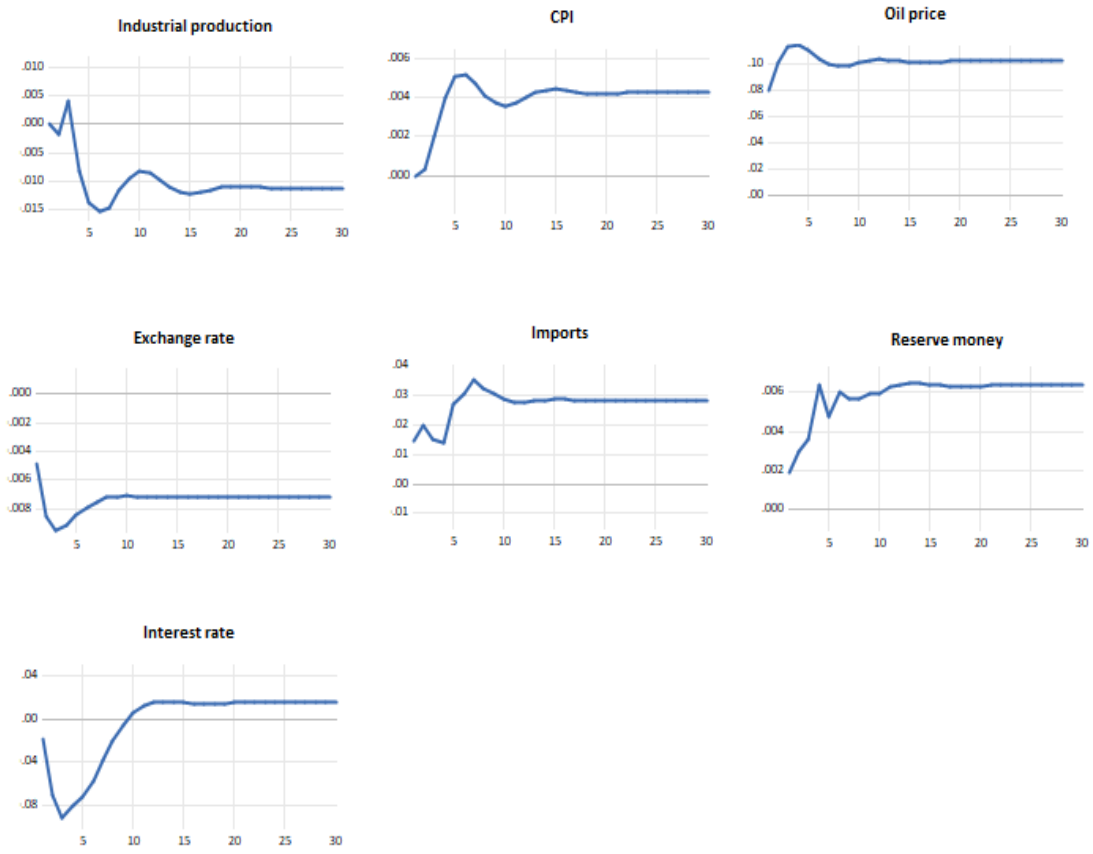


FIGURE 2.7: Oil Price Shock

the costs of imports and therefore, demand for foreign currency increases. The impulse-response functions to a shock in oil price are shown in Figure (2.7). From the impulse responses we can see that Bangladeshi currency depreciates instantly with oil price shock, then appreciates slightly and remains stable after that. Imports respond positively first and after that increases slowly. After one month imports start to decrease and persists after that. An increase in oil price is stagflationary. In our analysis, oil price shock decreases industrial production persistently after some increase for three months. Domestic price level increases by raising costs of production which is unfavourable to industrial production. Inflation has a positive response for all the response horizon and increases persistently. Interest rate responses negatively due to oil price shock which indicates monetary

expansion by the central bank to boost the economy. Besides this, from the impulse response of reserve money we can see a permanent increase in money supply after an oil price shock.

2.6.3 Historical Decomposition of Output and Inflation

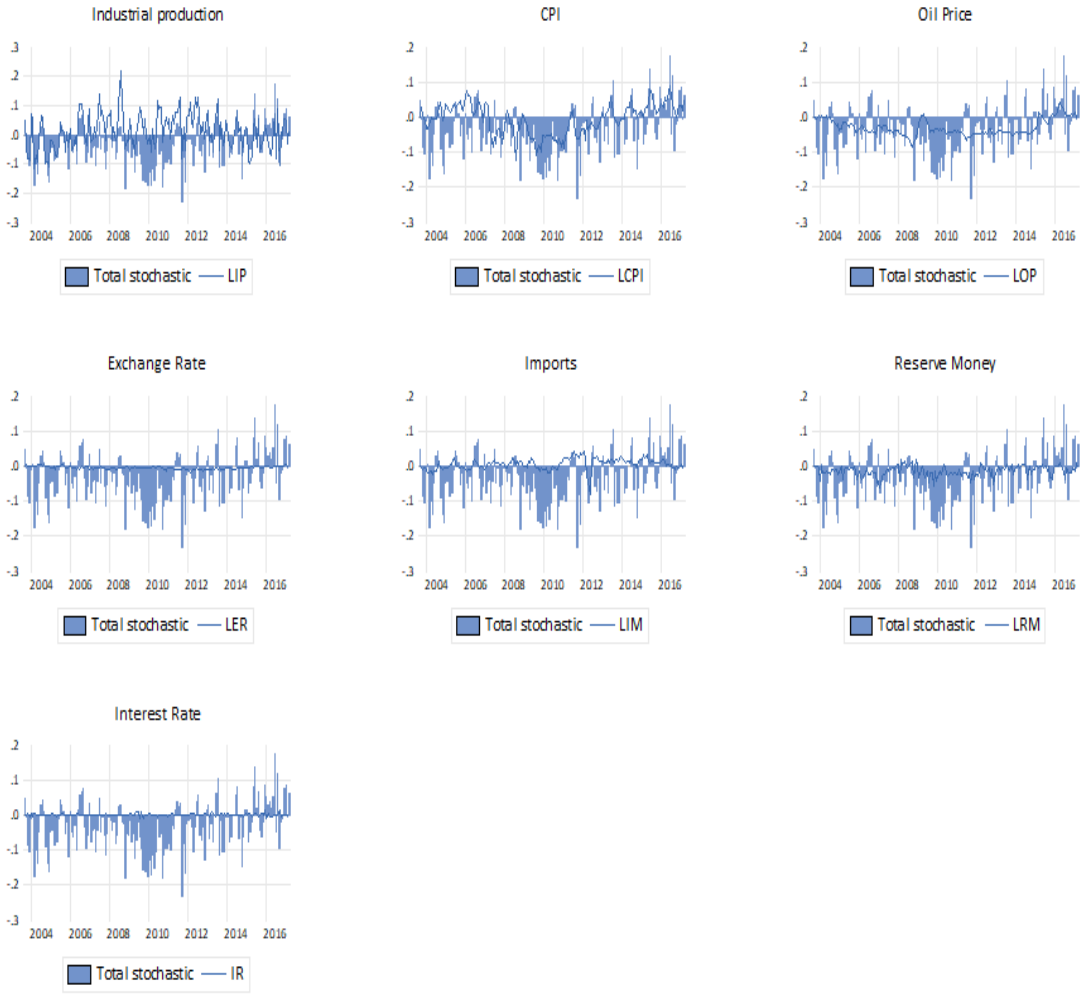


FIGURE 2.8: Historical Decomposition of Output

The historical decomposition of output and inflation represents output and inflation in terms of the product of their impulse responses with estimates of the structural shocks. This helps to evaluate the contribution of each shock to output and inflation over time.

Figure 2.8 represents the historical decomposition of output into its component shocks. Each of the contributions is represented in the identical scale. Most influential shocks are inflation, oil price and imports. In particular, oil price shocks has been contributing negatively over the all time horizon except recent two years. Inflation shocks also contribute to the variation in output. However, monetary policy shocks have no significant influence on output.

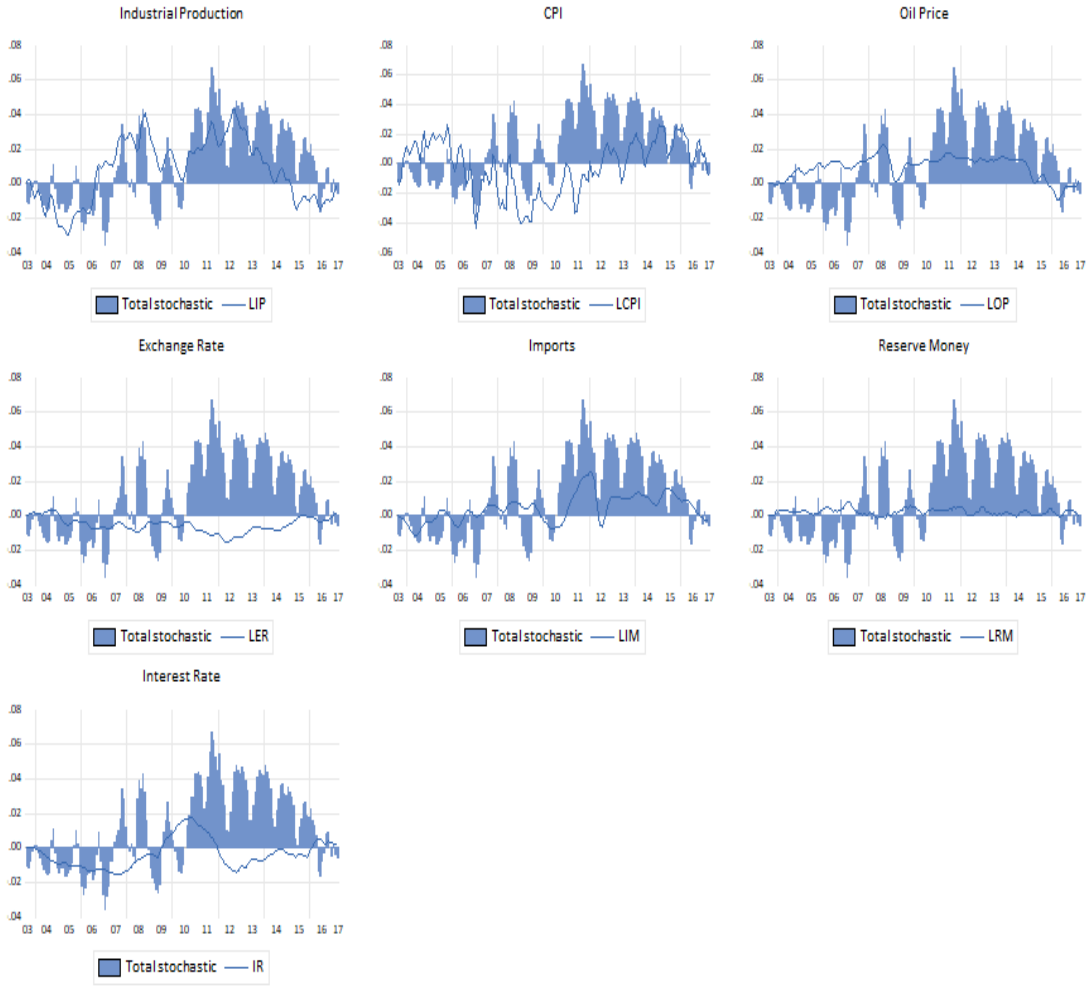


FIGURE 2.9: Historical Decomposition of Inflation

Figure 2.9 represents the historical decomposition of inflation into its component shocks. Most influential shocks are output gap, interest rate and oil price. In particular, monetary policy shocks has been contributing significantly to the movements of inflation.

Imports shock also have some impact on inflation. However, exchange rate and reserve money shocks don't have significant influence on inflation.

2.7 Conclusion

This paper examines the monetary policy transmission mechanism in Bangladesh during the modern era of market based monetary policy instruments and flexible exchange rate regime using monthly data. Using vector error correction modeling framework, we find that a contractionary monetary policy shock reduce inflation but has no influence output. In Bangladesh, both interest rate and exchange rate channels are effective as shock the transmission mechanism. Besides this, external shocks such as oil price shocks are also play an important role in the fluctuations of domestic macroeconomic variables. Traditional SVAR model includes only temporary shocks whereas this chapter emphasizes on both the long- and short-run relationships. It is found that the magnitude of the impact of monetary policy is small compared to the level-based model. So, it is highly likely that the impact of monetary policy shock is accurately estimated.

While the study covers a relatively small short period, as we only covered flexible exchange rate regime, further research could improve the results using a longer series. In addition, the study uses industrial production index as proxy to GDP due monthly GDP data unavailability in Bangladesh. The results can be re-estimate when monthly GDP data become available.

Appendix A

TABLE A1: Descriptive Statistics

Outcome variables	obs.	Mean	Std dev	Min	Q_1	Q_2	Q_3	Max
Money Supply	175	5325736	3348779	1435477	2429015	4468353	7740952	13000000
Interest Rate	175	6.229657	2.388503	1.86	4.05	6.89	7.64	11.37
Exchange Rate	175	72.10766	9.9456886	57.90	68.58	70.27	77.87	83.41
CPI	175	106.5174	32.10333	58.4	76.05	102.55	134.37	166.15
IP	175	118.4847	47.87325	54.57	80.14	104.39	151.38	253.41
Imports	175	147207.8	71941.91	36104	82712	129187	209996	295045.1
Oil Price	175	73.25017	28.40047	27.10	49.733	67.48	103.14	133.87

TABLE A2: Lag Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	405.0449	NA	1.53e-11	-5.038543	-4.902859	-4.983440
1	1674.463	2410.288	2.99e-18	-20.48688	-19.40140*	-20.04605
2	1785.669	201.2954	1.36e-18*	-21.27428	-19.23902	-20.44774*
3	1835.271	85.39185	1.37e-18	-21.28191*	-18.29685	-20.06964
4	1872.550	60.87321	1.61e-18	-21.13355	-17.19869	-19.53555
5	1918.395	70.79816*	1.72e-18	-21.09360	-16.20896	-19.10989
6	1956.550	55.54197	2.06e-18	-20.95633	-15.12189	-18.58689
7	1998.125	56.83661	2.40e-18	-20.86234	-14.07811	-18.10718
8	2041.815	55.85673	2.79e-18	-20.79512	-13.06110	-17.65424

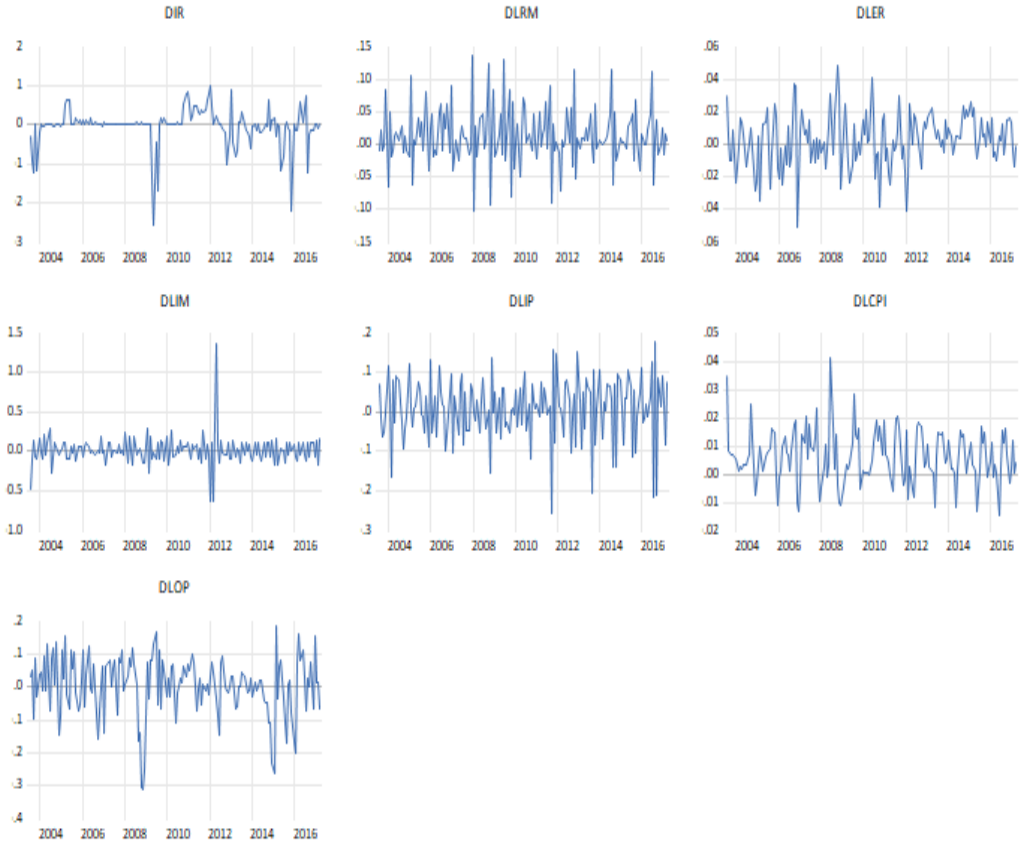


FIGURE A1: First difference of the variables

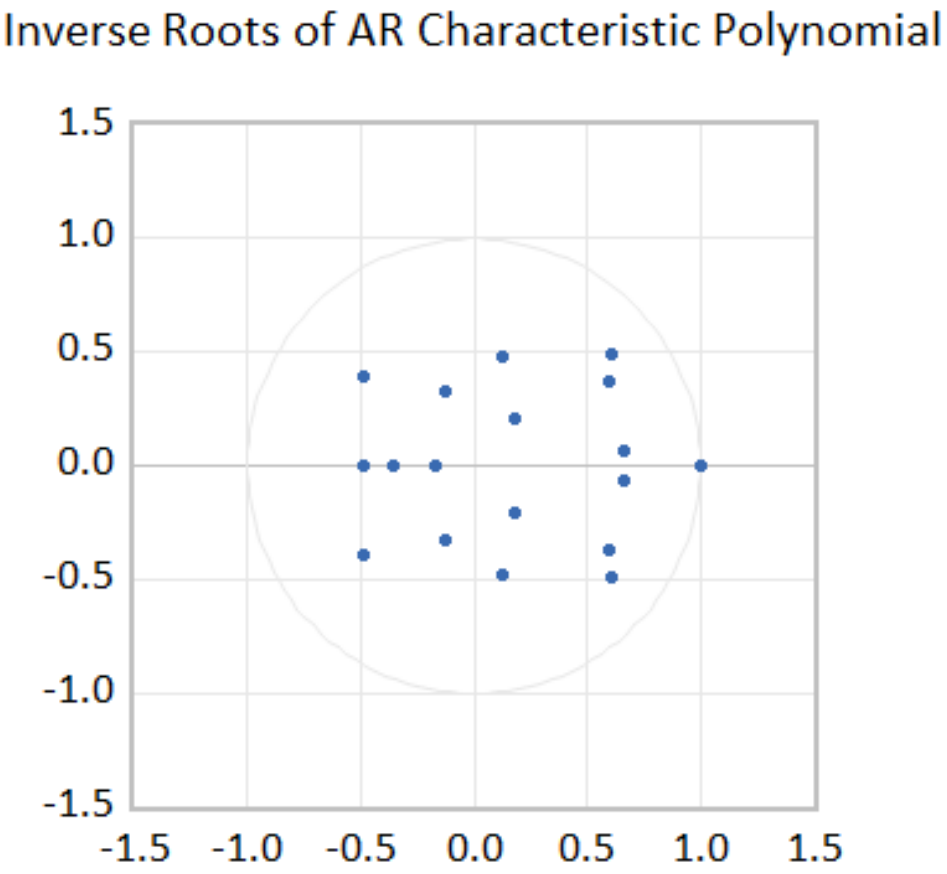


FIGURE A2: Residual stability test of error correction model.

Chapter 3

The Macroeconomic Effects of Fiscal Policy in the Euro-zone

Abstract

This paper examines the macroeconomic impact of fiscal policy in Euro-area countries under the same Monetary Union: Austria, Belgium, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Portugal, Spain. Using structural VAR model framework, we show that a positive government spending shock has expansionary macroeconomic effects in Finland and France, a contractionary effect in Austria, Belgium, Germany, Netherlands, Portugal and Spain, but no significant effect is observed in Ireland and Luxembourg. Furthermore, a positive tax shock has a permanent recessionary effect in Belgium, Finland, France and Germany; a non-Keynesian effect in Luxembourg, Ireland, Netherlands and Portugal and almost unresponsive in Spain and Austria. Moreover, the estimated fiscal multipliers range between 0 to 1 on impact and negative for high debt countries. The signs of these multipliers also show a divide between countries, demonstrating both a Keynesian and non-Keynesian nature fiscal policy across these Monetary Union countries.

Key Words: Fiscal policy, EMU, SVAR, Unemployment, Multiplier

Statement of Authorship

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Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	08/09/2021

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

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Contribution to the Paper			
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3.1 Introduction

Research on the impact of discretionary fiscal policy has often been overshadowed by the large literature on monetary policy effects on the economy. In recent years, fierce arguments have, however, emerged both in the political world and among economists, about the effectiveness of a fiscal stimulus and the consequences of fiscal consolidation. As a result, there is growing literature on fiscal policy impact, and this chapter contributes to that literature. Specifically, the chapter aim to identify and quantify the impact of changes in taxation and government spending on the macroeconomic variables for ten European Union member countries.

There is a lack of consensus regarding the empirical evidence of the impact of fiscal policy. Two fundamental views are predominant in the literature. On one hand, the New Keynesian view that a positive fiscal policy shock increases consumption and wages through the increase in aggregate demand and labour demand (Muscatelli, Tirelli, and Trecroci, 2006). On the other hand, the neoclassical view that a positive fiscal policy shock (often considered as a negative wealth shock) increases future tax, thus household will supply more labour and also reduce their consumption (Linnemann and Schabert, 2003). According to both theories a fiscal policy will lead to an expansion of output, but from different channels. The latest increase in fiscal policy analysis is closely related to recent economic recession which began in late 2007, as fiscal policy is expected to be more effective during economic recovery (Ray, 2009). Besides this, during recession fiscal policy has a wider scope in stabilizing business cycles through different stimulus packages, while this is not possible through monetary policy. However, the traditional Keynesian theory predicts that expansionary fiscal policy has expansionary effects on aggregate output, and as such plays an important stabilizing role during recession. Thus, according to the Keynesian view, in the context of economic downturn during 2008, a robust expansionary fiscal policy would be required in order to achieve economic growth and jobs more promptly.

A number of recent empirical studies shed some light on the impact of fiscal policy. There is a widespread fiscal policy literature that mainly focuses on the U.S economy. Ramey and Shapiro (1998) use a two sector dynamic stochastic general equilibrium

Model (DSGE) to evidence the sectoral nature of the effect of government spending. Edelberg, Eichenbaum, and Fisher (1999) use the same approach as in Ramey and Shapiro (1998) to show that an expansionary fiscal policy shock increases output, employment and nonresidential investment increase, whereas real wages, residential investment and consumption expenditures increase. To identify the responses of the macroeconomic variables due to fiscal policy, most studies often use SVAR models. The seminal work of Blanchard and Perotti (2002) examine the impact of fiscal policy on economic activity in the US using SVAR modelling approach. They show that positive government spending shocks have a positive impact and positive tax shocks have a negative impact on output, but the multipliers for both spending and tax shocks are small. Blanchard and Perotti (2002) identify the fiscal policy shocks through institutional information about the elasticity of fiscal variables to economic activity and decision lags in fiscal policy. This identification method is employed in many other studies. For example, Fatás and Mihov (2001) and Galí, López-Salido, and Vallés (2007) confirmed the main results in Blanchard and Perotti (2002) by investigating the postwar US economy using SVAR techniques. These two studies mainly focused on the response of consumption to government spending shocks and they find that an increase in government expenditures increases aggregate consumption.

Galí, López-Salido, and Vallés (2007) estimated the effects of fiscal shocks on aggregate output and found that the government spending multiplier, is 0.78 at impact and 1.74 at peak. Mountford and Uhlig (2009) use the sign restrictions approach to identify fiscal shocks, and they obtain almost the same results as Blanchard and Perotti (2002). In particular, their estimated fiscal multiplier is 0.65 in the case where government spending is financed through deficit. Canova and Pappa (2011) find a positive fiscal multiplier at impact by imposing sign restrictions to identify government consumption expenditure shocks for the US economy. Monacelli, Perotti, and Trigari (2010) find the Keynesian effects of fiscal policy in the US for the postwar period, with an estimate of unemployment fiscal multiplier around is 0.6 at the peak.

There are many empirical analyses of fiscal policy shocks in the context of developed countries. However, the evidence is mixed and most of the papers focus on OECD, G7 and other industrial economies. Mirdala et al. (2009) estimate the effectiveness of fiscal

policy shocks and find fiscal multipliers positive but small for six emerging economies: Czech Republic, Hungary, Poland, the Slovak Republic, Bulgaria and Romania in the period 2000 − 2008, while Cuaresma, Eller, and Mehrotra (2011) also find small fiscal multipliers with dissimilar sign for Czech Republic, Hungary, Poland, the Slovak Republic. Parkyn and Vehbi (2014) investigates the macroeconomic effects of fiscal policy in New Zealand using a five-variable SVAR framework proposed by Perotti (2005) and find positive but small effects of government expenditure shocks in the short run at the cost of higher interest rates and lower output. Tang, Liu, and Cheung (2013) investigates the effectiveness of fiscal policy in five Asian countries– Indonesia, Malaysia, the Philippines, Singapore and Thailand. Using time varying VAR approach, they find weak and insignificant effect of government spending on output. Jha et al. (2014) examine the effectiveness of fiscal policy in the context of developing Asia, and Karagöz and Keskin (2016) employ the Bayesian VAR methodology to analyse the impact of fiscal policy on Turkey's macroeconomic aggregates. Yadav, Upadhyay, and Sharma (2012) and Najaf (2016) explore the impact of fiscal shocks on Indian economy. Both studies use different time period and different modeling strategy to identify the fiscal shocks.

Since the start of the Global Financial Crisis of 2007, European countries' economies faced resilient adverse economic shocks. As a result, European economies went through a deep recession and an accompanying rise in unemployment to the highest levels in 20 years. As such, the usefulness of the Monetary Union (EMU) was questioned due to social and economic problems experienced by many Euro-area countries. Indeed, the profound and persistent economic crisis has raised important questions regarding the effective policy tools available to Euro-area economies to contrast strong adverse shocks, as fiscal policy is the sole instrument on the demand side to counterbalance individual shocks since they have a single monetary policy. There are limited research on the impact of fiscal policy shocks in the context of Euro area countries. Some of the existing studies focus on the effects of fiscal shocks at the aggregate level (see e.g. Canova and Pappa, 2011; Burriel et al., 2010) rather than country level. Ilzetzki, Mendoza, and Végh (2013) use panel VAR techniques to estimate fiscal multipliers for a group of Euro-area countries but their focus was not at country level. They find negative government spending

multipliers for high debt countries. Bergin (2000) analyses the fiscal theory of price level determination in the context of a monetary union. Perotti (2005) examines the impact of fiscal shocks using a five-variable VAR (GDP, the GDP deflator, government direct expenditure, net revenue and the interest rate) in 5 OECD countries including the US, while Biau and Girard (2005) assess the effects of fiscal policy in France using a similar method. Giordano et al. (2007) apply Blanchard-Perotti's methodology to the Italian context and De Castro and Fernández (2013) employ it for Spain. Afonso and Sousa (2011) analyse the macroeconomic effect of fiscal policy in Portugal using Bayesian SVAR method. They find that a positive shock to government spending leads to a decrease in real output, increase in price level and also has a crowding out effect of consumption and investment. De Castro (2006) find non-Keynesian effects of fiscal shocks in Spain using a VAR approach. Afonso and Sousa (2012) use the methodology for the US, the UK, Germany and Italy by incorporating the government debt dynamics into the model. Tagkalakis (2013) analyse the unemployment effects of fiscal policy in Greece using SVAR methodology.

Despite the growing literature on this topic in the last decade, there is a lack of consensus regarding the macroeconomic impacts of fiscal shocks, as well as the estimated magnitudes of the fiscal shocks. There is heterogeneity in the estimated impact as well as response horizon-specific of macro variables to fiscal shocks and, a widespread dispersion in the size of estimated fiscal multipliers. As such, it is interesting to understand how similar or different are the impact of fiscal policy shocks and their domestic transmission channels in Euro-area countries. This study mainly focuses on the effects of fiscal policy shocks on EMU countries in a multivariate analysis setting. In particular, we use the structural VAR approach to identify the fiscal policy shocks and quantify the fiscal multipliers for 10 EMU countries: Austria, Belgium, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Portugal, Spain. While a large literature using SVAR approach has aimed to measure the fiscal policy in the U.S. economy and in other OECD countries in the last decade, less attention has been devoted to Euro-area member countries. This study fills in this gap by analyzing the effects of government expenditure shock and tax revenue shock on economic activity. More specifically, three research questions are addressed. Firstly, how does fiscal policy shock transmit to the macro-economy across the

Euro-zone? Secondly, how big/small is the size of fiscal spending and tax multipliers across Euro-zone countries? Finally, what are the differences in transmission and fiscal multipliers between Euro-zone countries?

The study contributes to the fiscal policy literature on European Union member countries under the same Monetary Union in general, by examining the impact of changes in taxation and government spending on the macroeconomic variables for ten different countries. In addition, the study quantifies the size and sign of fiscal spending and tax multipliers across Euro-zone countries. In these perspectives, employing structural VAR techniques enables to capture the simultaneous interactions among the macroeconomic variables in each country. Overall, the main findings of this study threefold. Firstly, a positive government spending shock has expansionary macroeconomic effects in Finland and France and contractionary effect in Austria, Belgium, Germany, Netherlands, Portugal and Spain. Meanwhile, the increase in government spending does not produce significant effects on aggregate output in Ireland and Luxembourg. Secondly, an increase in government tax revenues has a permanent recessionary effects for Belgium, Finland, France and Germany as output decreases due to a fiscal shock. Meanwhile, government tax revenue shock has a non-Keynesian effect on Luxembourg, Ireland, Netherlands and Portugal. Fiscal policy shock using tax revenue remain almost unresponsive in Spain and Austria. Third, the estimated fiscal multipliers range between 0 to 1 on impact and they are negative for high debt countries. However, differences across Euro-area countries are mainly due to the debt dynamics among them.

The rest of the chapter is organized as follows. Section 2 reports theoretical and empirical models. The data is described in Section 3. Section 4 presents the results. This Section, represent the responses of variables to fiscal shocks for individual country and then, compare and contrast them across countries and finally describe the fiscal multipliers. Section 5, contains some concluding remarks.

3.2 Model

3.2.1 Background

Fiscal policy is defined as the use of fiscal tools to achieve some macroeconomic goals. There are two main tools that are used to formulate the fiscal policy. They are government's spending on goods, services and transfer payments, and government's earnings from tax revenue. Government can controls the amount of fiscal spending and tax rate to manage the fiscal policy. There are three main purposes of fiscal policy named allocation, distribution and stability, according to the traditional approach. The method of sharing the total resources between private and public goods is known as allocation function. The assurance of proper distribution of income and wealth according to the society's beliefs of justice is known as distribution function. To attain the main macroeconomic goals such as economic growth, price stability and sustainable external balance, using the fiscal tools by fiscal authority is known as the stabilization function.

Traditional $IS - LM$ model and $AD - AS$ (aggregate demand - aggregate supply) Model has been used to find the theoretical impact of fiscal policy instruments on the overall macro-economic framework. In the open economy macro model, fiscal expansion increases total output and shifts the IS curve to the right whereas, monetary expansion also moves the LM curve to the right because of increased demand. Therefore, it is clear that the fiscal policy affects domestic production and income directly. The magnitude of this effect depends on the structure of the foreign exchange and capital markets. A debt-financed fiscal expansion shifts the IS curve to the right shifts and at the same time, shifts the AS curve to the right also. The effectiveness of fiscal expansion and contraction on output and prices depends on the slope of the IS curve.

Historically, different economic schools represent diverse point of views regarding the effectiveness of the fiscal policy. Classical approach was the dominant economic paradigm until the occurrence of the Great Depression in 1929 (Laybourn-Langton and Jacobs, 2018). According to classical economic theory, balanced budget is important and it was highlighted that budget deficits would lead to economic uncertainty. They always argued that the budget should be same, except in unpredicted situations. The classical

approach emphasized that funding the budget deficit by borrowing could risk higher fiscal deficits.

Emphasizing the government intervention to the economy by public spending, revenues and budget, the Keynesian theory supports and argued for the principle of balanced budget and debated for the significance and the macroeconomic effect of the unbalanced budget (Musgrave, 1987). It is more convenient to increase aggregate demand by public spending and revenues. Therefore, contractionary fiscal policy should be adopted to reduce the inflation level by following budget surplus policy, whereas during the recession monetary expansion policy would be taken by budget deficit (Musgrave, 1987). According to Keynesian point of view, fiscal policy is a temporary tool which works through aggregate demand channel (Fazzari, 1994). Fiscal expansion has a multiplier effect on aggregate demand and hence on outcome. In addition, the Keynesian theory suggests that the multiplier is greater than one (i.e. marginal propensity to save is greater than marginal propensity to consume) and the government spending multiplier is higher than tax multiplier (Hemming, Kell, and Mahfouz (2002)).

3.2.2 Empirical Model

This paper considers the following structural VAR (p) model

$$A_0 X_{it} = A_1 X_{i(t-1)} + \ldots + A_p X_{i(t-p)} + \epsilon_t, \tag{3.2.1}$$

where $X_{it} = [G_{it}, T_{it}, Y_{it}, U_{it}, P_{it}, C_{it}, I_{it}]'$ is an $n \times 1$ column vector of endogenous variables ($n = 7$), $A_0, A_1, \ldots, A_p : n \times n$ are matrices of parameters, p is the lag length, and $\varepsilon_t : K \times 1$ is a vector of structural shocks with mean zero and a positive semi-definite co-variance matrix, Σ. Within X_{it}, G_{it} is the government expenditure, T_{it} is the tax revenue, Y_{it} is the real GDP, U_{it} is the unemployment rate, P_{it} is the GDP deflator, C_{it} is the consumption expenditure, and I_{it} is the investment expenditure.

The above structural VAR (SVAR) model can be written as:

$$A_0 \Delta X_{it} = A(1) X_{i(t-1)} + \Gamma_1 \Delta X_{i(t-1)} + \ldots + \Gamma_{p-1} \Delta X_{i(t-p+1)} + \epsilon_t, \tag{3.2.2}$$

where $A(1) = -(A_0 - A_1 - \ldots - A_{p-1})$ and $\Gamma_i = -(I - A_1 - \ldots - A_{p-1})$ and the associated reduced form first-differenced VAR model is given by:

$$\begin{aligned} \Delta X_{it} &= A_0^{-1} A(1) X_{i(t-1)} + A_0^{-1} \Gamma_1 \Delta X_{i(t-1)} + \ldots + A_0^{-1} \Gamma_{p-1} \Delta X_{i(t-p+1)} + A_0^{-1} \epsilon_t \\ &= \Pi X_{i(t-1)} + \Psi_1 \Delta X_{i(t-1)} + \ldots + \Psi_{p-1} \Delta X_{i(t-p+1)} + e_t, \end{aligned} \tag{3.2.3}$$

where $\Pi = A_0^{-1} A(1)$, $\Psi_j = A_0^{-1} \Gamma_{p-1}$ for $j = 1, \ldots, p-1$ and $e_t = A_0^{-1} \epsilon_t$. Now suppose that there are $r < n$ co-integrating relations in this system, so that Π is rank deficient and $\Pi = \alpha \beta'$, where α and β are $n \times r$ full column rank matrices. Then,

$$\Delta X_{it} = \alpha \beta' X_{i(t-1)} + \Psi_1 \Delta X_{i(t-1)} + \ldots + \Psi_{p-1} \Delta X_{i(t-p+1)} + e_t, \tag{3.2.4}$$

The following SVECM model can be written, where there are r transitory shocks and $n - r$ permanent shocks:

$$A_0 \Delta X_{it} = \alpha^* \beta' X_{i(t-1)} + \Gamma_1 \Delta X_{i(t-1)} + \ldots + \Gamma_{p-1} \Delta X_{i(t-p+1)} + \epsilon_t, \tag{3.2.5}$$

where, $\alpha^* = A_0 \alpha$ and ϵ_t is the structural errors of interest. The first $(n - r)$ shocks are known to be permanent and the remaining r shocks, are transitory. Such a decomposition is possible since it is assumed that there are r co-integrating relations amongst the n, $I(1)$ variables in X_{it}. In the existing literature, when only $I(1)$ variables are present, the SVECM form is often transformed to an SVAR form involving $(n - r)$ of the ΔX_{it} and r ECM terms $\beta' X_{i(t-1)}$.

The identification method first use to identify the structural shocks (the government spending shock and the tax revenue shock) is Cholesky decomposition of variance-covariance matrix of VAR residuals. To identify the third relation it is necessary to impose restrictions assuming that some structural shocks have no contemporaneous effects

on some endogenous variables. According to Cholesky decomposition the matrix A_0 is identify as a lower triangular matrix and matrix B as n-dimensional identity matrix. The ordering of the variables are crucial for this method. The ordering presented in the matrix is according to previous studies that investigated the fiscal policy shocks. The variables are ordered as follows: government expenditure, taxes, inflation, real output, unemployment, consumption and investment.

3.3 Data

The empirical analysis in this paper employs quarterly time series data for 10 EMU countries: Austria, Belgium, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Portugal and Spain. The estimation period varies for 10 countries depending on the data availability. For Belgium, Finland, Netherlands and Portugal, data ranges from 1999Q1 to 2019Q4; for Germany, Ireland and Luxembourg, data ranges from 2002Q1 to 2019Q4; for Austria, data ranges from 2001Q1 to 2019Q4; for France, data ranges from 1991Q1 to 2019Q4 and for Spain, data ranges from 1996Q1 to 2019Q4. This paper primarily uses quarterly and seasonally adjusted data for real GDP, GDP deflator, consumption expenditures and investment expenditures from *IFS* database for all the countries. The sample is complemented with *Eurostat* data for quarterly fiscal variables and unemployment rate. As fiscal variables, current study uses government spending and government tax revenues of the general government. Government spending is defined as the sum of government consumption and government investment and government tax revenues are obtained by subtracting transfer payments and interest expenses from total revenues. All variables are deflated by the GDP deflator except the unemployment rate. All the data used in the estimation process are seasonally adjusted and in logarithm except the unemployment rate.

Hence, this section is going to represent the preliminary analysis of the data, and briefly discuss, some descriptive statistics of the variables for the ten economies. Table 3.1 represents the descriptive statistics of the variables included in this study.

TABLE 3.1: Descriptive statistics for the ten economies

	$\frac{\Delta y}{y}$	P	$\frac{g}{y}$	$\frac{t}{y}$	U	$\frac{C}{y}$	$\frac{I}{y}$
Austria	0.37	100.9	22.4	21.4	5.0	53.1	23.1
	(0.6)	(9.9)	(1.3)	(1.5)	(0.7)	(0.9)	(0.7)
Belgium	0.43	98.6	25.1	21.1	7.6	51.3	22.6
	(0.5)	(9.8)	(1.5)	(1.3)	(0.9)	(0.8)	(1.0)
Finland	0.40	100.4	26.2	29.2	8.3	51.3	22.8
	(1.2)	(10.0)	(2.2)	(1.6)	(0.9)	(2.5)	(0.9)
France	0.38	92.9	27.1	21.4	9.5	54.4	21.6
	(0.5)	(10.1)	(0.8)	(1.2)	(1.4)	(0.6)	(1.1)
Germany	0.32	102.0	21.5	16.2	6.8	54.4	20.1
	(0.9)	(7.0)	(1.4)	(1.9)	(2.6)	(1.6)	(0.7)
Ireland	1.04	106.5	18.9	15.7	8.7	41.7	25.5
	(3.2)	(5.8)	(3.5)	(5.3)	(4.2)	(6.3)	(9.8)
Luxembourg	0.66	100.9	20.7	21.8	5.1	32.9	18.9
	(1.4)	(13.9)	(2.8)	(1.8)	(0.9)	(3.1)	(1.5)
Netherlands	0.39	97.2	27.7	19.3	4.7	46.8	20.7
	(0.7)	(8.7)	(2.1)	(1.6)	(1.5)	(2.3)	(2.4)
Portugal	0.22	95.9	22.5	18.6	9.0	64.7	20.7
	(0.7)	(10.4)	(3.8)	(2.6)	(3.7)	(1.2)	(4.3)
Spain	0.53	89.9	21.9	17.8	16.7	58.7	23.1
	(0.7)	(13.2)	(2.1)	(3.7)	(5.5)	(1.0)	(4.1)

Note: The table represents the mean and the standard deviation (in parenthesis) for each series. $\frac{\Delta y}{y}$ is the GDP quarterly growth rate. $\frac{g}{y}$, $\frac{t}{y}$, $\frac{C}{y}$, and $\frac{I}{y}$ are the ratios, respectively, of government spending, government tax revenues, consumption expenditures and investment expenditures to GDP.

As shown in Table 3.1, the average growth rates of real GDP over the sample period show some similarities between countries such as Austria, Belgium, Finland, France, Germany and Netherlands. The growth rate is around 0.4 percent in these countries. Nevertheless, the average value hides the very different variability of the growth rate of real GDP. For example, in the case of Austria, given an average value of 0.37 percent over the period, the minimum growth rate was observed in the last quarter of 2008, at a negative value of 1.9 percent, while the maximum value was reached in the second quarter of 2010, with the growth rate near 1.6 percent. As for Belgium, the minimum growth rate was observed in the last quarter of 2008, at a negative value of 2.2 percent, while the maximum value was reached in the first quarter of 2004, with the growth rate of 1.5 percent. Instead, in Finland, given an average value of 0.40 percent over the period, the minimum growth

rate was observed in the first quarter of 2009, at a negative value of 6.9 percent, while the maximum value was reached in the first quarter of 2006, with the growth rate near 2.8 percent. A similar variability also noticed in the case of France (the minimum growth rate was observed in the first quarter of 2009, at a negative value of 1.7 percent, while the maximum value was reached in the last quarter of 1999, with the growth rate of 1.4 percent) and Germany (the minimum growth rate was observed in the first quarter of 2009, at a negative value of 4.9 percent, while the maximum value was reached in the second quarter of 2010, with the growth rate near 2.2 percent). In the case of Netherlands, given an average value of 0.39 percent over the period, the minimum growth rate was observed in the first quarter of 2009, at a negative value of 3.7 percent, while the maximum value was reached in the second quarter of 2006, with the growth rate of 1.5 percent. On the other hand, Ireland, Luxembourg and Spain has higher average real GDP growth (1.04 percent, 0.66 percent and 0.53 percent respectively) compared to the other countries. Finally, in Portugal the average growth rate of real GDP, over the sample period, is around 0.22 percent over the period where, the minimum growth rate was observed in the first quarter of 2009, at a negative value of 2.6 percent, while the maximum value was reached in the first quarter of 2000, with the growth rate near 2.2 percent.

The average unemployment rate shows very different variability across countries (see Table 3.1). Austria, Luxembourg and Netherlands have the lowest average unemployment rate over the sample period which is around 5.0 percent. However, the average unemployment rate is highest in Spain around 16.7 percent. In addition, the average unemployment rate is around 8.0 percent in Belgium as well as Finland and around 9.0 percent in France, Ireland and Portugal over the sample period. Moreover, in the table we have represented the share of government spending and tax revenue to real GDP. The average ratios for government spending varies between 21.0 percent to 27.0 percent of GDP across countries and the average ratios for tax revenue varies between 18.0 percent to 21.0 percent of GDP (except 29.2 percent of GDP in Finland) across countries.

To analyse the impact of fiscal policy shocks on GDP or output, this paper has included consumption expenditures and investment expenditures, two major component

of GDP in this study. From Table 3.1, it can be observes that on average the share of consumption expenditures to real GDP are 53.1 percent in Austria, around 51.0 percent in Belgium and Finland and around 54.0 percent in France and Germany. However, the average share of consumption expenditures to real GDP are comparatively low in Ireland, Luxembourg and Netherlands (41.7 percent, 32.9 percent and 46.8 percent respectively). In contrast, the average share of consumption expenditures to real GDP are comparatively high in Portugal and Spain (64.7 percent and 58.7 percent respectively). On the other hand, the average share of investment expenditures to real GDP are around 20.0 percent in France, Germany, Luxembourg, Netherlands and Portugal; around 23.0 percent in Austria, Belgium, Finland and Spain, and around 25.5 percent in Ireland.

TABLE 3.2: General government financial balances (Surplus (+) or deficit (-) as a percentage of GDP)

	2012	2013	2014	2015	2016	2017	2018	2019
Austria	-2.2	-2.0	-2.7	-1.0	-1.5	-0.8	0.2	0.7
Belgium	-4.3	-3.1	-3.1	-2.4	-2.4	-0.7	-0.8	-1.9
Finland	-2.2	-2.5	-3.0	-2.4	-1.7	-0.7	-0.9	-1.0
France	-5.0	-4.1	-3.9	-3.6	-3.6	-3.0	-2.3	-3.0
Germany	0.0	0.0	0.6	1.0	1.2	1.4	1.8	1.5
Ireland	-8.1	6.2	-3.6	-2.0	-0.7	-0.3	0.1	0.5
Luxembourg	0.5	0.9	1.4	1.3	1.9	1.3	3.1	2.4
Netherlands	-3.9	-2.9	-2.2	-2.0	0.0	1.3	1.4	1.7
Portugal	-6.2	-5.1	-7.4	-4.4	-1.9	-3.0	-0.3	0.1
Spain	-10.7	-7.0	-5.9	-5.2	-4.3	-3.0	-2.5	-2.9

Source: Government Finance Statistics, Eurostat Database.

Table 3.2 exhibits the financial balances of the general government as a percent of GDP over some recent years. In Austria, the budgetary position improved sharply and faster than the Euro-area average from 2012 to 2019. The general governments financial balance moved from a deficit of 2.2 percent in 2012 to a small surplus of 0.7 per cent in 2019 (see Table 3.2). Formerly, Austrian budgetary policies have followed a partial Keynesian approach. But, recently, due to low growth, the government has engaged in extra spending regarded as an investment in the enhancement of growth. On the other hand,

during high growth, available funds have not been used efficiently to prepare the government for worse times. Besides this, Austria enacted the Federal Medium-term Expenditure Framework Act (BFRG), which enables the government to plan the budget over the medium term. However, Austrian tax policy faces a substantial bias, as the source of tax revenue is immensely skewed toward the personal income of the working population. According to the OECD, Austria ranked 6 out of 36 OECD countries in terms of the tax-to-GDP ratio in 2018. The tax structure in Austria is characterized by higher revenues from social security contributions and payroll taxes, and less revenue from taxes on personal income, capital gains, corporate profits and, in particular, property. However, in Case of Belgium, the general governmental deficit was reduced from a 4.3 percent of GDP in 2012 to 1.9 percent in 2019. In Belgium, total expenditures as a percent of GDP is very high compared to other countries in the Euro area. However, Belgium's taxes are the third highest in the European Union and tax structure is only just focused on labour income. The share of indirect tax revenues is the second lowest in the European Union. To confirm sustainability, the Government is continuously trying to balance the budget across all levels of government, with slow cut in spending while maintaining fiscal revenues. Finland is also facing a deficit in general government financial balances over time. But currently, the deficit is small amount of 1.0 percent of GDP. In addition, France has recorded a budget deficit in more than 25 years in general government financial balances and the deficit is quite high compared to the Euro-area deficit. The deficit was reduced from a 5.0 percent of GDP in 2012 to 3.0 percent in 2019. However, fiscal consolidation is a key priority in Germany. There is a commitment of balanced budgets. So, there is no deficit in general government financial balances over time.

On the other hand, in Ireland, the general government's financial balance moved from high deficit of 8.1 percent in 2012 to a small surplus of 0.5 per cent in 2019. Since 2015, there had been no improvement in the budget balance in Ireland, excluding interest costs. Besides this, non-interest spending by the government has expanded at the same pace as government revenues. During $2012 - 2019$ the budget surplus rose in Luxembourg from 0.5 percent to 2.4 percent of GDP. Furthermore, due to general government surpluses during recent years, Luxembourg implemented structural reforms consist of multi-year

tax cuts and further expenditure limits. The purpose is to allocate the growth surplus extensively, to further increase the competitive position of Luxembourg. However, Netherlands and Portugal slowly improves their general government's financial balance from a deficit of 3.9 percent in 2012 to a surplus of 1.7 percent in 2019 and from a deficit of 6.2 percent in 2012 to a surplus of 0.1 percent in 2019 respectively. In contrary, Spain is facing highest deficit in general government financial balances over time compared to the Euro-area average deficit level. The deficit was reduced from a 10.7 percent of GDP in 2012 to 2.9 percent in 2019.

TABLE 3.3: General government public and private debt to GDP ratio

		2000	2005	2010	2015	2019	Average
Austria	public	66.1	68.6	82.7	84.9	70.4	74.2
	private	121.4	127.4	132.3	124.9	120.1	125.0
Belgium	public	109.6	95.1	100.3	105.2	98.1	101.0
	private	114.9	121.3	168.7	176.1	179.1	154.5
Finland	public	42.5	39.9	46.9	63.6	59.3	48.3
	private	91.9	114.3	146.2	152.1	147.7	129.6
France	public	58.9	67.4	85.3	95.6	98.1	79.8
	private	99.5	109.6	132.0	142.8	153.3	126.2
Germany	public	59.1	67.3	82.4	72.1	59.8	68.4
	private	123.5	117.7	106.3	97.9	105.4	109.8
Ireland	public	36.5	26.1	86.0	76.7	57.4	60.8
	private	139.3	170.1	257.1	305.1	202.4	223.5
Luxembourg	public	7.5	8.0	20.2	22.0	22.0	15.5
	private	118.4	172.7	272.5	332.7	318.7	256.7
Netherlands	public	52.1	49.8	59.3	64.7	48.7	55.4
	private	212.5	232.4	245.2	263.9	234.0	239.4
Portugal	public	54.2	72.2	100.2	131.2	117.2	96.0
	private	138.8	169.9	201.7	179.3	148.8	176.3
Spain	public	57.8	42.4	60.5	99.3	95.5	68.5
	private	103.3	155.6	203.2	155.8	129.4	158.3

Source: Government Finance Statistics, Eurostat Database.

Finally, Table 3.3 exhibits the general government public and private debt to GDP ratio. In Austria, the average public debt to GDP ratio is 74.2 percent, a little bit above the Euro-area threshold level of 60 percent, whereas, the average private debt to GDP ratio is 125.0 percent, below the threshold level of 160 percent. In Belgium, the average public debt to GDP ratio is very high – compared with the Euro-area level, 101 percent of

GDP and the average private debt to GDP ratio is 154.5 percent, very close to the threshold level. Belgium's public debt is against the stability and growth plan since it is about 100 percent of GDP. This necessitates that the government should reduce public debt immediately by cutting public investments, healthcare and pension spending, and slow progresses in the education system and environmental safeguards. Furthermore, the average public debt to GDP ratio is 48.3 percent of GDP, lower than the Euro-area level and the average private debt to GDP ratio is 129.6 percent in Finland. Since the early 1990s, Finland has had a system of national fiscal rules named as expenditure rule. According to this rules Finland government sets a spending limits which has been accompanied by balanced budget and deficit targets.

In France, the average public debt to GDP ratio is higher than the Euro-area level, which is about 79.8 percent of GDP, but the average private debt to GDP ratio is lower than the Euro-area level, which is about 126.2 percent of GDP. The main objective of the government's fiscal approach is to ensure some structural changes that boost economic growth and to improve the control of public spending, rather than increasing taxes separately. France has safeguarded future-oriented investments from its multi-year consolidation efforts. However, Germany has lower average public and private debt to GDP ratios of 68.4 and 109.8 percent of GDP as the government surpluses increased over time. This decrease has resulted from surpluses in general government balances since 2010, as a consequence of dynamic employment growth, a stable GDP increase and historically low government-bond interest rates.

Furthermore, Ireland, Luxembourg and Netherlands have the lowest average public debt to GDP ratios and highest average private debt to GDP ratios among the ten countries. The average private debt to GDP ratios are 223.5 percent, 256.7 percent and 239.4 percent of GDP in Ireland, Luxembourg and Netherlands respectively. From Table 4.1, it can be noticed that these three countries are exhibiting higher average GDP growth rate. Portugal has the second highest average public debt to GDP ratio compared to other countries considering in this study and experienced the lowest average rate of GDP growth (see Table 3.1). However, the average private debt to GDP ratio is also quit high (176.3 percent of GDP) compared to the threshold level. Moreover, in Spain, both

the average public and private debt to GDP ratio is align with the Euro-area level at 68.5 percent and 158.3 percent of GDP.

3.4 Results

In this section, the paper is going to discuss the responses of macroeconomic variables to government spending and tax shocks for individual country separately. After that, it will compare and contrast the impact of fiscal policy shocks between countries. Later on, the estimated fiscal multipliers will be described.

The paper examines the unit root test to find the stationary properties of the variables. Table B1 in appendix, reports the unit root test results of the variables for all the countries. All the variables are integrated of order 1 (i.e., $I(1)$) for all the 10 countries included in the study. This means that the variables are non-stationary. Because of this, it is important to emphasise on cointegration analysis as the paper does. This paper first checks if there is evidence of cointegrating relationships between the seven variables for individual country separately. Johansen's cointegration test results are reported in Table B2 on appendix, with both the trace and maximum eigenvalue statistics. Both the trace statistic (first part of Table B2) and the maximum eigenvalue statistic (second part of Table B2) indicate evidence of cointegrating equations for all the countries. This means that there exists long run equilibrium relationships among the variables in Table B2. From the cointegration test results reported in Table B2, it can be seen that in Austria, Belgium and Luxembourg there are two transitory shocks ($r = 2$) and 5 permanent shocks ($n - r = 5$) exist. Besides this, Germany and Ireland have 3 transitory and 4 permanent shocks; Netherlands and Portugal have 4 transitory and 3 permanent shocks and France and Spain has 5 transitory and 2 permanent shocks. On the other hand, Finland has only 1 transitory and 6 permanent shocks. So, using this information this paper will impose long run restrictions in the identification of the SVAR model.

3.4.1 Response of Macroeconomic Variables to Fiscal Shocks

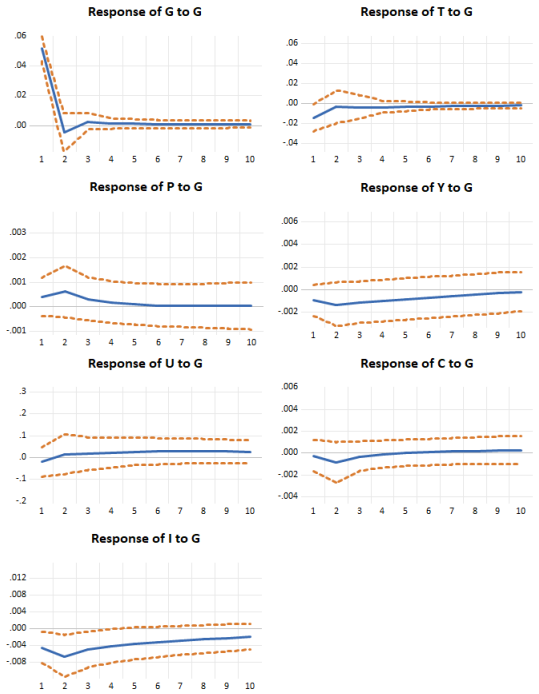
Impulse response functions exhibit the impact of a shock to any variable on the other variables of the model. This paper is illustrating the estimated impulse response functions of the macroeconomic variables of the model due to a one-standard-deviation shock in government expenditure, and the tax revenue. The horizontal axis represents the response horizon in quarters. The solid lines are the impulse responses and the upper and lower dashed lines are representing the 95% confidence interval.

Government Spending Shock

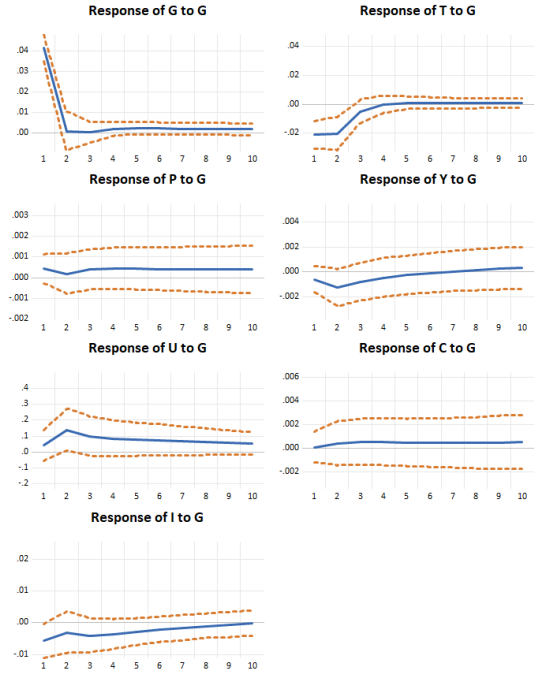
Figure (3.1a) represents the impulse response functions of all the variables to a shock in government spending in Austria. From the impulse responses, it can be seen that in Austria, government spending shock has temporary impact on all the macroeconomic variables considered in the model as the impulses coming back to origin after few periods. It can be seen that the effects on GDP or output is negative initially. Output responses positively with a fiscal expansion after almost two years. The impact on both private consumption and private investment is negative which is supporting the "Non-Keynesian" effect in the economy due to a government spending shock. Private consumption, the most important component of aggregate demand is almost 53.1 percent over the sample period. However, there is no crowding-out effect for Austria. Besides this, the response of GDP deflator is positive. Unemployment rate starts to decrease after one quarter with an initial increase.

The impulse response functions to a shock in government spending in Belgium are represented in Figure (3.1b). It provides the evidence of "Non-Keynesian" effects. Because, the impact on output is negative. But, the impact on private consumption is very small and positive, whereas the private investment is negative. Besides this, the response of unemployment rate and GDP deflator is positive. So, Fiscal expansion using government spending is ineffective in Belgium and showing contractionary effect on production. Government spending has temporary effect on all the variables except GDP Deflator.

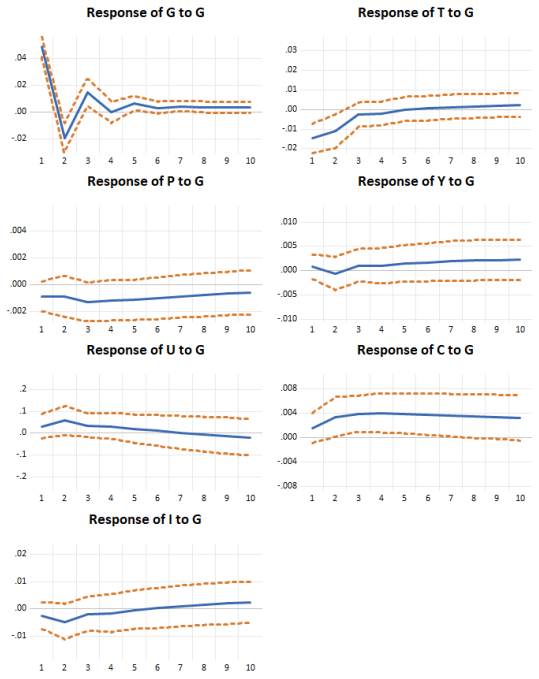
(A) Austria



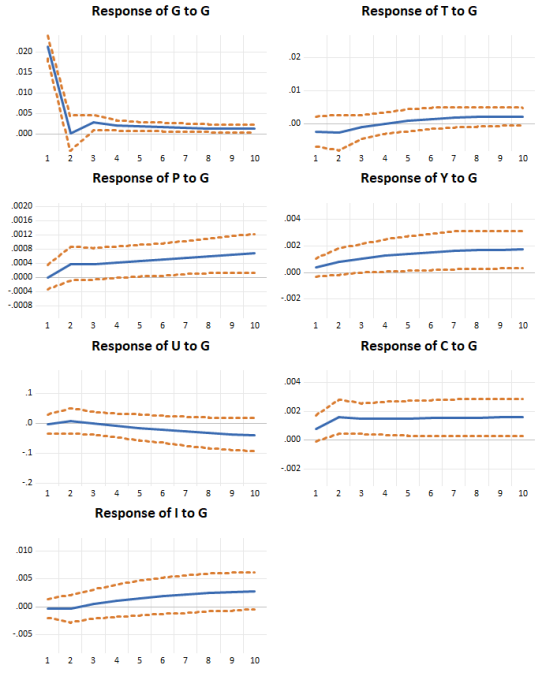
(B) Belgium



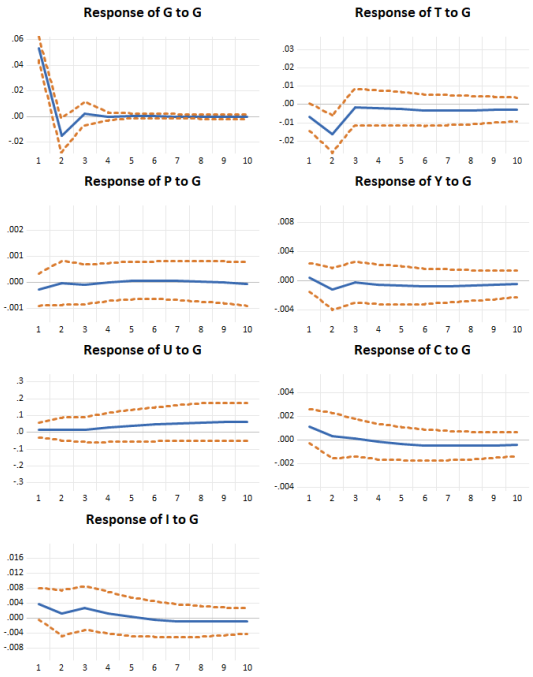
(C) Finland



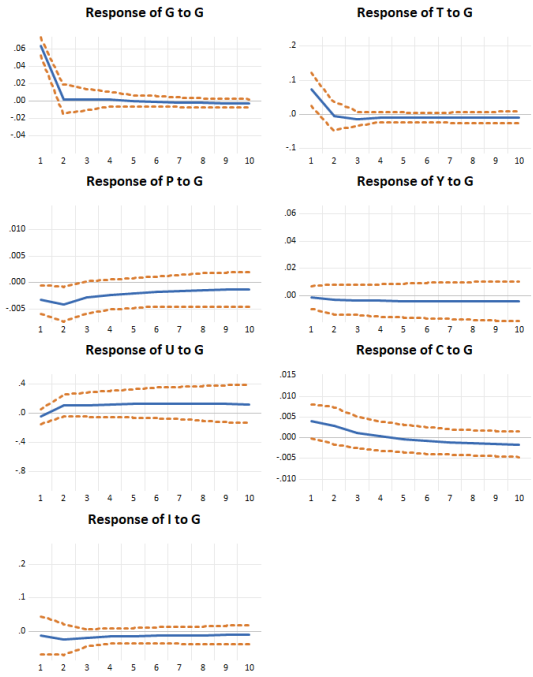
(D) France



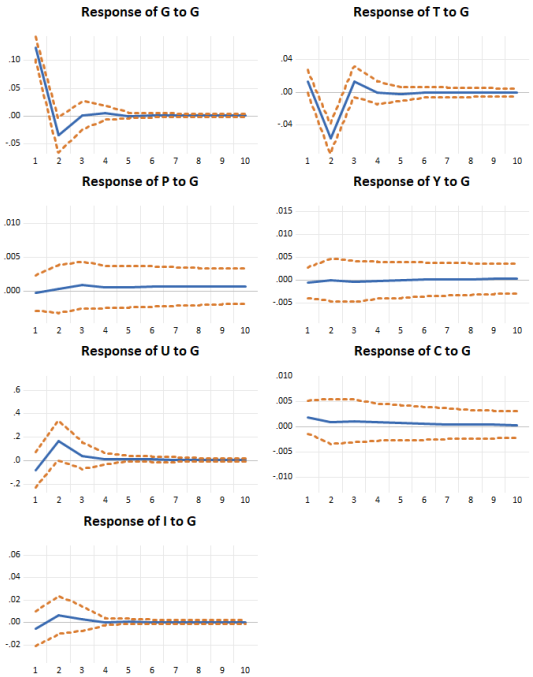
(E) Germany



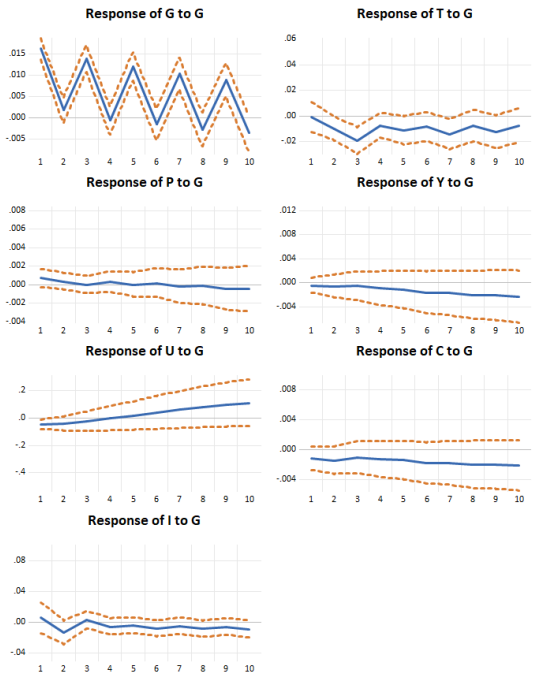
(F) Ireland



(G) Luxembourg



(H) Netherlands



(I) Portugal (J) Spain

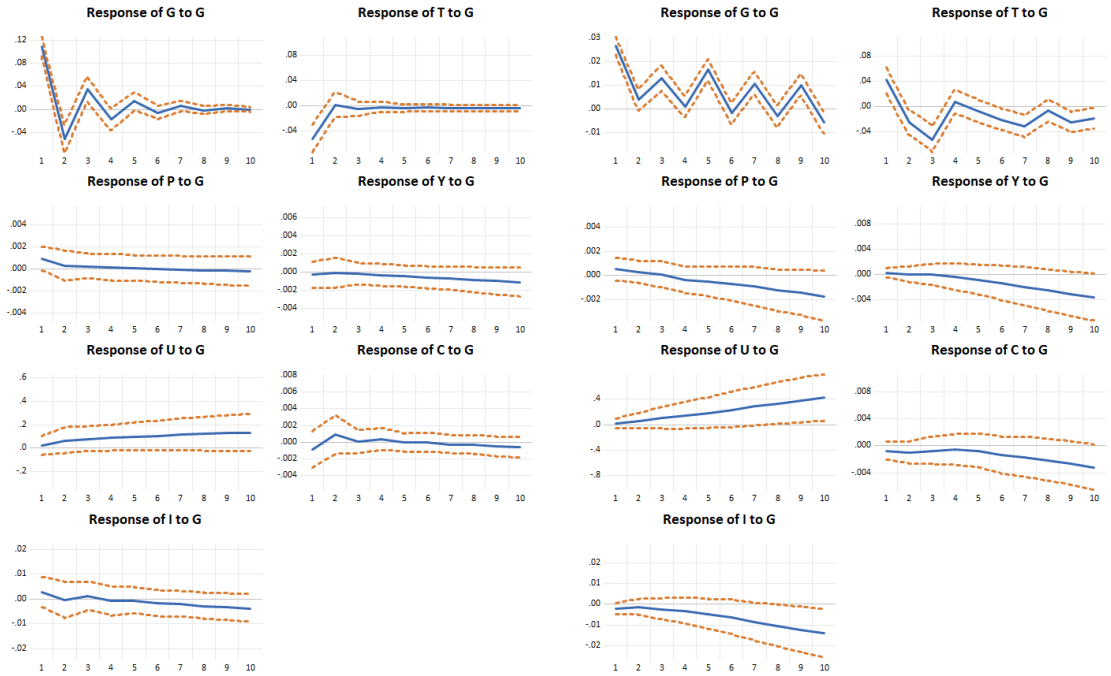


FIGURE 3.1: Impulse-response functions of government spending shock

The impulse response functions to a shock in government spending in Finland are represented in Figure (3.1c). It can be seen that output respond significantly with the government spending shock. The impact on private consumption due to a government spending shock is positive, but private investment responded negatively for first year and after that become positive. Besides this, the response of unemployment rate become negative as expected according to theory after six quarters. GDP deflator has a negative response with a positive fiscal shock.

Figure (3.1d) represents the impulse response functions of all the variables to a shock in government spending in France. It can be seen that the effects on output is positive for all time horizons. Output represents expansionary effect with a fiscal expansion. The impact on private consumption as well as private investment is positive which is supporting the "Keynesian" effect in the economy due to a government spending shock. There is no

crowding-out effect for France. Besides this, the response of GDP deflator is positive. Unemployment rate starts to decrease after second quarter with an initial increase. So, Fiscal expansion using government spending is effective in France.

The impulse response functions to a shock in government spending in Germany are represented in Figure (3.1e). It provides the evidence of "Non-Keynesian" effects due to a fiscal expansion. Because, the impact on output is negative and the impact on private consumption and private investment is also negative with a lag of six months. Besides this, the response of unemployment rate is positive and GDP deflator is not responsive. So, fiscal expansion using government spending is not effective in Germany.

The impulse response functions to a shock in government spending in Ireland are represented in Figure (3.1f). It can be seen that output is not responding significantly with the government spending shock. The impact on private consumption is positive whereas the impact on private investment is negative due to a government spending shock. Besides this, the response of unemployment rate is positive. With an initial negative response. GDP deflator responded positively for all the response horizons.

Figure (3.1g) represents the impulse response functions of all the variables to a shock in government spending in Luxembourg. It can be seen that output is not responding significantly with the government spending shock. The impact on private consumption as well as private investment is positive which is supporting the "Keynesian" effect in the economy due to a government spending shock. There is no crowding-out effect in Luxembourg. Besides this, the response of GDP deflator is very small positive. Unemployment rate starts to decrease after second quarter with an initial increase, but the effect dies out after fifth quarter.

The impulse response functions to a shock in government spending in Netherlands are represented in Figure (3.1h). It provides the evidence of "Non-Keynesian" effects due to a fiscal expansion. Because, the impact on output is negative which is not supported by Keynesian theory. Besides this, the impact on private consumption and private investment is also negative. On the other hand, the response of unemployment rate is positive and GDP deflator is negative. So, Fiscal expansion using an increase in government spending is not effective in Netherlands.

The impulse response functions to a shock in government spending in Portugal are represented in Figure (3.1i). It can be seen that output is not responding significantly with the government spending shock. The impact on private consumption and private investment is also very negligible amount to a government spending shock. Besides this, the response of unemployment rate is positive against the Keynesian theory. With an initial positive response, GDP deflator become unresponsive after two quarters.

The impulse response functions to a shock in government spending in Spain are represented in Figure (3.1j). It can be seen that output is responding negatively with the government spending shock. The impact on private consumption and private investment is also negative due to a government spending shock. It provides the evidence of "Non-Keynesian" effects due to a fiscal expansion. Besides this, the response of unemployment rate is positive. On the other hand, GDP deflator responded negatively.

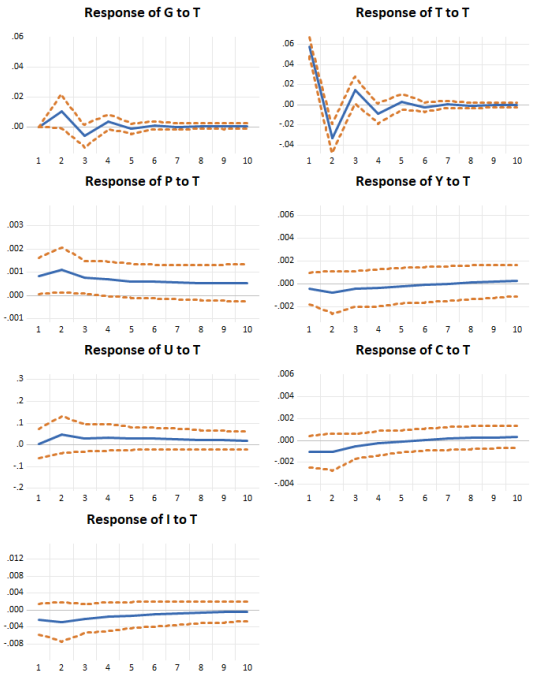
Tax Revenue Shock

Figure (3.2a) represents the impulse response functions of all the variables to a tax shock in Austria. Tax shock has temporary effect in Austria. The results show that tax shock has a gradual decreasing effect on output. In this case, tax shock has very small negative effect on the GDP's major components: private consumption, and the private investment. In addition, the unemployment rate increases with a positive tax shock. GDP deflator has a positive response immediately and remain positive for full response horizon.

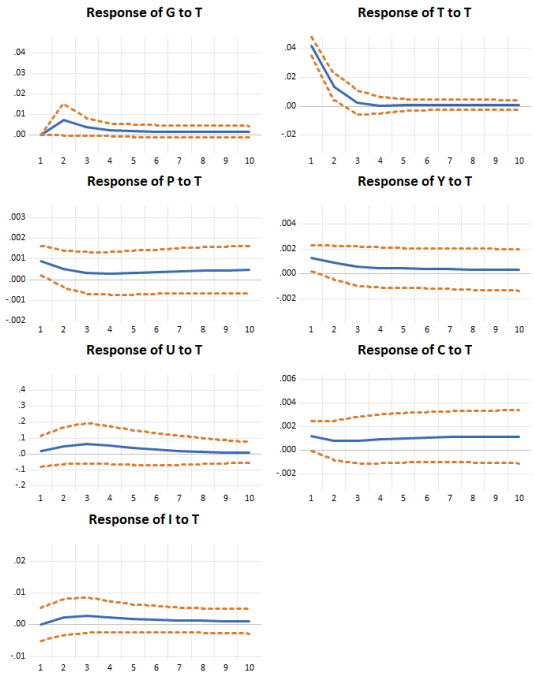
Figure (3.2b) represents the impulse response functions of all the variables to a tax shock in Belgium. The results show that tax shock has a positive effect on output. In this case, there is a difference in the GDP's major components: while tax shock has a positive but decreasing effect on private consumption and negative increasing effect on the private investment. In addition, the unemployment rate has positive effect for first two quarters and gradually decreases after that. GDP deflator is not that responsive in Belgium with a positive tax shock.

Figure (3.2c) represents the impulse response functions of all the variables to a tax shock in Finland. The results show that tax shock has a positive effects on output. In this case, tax shock has a positive effect on private consumption and on the private investment

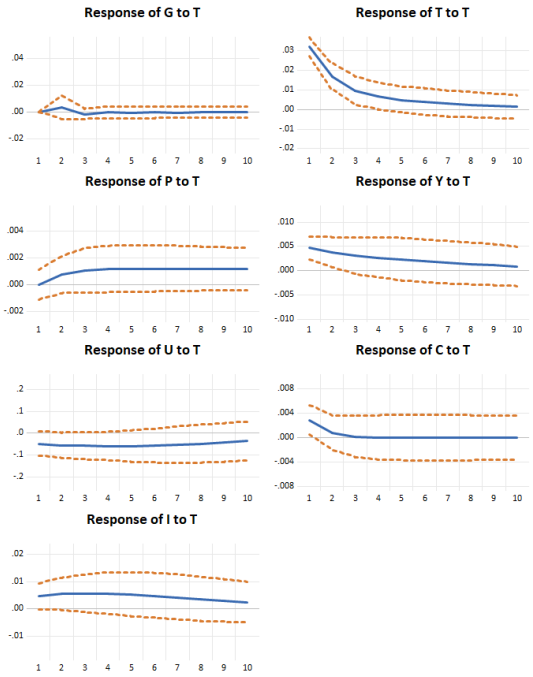
(A) Austria



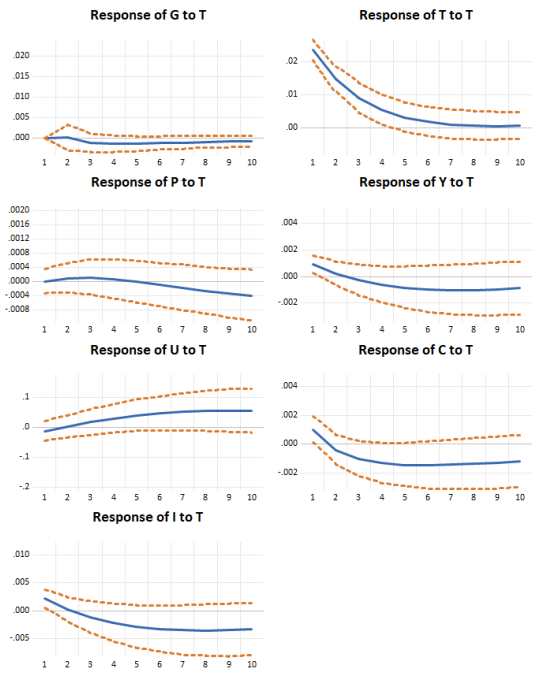
(B) Belgium



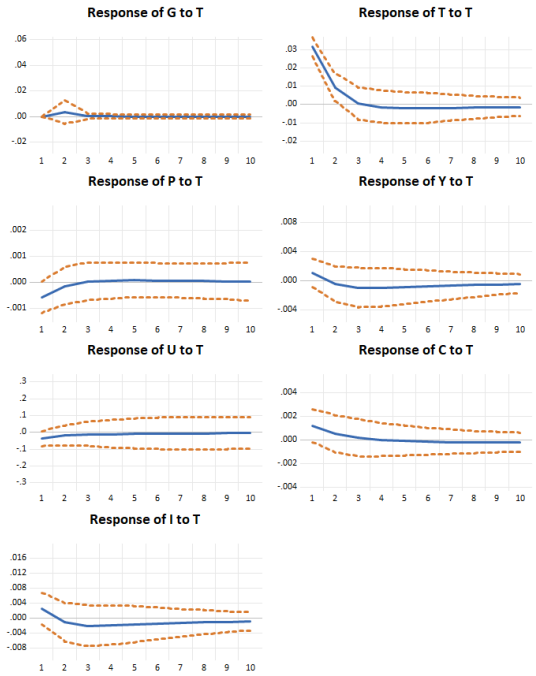
(C) Finland



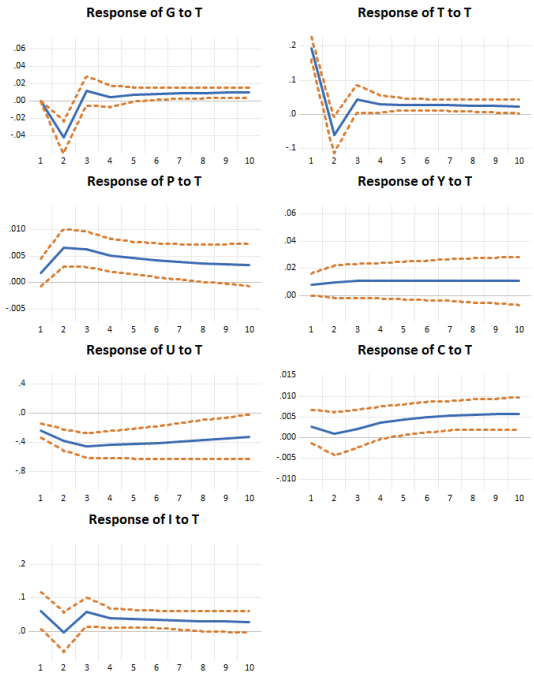
(D) France



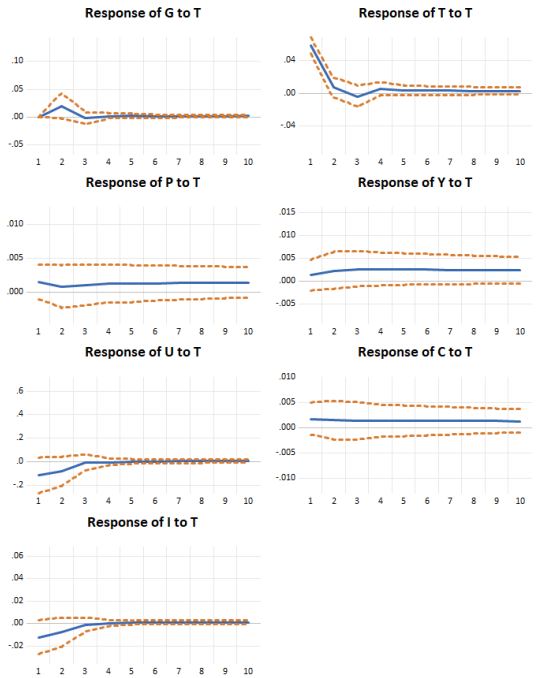
(E) Germany



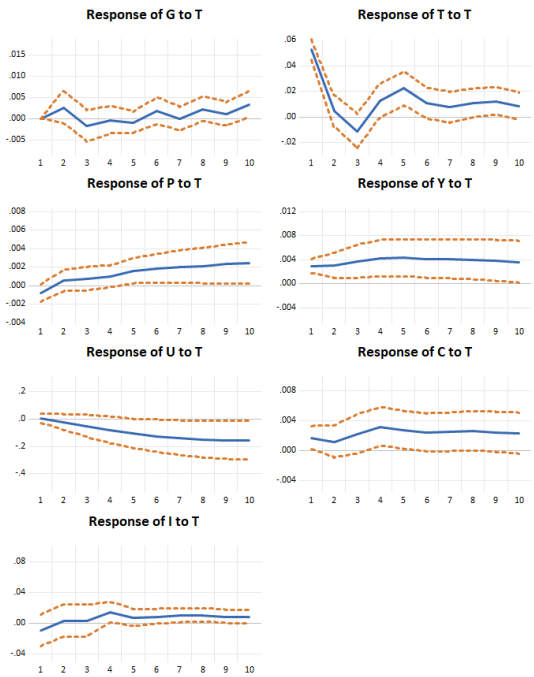
(F) Ireland



(G) Luxembourg



(H) Netherlands



(I) Portugal (J) Spain

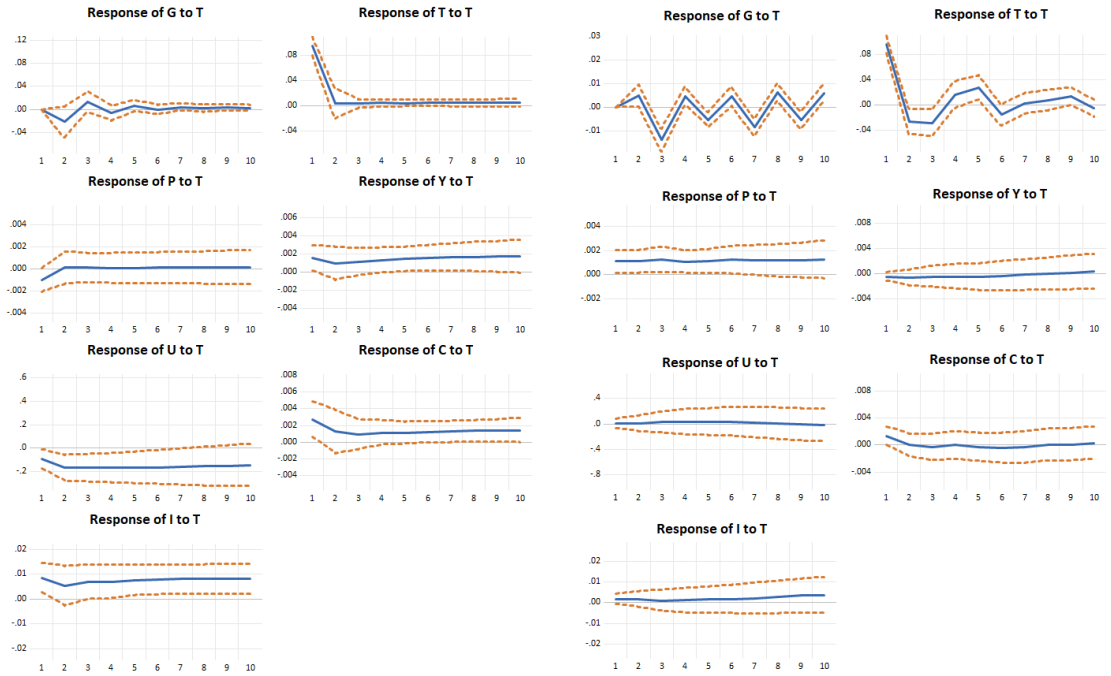


FIGURE 3.2: Impulse-response functions of tax revenue shock

too. In addition, the unemployment rate decreases with a fiscal contraction whereas GDP deflator increases over time.

Figure (3.2d) represents the impulse response functions of all the variables to a tax shock in France. The results show that tax shock has a decreasing effect on output. In line with this, GDP's major components, private consumption and private investment have also decrease over time. So, there is no crowding-out effect for the tax shock. In addition, the unemployment rate increases with a positive tax shock and GDP deflator has a positive response immediately and become negative for rest of the response horizon.

Figure (3.2e) represents the impulse response functions of all the variables to a tax shock in Germany. The results show that tax shock has a negative effect on output. In this case, there is a difference in the GDP's major components: while private consumption is almost unresponsive with a tax shock but private investment has a negative response. In addition, the unemployment rate has very small positive effect for first two quarters and the effect dies out after that. GDP deflator has an increasing effect with a positive tax

shock, but the effect dies out within six months.

Figure (3.2f) represents the impulse response functions of all the variables to a tax shock in Ireland. The results show that tax shock has a positive effects on output. In this case, tax shock has also a positive effect on private consumption and on the private investment. In addition, the unemployment rate decreases with a fiscal contraction whereas GDP deflator increases initially and decreases after that.

Figure (3.2g) represents the impulse response functions of all the variables to a tax shock in Luxembourg. The results show that tax shock has a very small increasing effect on output. GDP's major components, private consumption and private investment has opposing effects whereas private consumption affected positively and private investment affected negatively by the shock. In addition, the unemployment rate decreases and GDP deflator increases with a positive tax shock.

Figure (3.2h) represents the impulse response functions of all the variables to a tax shock in Netherlands. The results show that tax shock has a positive effect on output. In this case, both private consumption and private investment has a positive response. In addition, the unemployment rate has a sharp negative effect for all the response horizons. However, GDP deflator has an increasing effect with a positive tax shock. So, Fiscal contraction using a decrease in tax revenue is also not effective in Netherlands.

Figure (3.2i) represents the impulse response functions of all the variables to a tax shock in Portugal. The results show that tax shock has a positive effects on output. In this case, tax shock has a positive effect on private consumption and on the private investment. In addition, the unemployment rate decreases with a fiscal contraction whereas GDP deflator increases till second quarter and the effect dies out after that.

Figure (3.2j) represents the impulse response functions of all the variables to a tax shock in Spain. The results show that tax shock has a very small negative effects on output. On the other hand, tax shock has a very small positive effect on private consumption and private investment. In addition, the unemployment rate decreases with a fiscal contraction whereas GDP deflator increases consistently. But the magnitude of the response for all the variables are very small. This suggests, fiscal contraction using tax revenue in Spain is almost unresponsive.

3.4.2 Heterogeneous Impact of Fiscal Policy Shocks Across Euro-area Countries

Fiscal policy shocks have mixed results in different countries. Over the same sample period, under the same monetary regime with a multinational central bank conducting the monetary policy, the two groups exhibit relatively diverse macroeconomic consequences accompanying with expansionary fiscal policies: a Keynesian, expansionary macroeconomic outcome in some countries and as an alternative, a more silent response of macro variables in the remaining countries. A positive government spending shock causes an increase of output in Finland and France; i.e. there are expansionary macroeconomic effects associated with the increase in government spending. This results support the finding of Blanchard and Perotti (2002), Mountford and Uhlig (2009) and Galí, López-Salido, and Vallés (2007). On the other hand, in Austria, Belgium, Germany, Netherlands, Portugal and Spain, the increase in government spending causes a decrease in output. In addition, the increase in government spending does not produce significant effects on aggregate output in Ireland and Luxembourg. Ilzetzki, Mendoza, and Végh (2013) find non-keynesian effect of fiscal shocks for high debt European countries. Hence, the impact of output is supported by the two most important components of aggregate demand, private consumption and private investment. The share of consumption and investment for the selected countries ranges from an average of 33 percent to 65 percent and 19 percent to 25 percent respectively over the sample period. The responses of these two variables are important to understand the overall effects of output due to fiscal shocks.

The results also differ for the response of unemployment rates across countries. The main reasons behind these differences is mainly due to country-specific elasticities of unemployment rate to fiscal shocks featured by structural factors of the Euro-area economies. Besides this, differences in labor force participation rate across the countries is also crucial in this context. In France, Netherlands, Ireland and Luxembourg unemployment rate exhibits an expected decline for a positive government spending shock. This results validate somewhat, the findings of Dallari and Ribba (2015), who conduct

an empirical analysis to illustrate the effect of fiscal shocks in unemployment in the peripheral European countries under the EMU and find the Keynesian effects. However, the government spending shock has an opposing positive effect for rest of the countries. Brückner and Pappa (2012) also find an increase in unemployment rate due to fiscal expansion, for the US economy and other OECD countries.

An increase in government tax revenues has a permanent recessionary effects for Belgium, Finland, France and Germany as output decreases due to a fiscal shock. This results confirm the main finding of Blanchard and Perotti (2002), Fatás and Mihov (2001) and Afonso and Sousa (2012). In addition, government tax revenue shock has a non-Keynesian effect on Luxembourg, Ireland, Netherlands and Portugal. Fiscal policy shock using tax revenue remain almost unresponsive in Spain and Austria. The impact of output due to tax revenue shock is also supported by the two most important component of aggregate demand, private consumption and private investment. By observing the responses of them due to tax shock, this paper can finds that they also have differing impact across countries. Besides this, prices decrease for Austria, France, Germany, Ireland and Luxembourg in response to tax shock, whereas increase for Belgium, Finland, Netherlands and Spain. Unemployment rate also exhibits a mixed impact due to fiscal shock. The macroeconomic outcomes of their fiscal policies in Euro area countries are affected by high public debt-to-GDP ratio, ranging from an average value over the sample period of 120 percent in Portugal to almost 100 percent in Belgium, France and Spain, therefore, well above the traditional threshold of 60 percent established in the Euro Area. As all these countries implement a combined monetary policy and a common currency, a justification for the relatively diverse responses to fiscal shocks depends on the reaction of financial markets and private sector to changes in domestic fiscal policy.

Forecast error variance decomposition gives an idea of national business cycle fluctuations. Specifically, it can be seen that the relative importance of government spending and tax shocks in the variation of output and unemployment in different time horizon. Table 3.4, represents the variation in output for all the countries in different time horizon. In all the seven countries except Austria, Germany and Portugal government spending shock describes highest amount of the variation in output in shorter time horizon. In

TABLE 3.4: Forecast error variance decomposition of Output attributable to fiscal shocks

Horizon-1	Govt. Spending	Tax Revenues	GDP Deflator
Austria	4.75	26.28	32.84
Belgium	32.86	15.58	1.99
Finland	42.17	38.72	3.42
France	24.71	0.00	23.31
Germany	32.17	6.49	47.48
Ireland	96.72	0.88	1.56
Luxembourg	49.22	25.37	2.80
Netherlands	58.23	0.09	28.92
Portugal	0.67	1.89	0.09
Spain	39.73	9.19	7.57
Horizon-4	Govt. Spending	Tax Revenues	GDP Deflator
Austria	1.99	31.72	37.75
Belgium	50.26	18.80	4.06
Finland	41.52	45.91	3.02
France	33.18	1.42	21.96
Germany	43.64	7.10	39.85
Ireland	97.02	0.46	1.13
Luxembourg	66.20	20.65	1.45
Netherlands	73.36	0.91	15.66
Portugal	8.34	4.14	3.14
Spain	59.66	7.23	13.00
Horizon-10	Govt. Spending	Tax Revenues	GDP Deflator
Austria	9.84	30.12	39.40
Belgium	68.24	12.40	3.99
Finland	45.88	45.06	1.58
France	46.00	1.21	13.45
Germany	51.67	6.26	32.65
Ireland	98.07	0.17	0.60
Luxembourg	75.71	15.43	1.47
Netherlands	82.82	0.47	11.53
Portugal	47.81	4.38	2.25
Spain	78.81	4.32	10.86

Austria and Germany the variation in output is mostly determined by the domestic price shock. Interestingly, in Portugal only 2 percent of output fluctuations are happening due to fiscal shocks. That means, fiscal policy is ineffective in Portugal in the short term. The pattern of the output fluctuations remain unchanged in medium time horizon. The only change in longer time horizon is that now government spending shock describes highest amount of the variation in output in both Germany and Portugal also. However, Finland

is the only country where relative importance of government spending and tax shocks in the variation of output is almost same.

Forecast error variance decomposition of unemployment is reported in Table B3. Unlike the output fluctuations, unemployment is fluctuated by different shocks in different countries for shorter time horizon. Government spending shock plays a dominant role in Austria, Belgium, Portugal and Spain whereas tax shock plays a dominant role in Finland, France and Netherlands and output gap plays a dominant role in Germany, Ireland and Luxembourg. But, in longer time horizon, government spending shock plays a dominant role for unemployment fluctuations in all the countries except Finland, France and Luxembourg.

3.4.3 Output Fiscal Multipliers

Fiscal multiplier is defined as the ratio of a change in output to an exogenous change in fiscal instruments with respect to their corresponding baseline (Spilimbergo, Schindler, and Symansky (2009)). Currently, fiscal multipliers are categorized in different way, for example- according to the time extent measured (impact, peak or cumulative multipliers) and to the fiscal shock considered (government spending or tax revenue multipliers). The magnitude of fiscal multipliers depends on the method used to measure it. There are many controversy regarding the size of fiscal multipliers. Review of the literatures by Ramey (2011) advice that fiscal spending multipliers should be ranges between 0.5 to 2. Ramey (2019) improves this estimate and suggests a lower range of 0.6 to 1. In this section, the paper discusses the estimated domestic fiscal multipliers and compares them across the ten countries considered in this study, at different time horizons. The paper calculates the fiscal multipliers on impact as well as cumulative multipliers at different time horizons.

The impact multiplier is calculated as:

$$\text{Impact Fiscal Multiplier} = \frac{\Delta Y_t}{\Delta F_t}, \tag{3.4.1}$$

where Y_t represents the aggregate output and F_t represents the fiscal variables, in this case government spending and tax revenues. However, the cumulative multiplier is calculated in terms of ratio of cumulative changes in Y and F (Spilimbergo, Schindler, and Symansky (2009)):

$$\text{Cumulative Fiscal Multiplier} = \frac{\sum_{j=0}^{k} \Delta Y_{t+j}}{\sum_{j=0}^{k} \Delta F_{t+j}} \tag{3.4.2}$$

TABLE 3.5: Government expenditures multipliers in Euro-area countries

	Impact	1 year	2 years
Austria	-0.5	-1.8	-2.9
Belgium	-0.5	-2.2	-2.5
Finland	0.3	0.8	2.8
France	0.5	3.5	5.6
Germany	0.2	-0.9	-2.1
Ireland	-0.4	-2.7	-5.4
Luxembourg	-0.1	-0.2	-0.2
Netherlands	-0.8	-2.2	-5.5
Portugal	-0.1	-0.2	-0.9
Spain	0.2	-0.2	-2.1

Tables 3.5 and 3.6, represent the government spending multipliers and tax multipliers respectively for all the countries considered in the study which are derived from the model. The highest government spending multiplier on impact is in Netherlands, followed by Austria, Belgium and France. But among them only France has a positive fiscal multiplier, representing an expansionary effect on output due to a positive government spending shock. Besides this, Finland, Germany and Spain also have positive but small multipliers on impact. The positive multipliers indicate that an increase in government spending has expansionary effect for all horizons. On the other hand, the small multipliers confirm that the expansionary fiscal effect is weak in Finland, Germany and Spain. The sign and the size of the estimated multipliers are similar to that obtained by Romer and Bernstein (2009), Burriel et al. (2010) and Canzoneri et al. (2016) for US. The multipliers are small on impacts, but grow over quarters. However, after two years France, Ireland and Netherlands have the biggest multipliers. The results find the negative sign

of the fiscal multiplier for high public debt countries which confirms the finding obtained by Ilzetzki, Mendoza, and Végh (2013).

TABLE 3.6: Tax multipliers in Euro-area countries

	Impact	1 year	2 years
Austria	-0.2	-1.3	-1.4
Belgium	0.6	0.8	0.9
Finland	2.9	5.8	8.7
France	0.8	0.2	-0.02
Germany	0.5	-0.6	-2.1
Ireland	0.6	3.1	4.5
Luxembourg	0.6	2.8	4.3
Netherlands	0.9	3.8	5.7
Portugal	0.4	0.9	1.7
Spain	-0.2	-0.9	-0.7

From Table 3.6, it can be seen that the tax multiplier is exceptionally highest in Finland with an unexpected positive sign in all time horizon. Only Austria and Spain have expected negative tax multipliers representing a contraction in output with a positive tax shock. But, after two years Austria, France, Germany and Spain have expected negative tax multipliers. So, fiscal policy has a lag effect in those countries. Besides this, tax multiplier is positive in rest of the countries. Therefore, the estimated government spending multipliers and the tax multipliers mainly confirms the separation between countries demonstrating Keynesian effects of fiscal policy and countries reflecting non-Keynesian effects.

3.5 Conclusion

This paper examines the macroeconomic impacts of fiscal policies in Euro-area countries. Using quarterly time series data, along with the SVAR approach embedded in Johansen cointeegration analysis context, we find that fiscal policy shocks have mixed results in different countries. Over the almost same sample period, under the same monetary regime with a multinational central bank conducting the monetary policy, two groups has emerged exhibiting relatively diverse macroeconomic impacts under expansionary fiscal

policies. Specifically, a positive government spending shock has expansionary macroeconomic effects in Finland and France but contractionary effects in Austria, Belgium, Germany, Netherlands, Portugal and Spain. Meanwhile, the increase in government spending does not produce significant effects on aggregate output in Ireland and Luxembourg. Besides, an increase in government tax revenues has a permanent recessionary effects for Belgium, Finland, France and Germany as output decreases due to a fiscal shock. Meanwhile, government tax revenue shock has a non-Keynesian effect on Luxembourg, Ireland, Netherlands and Portugal. Fiscal policy shock using tax revenue remain almost unresponsive in Spain and Austria. Moreover, the estimated fiscal multipliers range between 0 to 1 on impact and negative for high debt countries. The differing results between countries are mainly due to the debt dynamics among countries. In general, these results advise that in the case of the small, and highly indebted, Euro-area countries, fiscal policies will not be able to stabilize the economic system. It will be highly ambitious to rely on expansionary fiscal policies to stimulate a complete recovery of the economies. However, the main policy recommendation from this paper is that a Euro-area common framework for national fiscal policies and national fiscal deficit and public debts should be established.

Appendix B

TABLE B1: Unit Root Test Results of the Variables

	G	T	P	Y	U	C	I
Austria	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$
Belgium	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$
Finland	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$
France	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$
Germany	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$
Ireland	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(2)$	$I(1)$	$I(1)$
Luxembourg	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$
Netherlands	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$	$I(1)$
Portugal	$I(1)$	$I(1)$	$I(2)$	$I(1)$	$I(2)$	$I(1)$	$I(1)$
Spain	$I(1)$	$I(1)$	$I(2)$	$I(1)$	$I(1)$	$I(1)$	$I(2)$

TABLE B2: Number of cointegration

	Cointegration Rank Test (Trace)	Cointegration Rank Test (Max Eigenvalue)
Austria	2	2
Belgium	2	1
Finland	1	1
France	5	1
Germany	3	3
Ireland	3	3
Luxembourg	2	2
Netherlands	4	1
Portugal	4	3
Spain	5	5

(A) Austria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	762.0663	NA	5.34e-19	-22.20783	-21.97935	-22.11730
1	1234.012	832.8451	2.13e-24	-34.64741	-32.81958*	-33.92317
2	1273.268	61.19304	2.97e-24	-34.36082	-30.93364	-33.00286
3	1329.897	76.61591	2.67e-24	-34.58520	-29.55867	-32.59354
4	1441.077	127.5295*	5.44e-25	-36.41402	-29.78813	-33.78864
5	1510.491	65.33102	4.59e-25	-37.01443	-28.78920	-33.75534
6	1596.807	63.46790	3.22e-25	-38.11197	-28.28739	-34.21917
7	1721.583	66.05783	1.25e-25	-40.34068	-28.91674	-35.81416
8	1877.807	50.54321	5.96e-26*	-43.49434*	-30.47105	-38.33411*

(B) Belgium

Lag	LogL	LR	FPE	AIC	SC	HQ
0	889.3408	NA	1.94e-19	-23.21950	-23.00482	-23.13370
1	1402.438	918.1746	9.70e-25	-35.43259	-33.71521*	-34.74624
2	1469.714	107.9952	6.19e-25	-35.91353	-32.69344	-34.62662
3	1527.400	81.97424	5.35e-25	-36.14210	-31.41929	-34.25464
4	1622.127	117.1630	1.89e-25	-37.34545	-31.11994	-34.85744
5	1683.815	64.93485	1.81e-25	-37.67935	-29.95113	-34.59078
6	1750.026	57.49897	1.87e-25	-38.13227	-28.90134	-34.44314
7	1840.170	61.67710	1.38e-25	-39.21499	-28.48135	-34.92531
8	1981.699	70.76478*	4.36e-26*	-41.64998*	-29.41363	-36.75974*

(C) Finland

Lag	LogL	LR	FPE	AIC	SC	HQ
0	775.2019	NA	3.92e-18	-20.21584	-20.00117	-20.13004
1	1307.910	953.2666	1.17e-23	-32.94499	-31.22761*	-32.25864
2	1354.774	75.22914	1.27e-23	-32.88878	-29.66869	-31.60188
3	1409.558	77.85184	1.19e-23	-33.04101	-28.31821	-31.15355
4	1487.780	96.74774	6.50e-24	-33.81000	-27.58449	-31.32198
5	1537.322	52.14934	8.57e-24	-33.82426	-26.09604	-30.73569
6	1587.110	43.23690	1.36e-23	-33.84499	-24.61406	-30.15587
7	1695.796	74.36440*	6.16e-24	-35.41569	-24.68205	-31.12601
8	1826.744	65.47379	2.58e-24*	-37.57220*	-25.33585	-32.68197*

(D) France

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1303.764	NA	3.49e-20	-24.93777	-24.75978	-24.86566
1	2341.181	1915.231	1.94e-28	-43.94579	-42.52188*	-43.36892*
2	2401.462	103.1729	1.58e-28	-44.16273	-41.49291	-43.08110
3	2433.813	51.01531	2.25e-28	-43.84256	-39.92682	-42.25618
4	2546.012	161.8261	7.09e-29	-45.05793	-39.89628	-42.96679
5	2609.771	83.37679	5.91e-29	-45.34175	-38.93419	-42.74586
6	2671.195	72.05504*	5.46e-29*	-45.58067	-37.92720	-42.48002
7	2728.008	58.99773	5.95e-29	-45.73092	-36.83152	-42.12551
8	2781.935	48.74169	7.61e-29	-45.82567*	-35.68036	-41.71550

(E) Germany

Lag	LogL	LR	FPE	AIC	SC	HQ
0	795.7290	NA	6.81e-20	-24.26858	-24.03442	-24.17619
1	1279.186	847.9084	1.07e-25	-37.63648	-35.76316*	-36.89733
2	1330.088	78.31218	1.07e-25	-37.69503	-34.18256	-36.30913
3	1405.465	99.72918	5.42e-26	-38.50662	-33.35500	-36.47397
4	1538.477	147.3358	5.39e-27	-41.09159	-34.30081	-38.41219
5	1626.789	78.80159*	2.68e-27*	-42.30119	-33.87126	-38.97504
6	1700.065	49.60214	3.10e-27	-43.04814	-32.97906	-39.07524
7	1804.088	48.01102	2.86e-27	-44.74118*	-33.03295	-40.12153*

(F) Ireland

Lag	LogL	LR	FPE	AIC	SC	HQ
0	199.5055	NA	6.31e-12	-5.923245	-5.689081	-5.830852
1	624.7249	745.7695	5.98e-17	-17.49923	-15.62591*	-16.76008
2	681.5701	87.45406	4.94e-17	-17.74062	-14.22815	-16.35472
3	754.6547	96.69653	2.70e-17	-18.48168	-13.33006	-16.44904
4	829.5634	82.97588*	1.60e-17	-19.27888	-12.48810	-16.59948
5	881.8476	46.65355	2.41e-17	-19.37993	-10.94999	-16.05378
6	951.0777	46.86344	3.17e-17	-20.00239	-9.933304	-16.02949
7	1077.349	58.27916	1.47e-17*	-22.37997*	-10.67174	-17.76032*

(G) Luxembourg

Lag	LogL	LR	FPE	AIC	SC	HQ
0	455.8301	NA	2.37e-15	-13.81016	-13.57599	-13.71776
1	808.3644	618.2909	2.10e-19	-23.14967	-21.27635*	-22.41053
2	847.6204	60.39394	2.98e-19	-22.84986	-19.33739	-21.46396
3	912.5329	85.88425	2.09e-19	-23.33947	-18.18785	-21.30683
4	997.3907	93.99629	9.17e-20	-24.44279	-17.65201	-21.76339
5	1076.918	70.96286*	5.96e-20	-25.38209	-16.95216	-22.05594
6	1154.501	52.51769	6.06e-20	-26.26157	-16.19248	-22.28867
7	1296.215	65.40626	1.75e-20*	-29.11429*	-17.40605	-24.49464*

(H) Netherlands

Lag	LogL	LR	FPE	AIC	SC	HQ
0	729.8023	NA	1.66e-17	-18.77409	-18.56101	-18.68886
1	1290.863	1005.538	2.79e-23	-32.07437	-30.36979	-31.39255
2	1419.665	207.4207	3.61e-24	-34.14714	-30.95104*	-32.86873*
3	1464.041	63.39462	4.41e-24	-34.02704	-29.33943	-32.15204
4	1521.634	71.80355	4.14e-24	-34.25022	-28.07110	-31.77863
5	1581.629	63.89113	4.11e-24	-34.53581	-26.86518	-31.46763
6	1665.064	73.68273*	2.65e-24	-35.43023	-26.26808	-31.76545
7	1758.967	65.85418	1.73e-24*	-36.59654*	-25.94288	-32.33517

(I) Portugal

Lag	LogL	LR	FPE	AIC	SC	HQ
0	608.3164	NA	3.16e-16	-15.82412	-15.60944	-15.73832
1	1208.144	1073.376	1.61e-22	-30.31959	-28.60221*	-29.63324
2	1273.559	105.0085	1.08e-22	-30.75157	-27.53147	-29.46466
3	1334.174	86.13591	8.64e-23	-31.05720	-26.33440	-29.16974
4	1424.588	111.8278*	3.43e-23*	-32.14704	-25.92153	-29.65903*
5	1481.430	59.83429	3.73e-23	-32.35342	-24.62520	-29.26485
6	1528.736	41.08138	6.31e-23	-32.30884	-23.07791	-28.61971
7	1588.053	40.58515	1.05e-22	-32.58033	-21.84669	-28.29065
8	1695.377	53.66235	8.17e-23	-34.11520*	-21.87885	-29.22496

(J) Spain

Lag	LogL	LR	FPE	AIC	SC	HQ
0	658.7291	NA	1.66e-15	-14.16802	-13.97615	-14.09058
1	1518.394	1569.823	3.69e-23	-31.79118	-30.25618	-31.17164
2	1716.019	330.8070	1.48e-24	-35.02215	-32.14403*	-33.86052
3	1800.131	127.9960	7.24e-25	-35.78545	-31.56420	-34.08172
4	1885.174	116.4729	3.62e-25	-36.56901	-31.00463	-34.32318*
5	1949.777	78.64647*	3.00e-25*	-36.90819	-30.00069	-34.12027
6	1994.520	47.66139	4.20e-25	-36.81566	-28.56502	-33.48563
7	2038.411	40.07421	6.78e-25	-36.70459	-27.11083	-32.83247
8	2105.386	50.95922	7.93e-25	-37.09535*	-26.15846	-32.68113

FIGURE B1: Lag selection criterion

TABLE B3: Forecast error variance of Unemployment attributable to fiscal shocks

Horizon-1	Govt. Spending	Tax Revenues	Output
Austria	33.00	10.31	11.78
Belgium	19.11	4.03	9.09
Finland	0.20	8.37	5.96
France	0.76	22.03	0.02
Germany	3.76	9.75	19.03
Ireland	0.58	0.01	29.36
Luxembourg	2.70	3.94	7.15
Netherlands	1.25	11.95	0.91
Portugal	47.21	7.95	5.00
Spain	46.77	0.24	0.60
Horizon-4	Govt. Spending	Tax Revenues	Output
Austria	44.07	4.69	5.95
Belgium	21.28	7.08	13.93
Finland	5.70	15.25	3.21
France	3.40	30.42	2.54
Germany	16.63	3.92	18.85
Ireland	17.14	4.03	39.56
Luxembourg	2.57	6.23	8.21
Netherlands	22.72	3.80	0.38
Portugal	65.04	2.41	1.09
Spain	63.04	0.56	0.10
Horizon-10	Govt. Spending	Tax Revenues	Output
Austria	44.39	6.66	4.12
Belgium	20.33	7.69	14.67
Finland	16.35	44.15	5.41
France	14.11	21.91	8.01
Germany	24.76	1.27	22.76
Ireland	55.74	10.14	19.27
Luxembourg	2.62	7.51	8.13
Netherlands	48.62	1.11	0.62
Portugal	69.93	14.09	0.69
Spain	73.60	0.49	0.03

Chapter 4

Financial Development and Economic Growth Nexus across Countries: Empirical Evidence

Abstract

This paper examines the nexus between financial development and economic growth in five countries: Australia, China, South Africa, the UK and the US. We find that in Australia and the US, only market-based financial intermediaries have significant long-run impacts on economic growth, while in China, South Africa and the UK both bank-based and market-based financial indicators have long-run impacts on economic growth. Moreover, in Australia and the USA, the financial shock impact the economic growth through stock market only, whereas in South Africa its impact is through banks. However, in China and the UK both the banks and stock market play an active role to transmit the shock of financial sector to real economy. Furthermore, we find that economic growth leads to both bank based and market based financial development in Australia, China and South Africa whereas it only leads to market based financial development in the UK and the USA.

Key Words: Financial development, Economic Growth, ARDL, Short-run, Long-run

Statement of Authorship

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Name of Principal Author (Candidate)	Ayasha Akter		
Contribution to the Paper	Contributed to initiating the research idea, planning the article and the methodology, conducted the literature review, collected the data, analyzed and interpreted the results, wrote parts of the manuscript.		
Overall percentage (%)	70%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	08/09/2021

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);
ii. permission is granted for the candidate in include the publication in the thesis; and
iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Firmin Doko Tchatoka		
Contribution to the Paper	Contributed to the planning of the article and the methodology, supervised the development of work, helped to interpret the results and wrote parts of the manuscript.		
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4.1 Introduction

The nexus between financial development and economic growth has turned out to be an important focus for the policy makers. The recent economic recession which began in late 2007 has shown how important the financial system is to the real economy. It is important for the policy makers to know the numerous channels through which financial development transmitted to real economy and vice versa. There is always a controversy regarding the issue whether the development of financial sector actually leads the real sector development or the opposite. So far, there has been no general consensus on the causal relationship between financial development and economic growth in both the developed and developing economies. According to the first version of endogenous growth theory (AK) by Frankel (1962), financial development can impact the production and economic growth in three different ways. Firstly, it rises the efficiency of investments; secondly, reduces operational costs and extends the amount of savings that transmitted to productive investments and finally, changes savings rate.

Following the pioneering work of Schumpeter (1934), numerous theoretical and empirical literature has argued the significance of finance on economic growth. The studies find that the financial sector promotes economic well-being by investing more funds in resourceful projects. Besides this, in the process of economic development, financial markets also play a transitional role among savers and investors. Precisely, the financial system is a set of institutions such as banks, non-bank financial institutions, insurance companies, stock exchange etc. Using this institutional framework, financial system facilitates funds, smooth transactions, pool the risk, allocate resources, monitor financial transactions and apply corporate control to organize savings and investments (Levine (1997)). Therefore, it is recognized that efficient financial markets can impact economic growth positively.

According to theoretical literature, the nexus between financial development and economic growth can be described by three different hypothesis. The first hypothesis is known as "supply leading" hypothesis. According to this hypothesis, financial development is essential for economic growth and the causality link runs from financial development to economic growth which is supported by Schumpeter (1934), Goldsmith

(1959), McKinnon (2010), and Shaw (1973). Goldsmith (1959) uses the ratio of bank assets to GDP as a proxy for financial development to examine the relationship between financial development and economic growth. The result shows a strong evidence of supply leading hypothesis. Likewise, King and Levine (1993) also try to find the relationship between them and the result confirms the finding of Goldsmith (1959). Rousseau and Wachtel (1998) examines the nature of links between the intensity of financial intermediation and economic growth in the USA, UK, Canada, Norway and Sweden and find a significant impact of financial intermediation on real economic activity via rapid industrial transformations of all five countries. Beck, Levine, and Loayza (2000) and Beck and Levine (2004) found that financial development has a positive effect on long-run growth. Bell and Rousseau (2001) and Banerjee and Ghosh (1998) finds the existence of a strong supply leading hypothesis for Indian economy.

Liu and Hsu (2006) investigated the dynamics between financial development and the source of growth for Taiwan, Korea and Japan. They found that financial development has a positive impact on growth for Taiwan's economy, but has negative effect on other countries. Ahmed (2010) find significant impact of financial development on economic growth for 15 Sub-Saharan African countries. Halkos and Trigoni (2010) find no relationship between financial development and economic growth in short run. But using vector error correction estimates, they find long run significant relationship between financial development and economic growth. Vazakidis and Adamopoulos (2011) find that financial development increases economic growth for UK, using general stock market index, the domestic bank credits to private sector and the industrial production index as the indicator of financial development. The findings of Bittencourt (2012) support Schumpeter's prediction which proposes that financial development promotes economic growth via high productive investment by entrepreneurs. Hsueh, Hu, and Tu (2013) using bootstrap panel Granger causality technique suggest that the direction of causality between financial development and economic growth depends on the variables used as a proxy of financial development. Uddin, Sjö, and Shahbaz (2013) find long run positive impact of financial development on economic growth in Kenya.

The second hypothesis is known as "demand-following" hypothesis supported by

Robinson (1952), Gurley and Shaw (1967) and Jung (1986). This hypothesis assumes that real economic growth leads financial development. According to this hypothesis, as the real sector of an economy develops, its demand for different financial services arises and the financial sector become gradually rich in financial assets, financial institutions and financial markets. Earlier literatures including Gurley and Shaw (1967), Jung (1986), McKinnon (2010) and Shaw (1973) suggested that economic growth leads financial development in developing countries, because of the increasing demand for financial services. Arestis and Demetriades (1997) investigate how and to what extent the financial system can contribute to the process of economic growth. They use banking system and stock market as a proxy of financial development and reveals demand following hypothesis. Ang and McKibbin (2007) observe the causality link between financial development and economic growth in the small open economy of Malaysia and recommended that economic growth causes financial development. Blanco (2009) using bank credits and bank deposits to GDP and finds causality from economic growth to financial development in Latin America.

The third hypothesis is known as "feedback" hypothesis which argues that there exists bidirectional causality between financial development and economic growth (Patrick (1966), Demetriades and Hussein (1996) and Greenwood and Smith (1997)). According to this hypothesis, economic growth fluctuates over the path of a country's development level. In his view, for the period of the initial stages of development financial development induces economic growth whereas in the later stages of economic development economic growth induces financial development. Demetriades and Hussein (1996) find significant evidence of bi-directionality and some evidence of reverse causation between growth and financial development in 16 countries. Blackburn and Hung (1998) recognized a positive mutual causal relationship between growth and financial development. Using both time-series and panel data for 30 developing countries Al-Yousif (2002) has found the existence of bidirectional causality.

Calderón and Liu (2003) has examined the nexus between financial development and economic growth in context of both developing and industrial countries and find the existence of two-way causality. The developing countries have stronger causal relationship

than in the industrial countries, as financial intermediaries have comparatively greater impact in developing countries. Gurgul and Łukasz (2011) investigated the matter and revealed that a bidirectional causality exists between financial development and economic growth whereas the causality running from the development of the stock market to economic growth and from economic growth to the development of the banking sector. Masoud and Hardaker (2012) found that bidirectional relation between stock market development and economic growth in 42 emerging economies.

Despite having a growing number of research in the last decade, there is still disagreement in findings regarding the dynamic relationship between financial development and economic growth. Each paper tended to use different time period, statistical methods and proxies for financial development. Most of the literatures conducted cross-sectional analysis. But the findings of cross-sectional analysis are not always supported by the time series analysis. De Gregorio and Guidotti (1995) recommend that financial development improves the growth performance but this positive impact, diverges from country to country and also over time. Arestis and Demetriades (1997) also argue that time-series approach is superior than cross-sectional analysis which indirectly assumes that economic structures, populations, and technologies are same across countries. For this reason, cross sectional analysis fails to capture the dynamic relationship between financial development and economic growth properly.

Bank-based and market-based financial system have differing impact on the domestic economic growth. Financial market plays a direct financing role whereas the bank-based financial system plays an indirect financing role. So the impact of financial development on economic growth varies across countries depending on the comparative role of bank-based and financial system. Against this backdrop, this study fills the knowledge gap by empirically investigating the dynamic relationship between financial development and economic growth in terms of bank-based and market-based system using a time-series framework for Australia, China, South Africa, UK and USA. The selection of countries represents a good cross-section of three developed economies versus two emerging economies. Among them, four have strong and open financial sectors, with the exception of China with comparatively compressed financial sectors.

In this paper, we will mainly refer to study the short-run and long-run relationship between financial development and economic growth across 5 countries based on multivariate time series techniques and, in particular, on the ARDL Bound testing approach employing quarterly time series data for Australia, China, South Africa, the UK and the USA. More specifically, this study addresses three research questions. Firstly, what is the nature of the long-run relationship between financial development (financial intermediaries and financial markets) and economic growth across countries? Secondly, what is the nature of the short-run relationship between financial development (financial intermediaries and financial markets) and economic growth across countries? Finally, are financial intermediaries (bank-based system) and financial markets (market-based system) playing different role in promoting growth in the economies?

This study contributes to the financial development literature on emerging and developed economies in general, by examining the nexus between financial development and economic growth for five different countries and in particular, it explores the short-run and long-run dynamics across countries. Besides this, the study uses ARDL model which is applicable regardless of whether the variables are stationary or non-stationary or mutually cointergrated.

The study therefore sheds new light on the nexus between financial development and economic growth. The main findings are that: firstly, market based financial intermediaries have significant long-run impact on economic growth in Australia and USA, while both bank based and market based financial indicators have long-run impact on economic growth in China, South Africa and the UK; secondly, the financial shock impact the economic growth of Australia and the USA through stock market only, whereas in South Africa the financial shock impact the economic growth through banks only. In addition, both the banks and stock market play active role to transmit the shock of financial sector to the economy of China and the UK; finally, the economic growth leads to both bank based and market based financial development in Australia, China and South Africa whereas only market based financial development in the UK and the USA.

The rest of the chapter is organized as follows. In Section 2, we report theoretical and empirical models. The data and estimation results are described in Section 3. Section 4,

presents the interpretation of the results. Section 5, contains some concluding remarks.

4.2 Model Specification

We consider the following generic p-order vector autoregressive process:

$$\Phi(L)(z_t - \mu - \gamma t) \quad = \quad \epsilon_t, \tag{4.2.1}$$

where z_t contains n variables, μ and γ are unknown vectors of intercept, the lag polynomial $\Phi(L)$=I_{n+1}-$\sum_{i=1}^{p} \Phi_i L^i$ and trend coefficients, ϵ_t is a vector of disturbances and L is the lag operator. We assume that $\epsilon_t \overset{i.i.d.}{\sim} N(0, \Sigma)$ with $\Sigma > 0$. The VAR(p) in (4.2.1) can be written in the following VECM form:

$$\Delta z_t \quad = \quad a_0 + a_1 t + \Pi z_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta z_{t-i} + \epsilon_t, \tag{4.2.2}$$

where $\Delta w_t = w_t - w_{t-1}$ for any variable w, $\Pi = \sum_{i=1}^{p} \Phi_i - I_n$ is the long-run impact matrix and $\Gamma_i = \sum_{j=i+1}^{p} \Phi_j$. Suppose that we interested in a scalar component y_t of z_t. Without any loss of generality, we can partition z_t as $z_t = (y_t, x_t')'$ where x_t is $(n-1) \times 1$. Let also consider the following partition of Π accordingly:

$$\Pi = \begin{bmatrix} \pi_{yy} & \pi_{yx} \\ \pi_{xy} & \Pi_{xx} \end{bmatrix}. \tag{4.2.3}$$

If the roots of $|I_{n+1} - \sum_{i=1}^{p} \Phi_i z^i| = 0$ are either outside or on the unit circle $|z| = 1$, $\pi_{xy} = \mathbf{0}$, and the matrix Π_{xx} has rank r ($0 \leq r \leq n$), then, Π is given by (see Pesaran, Shin, and Smith (2001)):

$$\Pi = \begin{bmatrix} 0 & \pi_{yx} \\ 0 & \Pi_{xx} \end{bmatrix}. \tag{4.2.4}$$

Therefore, the ECM representation for y_t is given by:

$$\Delta y_t = a_0 + a_1 t + \Pi_{yy} y_{t-1} + \Pi_{yx.x} x_{t-1} + \sum_{i=1}^{p-1} \Psi_i \Delta z_{t-i} + w' \Delta x_t + \epsilon_{yt}. \tag{4.2.5}$$

Model (4.2.5) is often refers to as autoregressive distributed lag (ARDL) cointegration model (see Pesaran, Shin, et al. (1995) and Pesaran, Shin, and Smith (2001)). If the $\Pi_{yy} \neq 0$ and $\Pi_{yx.x} = 0$, y_t is trend stationary, irrespective of the value of r. As a result, Δy_t depends only on its own lagged level y_{t-1} in the ECM representation (4.2.5). However, if $\Pi_{yy} = 0$ and $\Pi_{yx.x} \neq 0$, Δy_t depends only on x_{t-1} in the ECM representation (4.2.5). Therefore, in order to test for the absence of level effects in (4.2.5) and more importantly, the absence of a level relationship between y_t and x_t, one can just test jointly the null hypothesis that $H_0 : \Pi_{yy} = 0,\ \Pi_{yx.x} = 0$ in (4.2.5). The rejection of H_0 implies the existence of long run relationship between y_t and x_t.

The cointegration bound tests (Pesaran, Shin, and Smith (2001)) places restrictions on the trend and intercept terms in (4.2.5), which yields the following five cases:

CASE 1. No intercepts and no trends: $a_0 = 0$ and $a_1 = 0$.

CASE 2. Restricted intercepts and no trend: $a_0 = -(\Pi_{yy}, \Pi_{yx.x})\mu$ and $a_1 = 0$.

CASE 3. Unrestricted intercepts and no trend: $a_0 \neq 0$ and $a_1 = 0$.

CASE 4. Unrestricted intercepts and restricted trends: $a_0 \neq 0$ and $a_1 = -(\Pi_{yy}, \Pi_{yx.x})\gamma$.

CASE 5. Unrestricted intercepts and trends: $a_0 \neq 0$ and $a_1 \neq 0$.

Our empirical investigation considers a four variable VAR with $z_t = (lgdp_t, lbms_t, lpsc_t, lspi_t)'$, where $lgdp$ is the natural log of real GDP, $lbms$ is the natural log of broad money supply, $lpsc$ represents the natural log of bank credit to private sector, and $lspi$ is the natural log of stock price index. We are interested in both the long-run relationships and short-run dynamic between economic growth and financial development, so, $y_t = lgdp_t$ and $x_t = (lbms_t, lpsc_t, lspi_t)'$. The ARDL ($p$, q_1, q_2,

q_3) model (4.2.5) can be written in a general form (see Pesaran, Shin, and Smith (2001)) as:

$$\begin{aligned}\Delta lgdp_t &= \delta_0 + \delta_1 lgdp_{t-1} + \delta_2 lbms_{t-1} + \delta_3 lpsc_{t-1} + \delta_4 lspi_{t-1} \\ &+ \sum_{i=1}^{p} \alpha_i \Delta lgdp_{t-i} + \sum_{i=0}^{q_1} \beta_i \Delta lbms_{t-i} + \sum_{i=0}^{q_2} \gamma_i \Delta lpsc_{t-i} + \sum_{i=0}^{q_3} \sigma_i \Delta lspi_{t-i} + \epsilon_{yt}, \end{aligned} \tag{4.2.6}$$

where δ_2, δ_3 and δ_4 capture the long-run effects of the financial development indicators $lbms$, $lpsc$, and $lspi$, respectively, α, β, γ and σ measure the short-run effects of these variables and p, q_1, q_2, and q_3 are the optimal lag lengths. In ARDL approach, there is flexibility in the choice of dynamic lag structures (see Pesaran, Shin, and Smith (2001)). The cointegration bounds test can then be applied to the ARDL model (4.2.6) to find the long run relationship between $lgdp_t$ and $x_t = (lbms_t, lpsc_t, lspi_t)'$. The null hypothesis of no cointegration is

$$H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0, \tag{4.2.7}$$

whose rejection implies that there is a cointegrating relationship between economic growth (measured by $lgdp_t$) and financial development (measured by $x_t = (lbms_t, lpsc_t, lspi_t)'$).

Once the co-integration is determined, the conditional ARDL long-run model for $lgdp$ can be estimated by using following equation:

$$lgdp_t = a_0 + \sum_{i=1}^{p} \delta_1 lgdp_{t-i} + \sum_{i=0}^{q_1} \delta_2 lbms_{t-i} + \sum_{i=0}^{q_2} \delta_3 lpsc_{t-i} + \sum_{i=0}^{q_3} \delta_4 \Delta lspi_{t-i} + \epsilon_{yt} \tag{4.2.8}$$

We can obtain the short-run parameters by estimating an error correction model (ECM) with the long-run estimates by using the below equation:

$$\begin{aligned}\Delta lgdp_t &= b_0 + \sum_{i=1}^{p} \alpha_i \Delta lgdp_{t-i} + \sum_{i=0}^{q_1} \beta_i \Delta lbms_{t-i} + \sum_{i=0}^{q_2} \gamma_i \Delta lpsc_{t-i} + \sum_{i=0}^{q_3} \sigma_i \Delta lspi_{t-i} + \\ &+ \lambda ECM_{t-1} + \epsilon_{yt}, \end{aligned} \tag{4.2.9}$$

where λ is the coefficient of error correction term (ECM_{t-1} is the lagged residual of the long run regression) that measures the speed of adjustment of the variables towards the long-run equilibrium.

4.3 Data and Estimation

4.3.1 Data

In our study, we estimate ARDL models to find short run and long-run relationships and also to test the hypothesis of causality between financial development and economic growth. For this purpose, we use real GDP index ($lgdp$) as the measurement for economic growth. In addition, we use bank credit to private sectors to nominal GDP ($lpsc$), broad money supply to nominal GDP ($lbms$) and stock price index to nominal GDP ($lspi$) to measure the level of financial development in Australia, China, South Africa, the UK and the USA. However, bank credit to private sectors measures the financial intermediation role played by the banking sector. Broad money supply on the other hand, measures the size of the financial sector. It is common to see in the literature that broad money supply to nominal GDP has been used as a financial indicator. These two indicators represent the bank-based system. Finally, the variable stock price index to nominal GDP is used to reflect the development in the stock markets. This indicator represents the market-based system. The functioning of stock market affects liquidity, risk diversification, acquisition of information about firms, corporate control, and savings. We collect the data for real GDP index and all share price index from OECD database. The bank credit to private sectors data are collected from Bank for International Settlements (BIS). Finally, the broad money supply is collected from Federal Reserve Economic Data (FRED). The variables that we are using in this paper are in logarithmic form. However, the empirical analysis in this paper employs quarterly time series data for all the four countries over the period of $1991Q1$ to $2019Q2$, except China. For China, we used quarterly data from the period of $1999Q1$ to $2018Q4$. The historical evaluation of the data are represented by the Figures

C1, C2, C3, C4 and C5 in the appendix. Besides this, Table C1 represents the descriptive statistics for the variables used in the model.

Before we proceed with the ARDL bound test, we test for the stationarity status of all the variables to determine their order of integration. This is to ensure that the variables are not $I(2)$, so as to avoid spurious results. To identify the integration order of the variables Augmented Dickey-Fuller (ADF) test statistics have been used. Employing ADF test, it is found that $lgdp$, $lbms$, $lpsc$, and $lspi$ all are non-stationary at level whereas stationary at first difference for all the countries. So, we can conclude that $lgdp$, $lbms$, $lpsc$, and $lspi$ all are integrated at first order, i.e. $I(1)$. The results of unit root tests are shown in the Table C2.

4.3.2 Estimation of the ARDL Model

This study uses bound testing approach of co-integration to determine the long-run relationship among the variables after determining the order of integration. Table 4.1 reports the results of the calculated F-statistics and critical values, when each variable is considered as a dependent variable (normalized) in the ARDL-OLS regressions.

For Australian data, the calculated F-statistics for $lgdp$ and $lpsc$ equations are 20.45 and 3.73 respectively which are higher than the upper bound critical value of 3.63 and 3.67 at the 5 percent level. Thus, the null hypotheses of no cointegration are rejected, implying long-run cointegration relationships amongst the variables when the regressions are normalized on both $lgdp$ and $lpsc$ variables (Table 4.1). Besides this, the calculated F-statistics for $lbms$ and $lspi$ equations are lower than the lower bound critical value at the 5 percent level. So, the null hypotheses of no cointegration can't be rejected which implies no long-run cointegration relationships exist between the variables.

In the case of China, the calculated F-statistics for $lgdp$ and $lspi$ equations are higher than the upper bound critical value implying long-run cointegration relationships amongst the variables. On the other hand, the calculated F-statistics for $lbms$ and $lpsc$ equations are lower than the lower bound critical value which can't reject the null hypotheses of no cointegration. Besides this, in South Africa both $lgdp$ and $lpsc$ variables have cointegration relationships amongst the variables whereas $lbms$ and $lspi$ variables

TABLE 4.1: ARDL bound testing for cointegration

	Dep. variable	Lower bound	Upper bound	F-statistics	Decision
Australia	lgdp	2.45	3.63	20.45	Cointegration
	lpsc	2.79	3.67	3.73	Cointegration
China	lgdp	2.45	3.63	19.77	Cointegration
	lspi	2.45	3.63	5.45	Cointegration
South Africa	lgdp	2.45	3.63	6.30	Cointegration
	lpsc	2.79	3.67	4.43	Cointegration
UK	lgdp	3.23	4.35	4.19	Cointegration
	lpsc	4.01	5.07	8.09	Cointegration
	lspi	2.45	3.63	5.22	Cointegration
USA	lgdp	3.23	4.35	9.75	Cointegration
	lbms	4.01	5.07	8.47	Cointegration
	lpsc	3.23	4.35	7.55	Cointegration

Note: The table represents the lower bound and upper bound of 5% level of significance.

have no cointegration relationships. Table 4.2 also represents that, in the UK, there are three cointegration relationship exists ($lgdp$, $lpsc$ and $lspi$). The critical value for $lgdp$ equation is within the lower and upper bound at 5 percent level, but very close to upper bound that's why we can reject the null hypothesis of no level relationship. However, in the USA there are also three cointegration relationship exists ($lgdp$, $lbms$ and $lpsc$).

Once we established that a long-run cointegration relationship existed, Equation (4.2.8) was estimated using the following ARDL (p, q1, q2, q3) specification. In ARDL model, for Australia, $p = 1, q1 = 1, q2 = 3, q3 = 2$; for China, $p = 2, q1 = 3, q2 = 3, q3 = 3$; for South Africa, $p = 2, q1 = 3, q2 = 1, q3 = 2$; for UK, $p = 2, q1 = 2, q2 = 3, q3 = 2$; for USA, $p = 1, q1 = 2, q2 = 3, q3 = 2$; and we have determined the lag using the lag selection criterion (Provided in the appendix). However, the results obtained by normalizing on real GDP per capita ($lgdp$), in the long-run are reported in Table 4.2.

Table 4.2 represents the long-run effect of financial development indicators on economic growth. Since both the dependent variable and the independent variables are in log form, the results can be explained in terms of elasticity. Thus, the output shows the

TABLE 4.2: Estimated long run coefficients using the ARDL approach (dependent variable: $lgdp$)

Regressors	Australia	China	South Africa	UK	USA
Intercept	0.034	-0.106	-0.202**	0.013	0.148***
lbms	-0.051	-0.003**	-0.035*	-0.061**	-0.076**
lpsc	-0.010	0.004**	0.032**	0.038	-0.027***
lspi	0.001	0.0001	0.022***	0.017**	0.010

Note: The table represents the coefficients. '*', '**', '***' indicates rejection of the null hypothesis at the 10%, 5% and 1% level of significance respectively.

response of economic growth to changes in the growth of the financial development indicators. Broad money supply (*lbms*) should have a positive impact on economic growth according to economic theory. But, in our estimation results in Table 4.2, we can observe a negative long-run relationship between broad money supply and economic growth for all the countries as indicated by the sign of their coefficients. The value of the coefficients indicate that, holding other factors constant, a one percent increase in *lbms* will lead to a reduction in GDP growth by 0.05, 0.003, 0.04, 0.06 and 0.08 percent in Australia, China, South Africa, the UK and the USA respectively. These estimates do not confirm the prior expectation of orthodox economic theory. Besides this, private sector credit (*lpsc*) has positive and significant long-run effect on economic growth in China, the UK and South Africa whereas the long-run effect of *lpsc* is negative in Australia and the USA. On the other hand, stock market index is shown to have a positive relationship with economic growth for all the countries. The coefficient shows that, holding other factors constant, a one percent increase in the stock market index will lead to an increase in economic growth by 0.001, 0.0001, 0.02, 0.02 and 0.01 percent in Australia, China, South Africa, the UK and the USA respectively in the long-run. But the magnitude of the effect is very low with a lower value of coefficients. So, we can observe that financial development has a long term significant impact on economic growth in all the countries in our study.

The results of the short-run dynamic coefficients associated with the long-run relationships obtained from the error correction model (ECM version) of ARDL Equation

TABLE 4.3: Error correction representation for the selected ARDL model (dependent variable: $\Delta lgdp$)

Regressors	Australia	China	South Africa	UK	USA
Intercept	0.003*	-0.0001*	0.0002	0.0002	-0.0023**
$\Delta lgdp(-1)$	0.569**	1.12***	1.432***	0.4458***	0.621***
$\Delta lgdp(-2)$	-	0.0450	-0.471**	0.1094	-
$\Delta lbms(-1)$	0.054	-0.004	0.0022	-0.0151	-0.457***
$\Delta lbms(-2)$	-	-0.0004	-0.0112	-0.0112	0.4366***
$\Delta lbms(-3)$	-	-0.0024	-0.0085	-	-
$\Delta lpsc(-1)$	-0.0424	0.0017	0.0438	0.1032***	0.0611*
$\Delta lpsc(-2)$	-0.0208	-0.0044	-	-0.0051	0.0163
$\Delta lpsc(-3)$	-0.0179	0.0021	-	-0.0316	0.0058
$\Delta lspi(-1)$	0.0030	-0.0022**	-0.0052	0.0112	-0.0050
$\Delta lspi(-2)$	0.0129	0.0007	-0.0069	0.0111	0.0307***
$\Delta lspi(-3)$	-	0.0019*	-	-	-
$ECM(-1)$	-0.74***	-1.28***	-1.14***	-1.02**	-0.70***

Note: The table represents the Coefficients. '*', '**', '***' indicates rejection of the null hypothesis at the 10%, 5% and 1% level of significance respectively.

(4.2.9) are given in Table 4.3. The model includes an error correction term $ECM(-1)$. The coefficient of the error correction term is an adjustment coefficient capturing the proportion of the disequilibrium in real GDP per capita (economic growth) in one period which is corrected in the next period. The larger the error term, the earlier the economy's return to the equilibrium rate of growth, following a shock. The estimated error correction term is 0.74, 1.28, 1.14, 1.02 and 0.70 respectively in Australia, China, South Africa, the UK and the USA, with a desired negative sign and also significant at 1 percent level. This indicates that following a shock, there is relatively fast return to the equilibrium growth in the following year. However, the models have valid error correction parameter with negative sign and statistically significant value.

This study uses Wald test to find out the direction of causality between financial development and economic growth, as we have found a stable long run relationship between them. The causality from financial development to economic growth (see Table C4)

carried out by testing the hypothesis that the coefficients of the lagged financial development indicators in the error correction model are jointly equals to zero. Private sector credit and broad money supply Granger causes economic growth in the UK and stock price index and broad money supply Granger causes economic growth in the USA. On the other hand, financial development does not Granger causes economic growth in Australia, China and South Africa. However, the granger causality from economic growth to financial development can also be carried out using the Wald test (see Table C5). Economic growth granger causes private sector credit in South Africa only. In addition, economic growth granger causes broad money supply in both South Africa and the UK. Finally, economic growth granger causes stock price index in both Australia and China. In Table C6, we can see the direction of causality across countries. In Australia, China and South Africa, there is a unidirectional causality running from economic growth to financial development. On the other hand, in the USA also there is a unidirectional causality running from financial development to economic growth. Besides this, in the UK there is a bi-directional causality between financial development and economic growth.

This study ran some diagnostic tests to reveal the stability in coefficients and to check if there is any serial correlation, heteroskedasticity or functional error in the model. Table C3 represents some diagnostic tests results (Breusch-Godfrey LM Test, Breusch-Godfrey Heteroskedasticity Test and Ramsey RESET Test) for them. Both the χ^2 and F-statistics and their probability values are reported in the table. Accordingly, our model passes all the diagnostic tests because all tests have p-values larger than 0.05. So there are no evidence of serial correlation and heteroskedasticity and the models are well specified. Finally, to check the stability of the model the cumulative sum of recursive residuals (CUSUM) is presented in Figures C6, C7, C8, C9 and C10 in appendix. The plots of cumulative sum of recursive residuals show that CUSUM statistics are well within the 5 percent critical bounds implying that short-run and long-run coefficients in the ARDL–ECM are stable.

4.4 Interpretation of Results

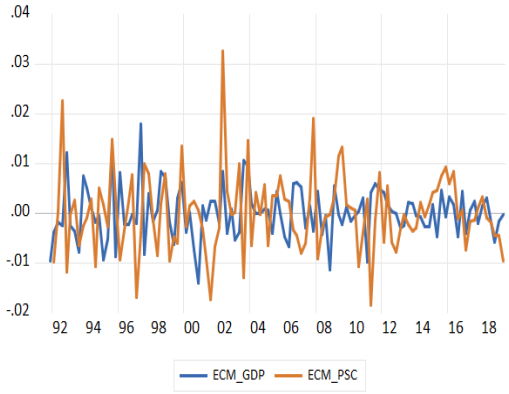
4.4.1 Long-run Relationships

Figure 4.1 represents cointegrating relationships across counties over times. Values of zero in these prediction indicate that the given system is at the long-run equilibrium (the zero horizontal line), while positive values indicate the system is above the long-run equilibrium and negative values depict a system is below the long-run equilibrium. We can then plot the dynamics of the cointegrating systems over time.

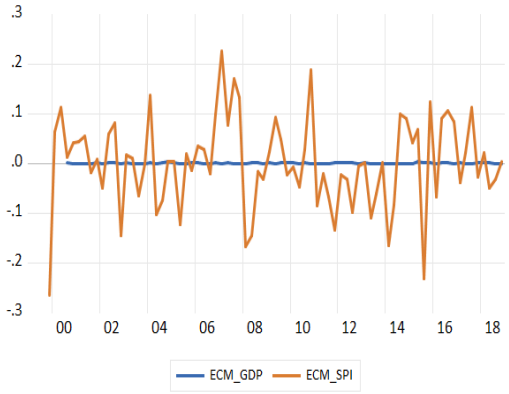
In Australia, the cointegrating relationships represents that both GDP and private sector credit has a long-run cointegration between them. Any short run deviation of economic growth from the equilibrium adjusted very quickly compared to private sector credit. On the other hand, China has two cointegration relation, GDP and stock price. The long-run equilibrium for GDP is very stable in China and any economic shock can adjusts very quickly with a very high speed. Besides this, any shock to stock market takes time to come back to long-run equilibrium. The cointegrating relationship in South Africa is more or less same as Australia. In the UK and the USA there are three cointegrating relationship in model, but there are differences in variables that are cointegrating. In the UK, the cointegrating variables are GDP, credit and stock price whereas in the USA the cointegrating variables are GDP, credit and money supply.

Interestingly, the cointegrating system for stock price index in the UK indicate large short-run deviations from the long-run equilibrium in 2002 and 2009. The stock market index has lost 25 percent of its value over the year of 2002 and faced annual loss due to the panics of war on Iraq, tensions in North Korea, corporate scandals and economic stagnation. In 2009, due to global financial crisis the stock price faces another drop in the UK. Besides this, cointegrating structure for money supply and private sector credit in USA also indicate a large deviation from equilibrium level. In December 2008, the Federal Reserve had lowered the federal funds rate essentially to zero in the USA leading to an increased money supply. Besides this, credit crisis happened in 2009, because of careless lending for years. This inflated a massive credit bubble as people borrowed cheap money and invested it into the USA property market.

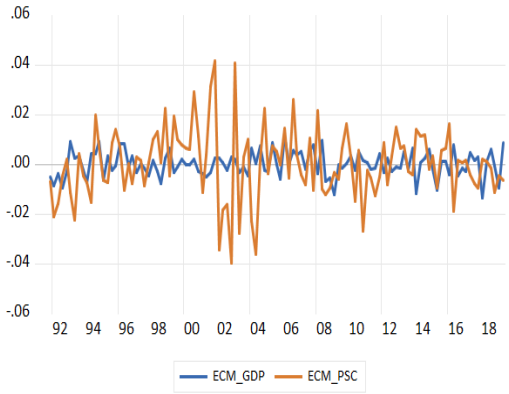
(A) Australia



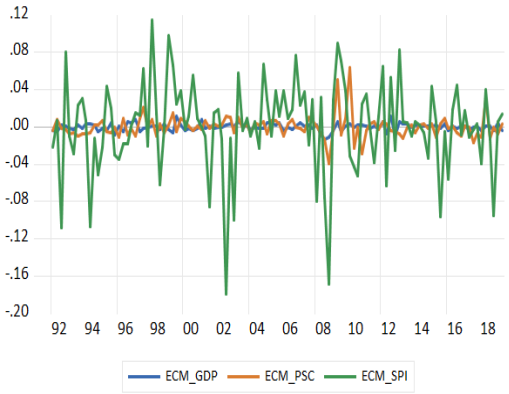
(B) China



(C) South Africa



(D) UK



(E) USA

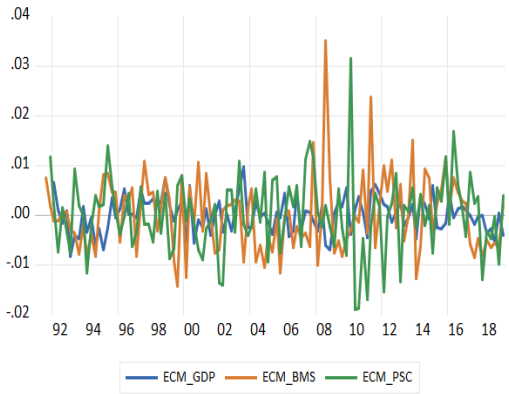


FIGURE 4.1: Cointegrating Relationships

4.4.2 Dynamics around the Long-run Equilibrium

The impulse response functions can represent the key insight of the dynamic relationships between financial development and economic growth, because it demonstrates the response of a variable to a shock in itself or another variable over time. In this section, we are illustrating the estimated impulse response functions of output due to a one-standard-deviation shock in financial development indicators and the estimated impulse response functions of financial development indicators due to a one-standard-deviation shock in output.

(A) Financial development shock (B) Output shock

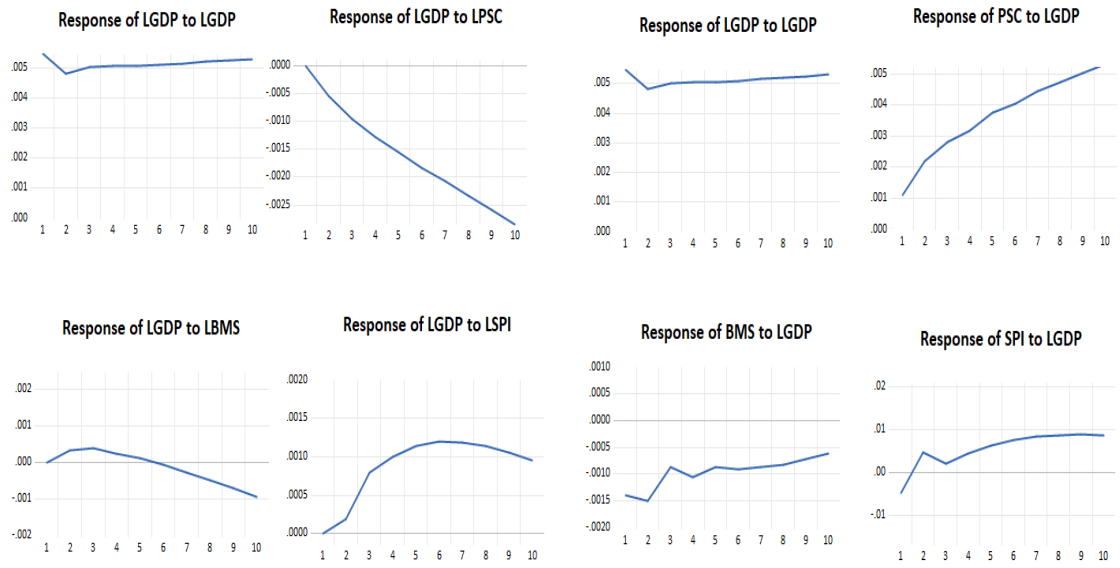


FIGURE 4.2: Impulse-response functions of Australia

Figures 4.2 and 4.3 represent the impulse response functions of Australia and China due to a positive financial development and output shocks. From the impulse responses, we can see that in Australia, an increase in broad money supply has positive impact on real GDP for first four quarters, after that become negative. In addition, shock in private sector credit has negative impact on real GDP, whereas stock price index has positive impact on real GDP. So, the results from impulse response functions show that financial market improves economic growth in Australia. On the other hand, in China, the shock in all the three indicators of financial development indicators permanently increases GDP.

(A) Financial development shock (B) Output shock

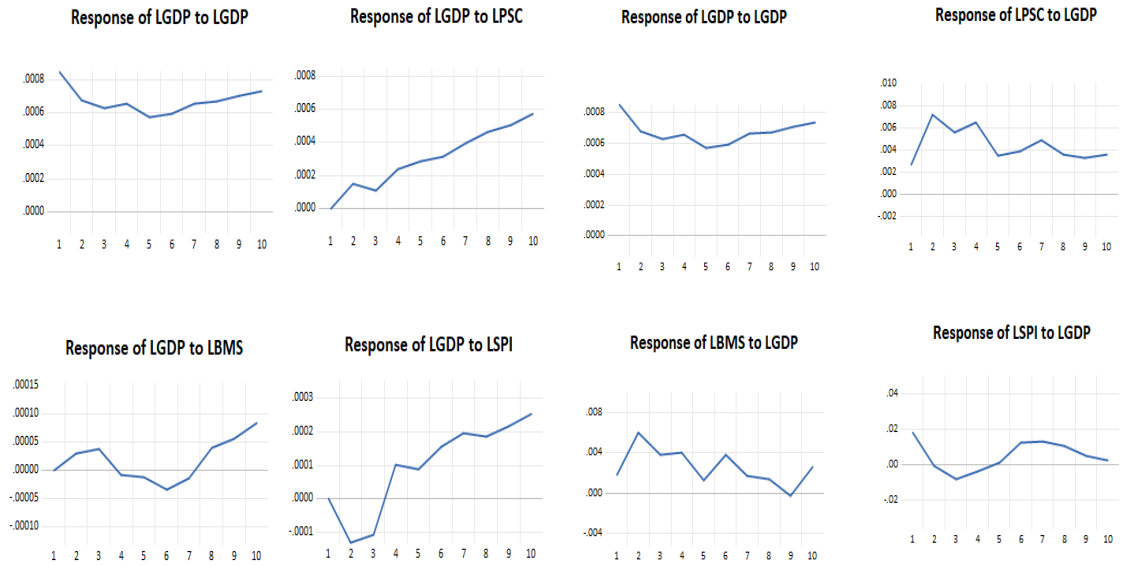


FIGURE 4.3: Impulse-response functions of China

That means, both the financial intermediaries and financial market improves economic growth in China. However, the shock in output has a positive impact on credit and stock market, but negative impact on money supply in Australia. Besides this, the shock in output has a positive impact on all the three financial indicators of China.

Figures 4.4 and 4.5 represent the impulse response functions of all the variables in the model to shocks in financial development and output for South Africa and the UK, respectively. In South Africa, the shock in private sector credit has positive impact on economic growth whereas the shock in broad money supply has negative impact on GDP. Besides this, an increase in stock price index increases GDP for first three quarters and started to decrease after that. On the other hand, in the UK, the shock in private sector credit and stock price index have positive impact on GDP whereas only the shock in broad money supply has negative impact on economic growth. In addition, the shock in output has a positive impact on financial development (all the three indicators) in South Africa and negative impact on financial development (except stock price) in the UK.

Figure 4.6 represents the impulse response functions of the USA due to a shock in financial development and output. GDP responses positively due to a shock in stock price

(A) Financial development shock (B) Output shock

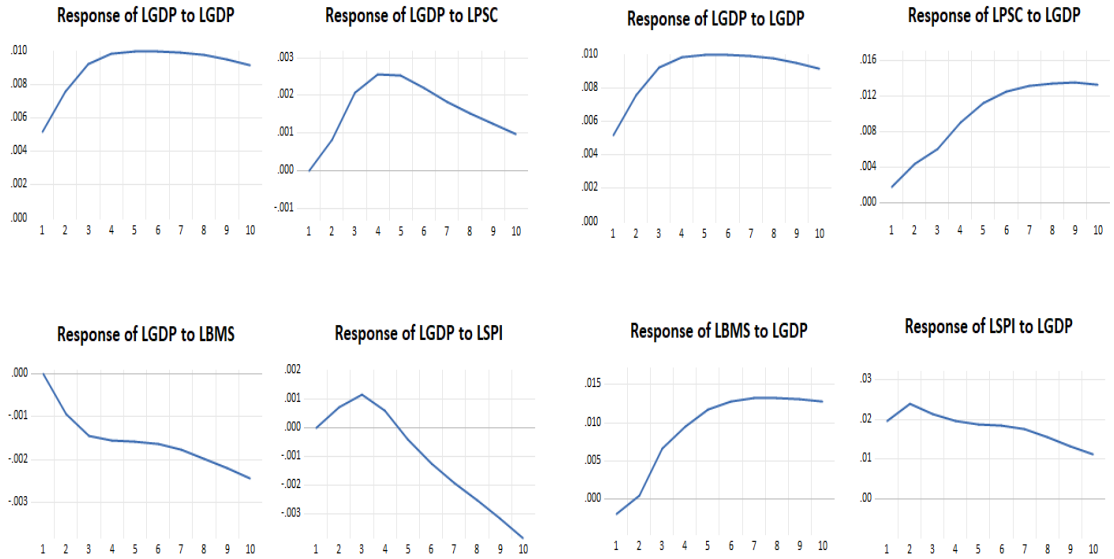


FIGURE 4.4: Impulse-response functions of South Africa

(A) Financial development shock (B) Output shock

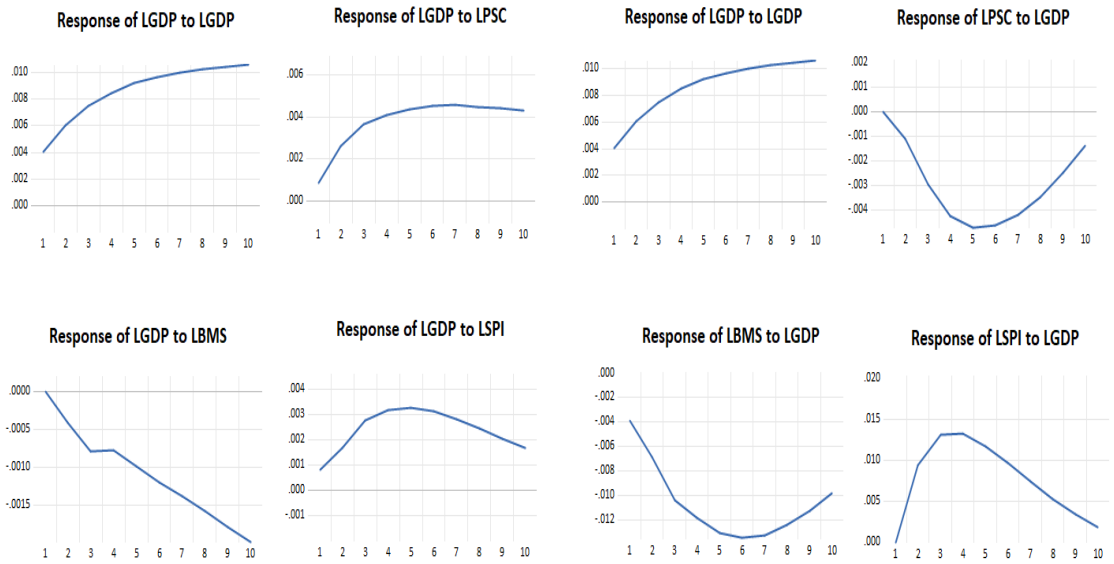


FIGURE 4.5: Impulse-response functions of UK

index and money supply whereas negatively due to a shock in credit. Furthermore, the shock in output has a negative impact on credit and money supply and positive impact

(A) Financial development shock (B) Output shock

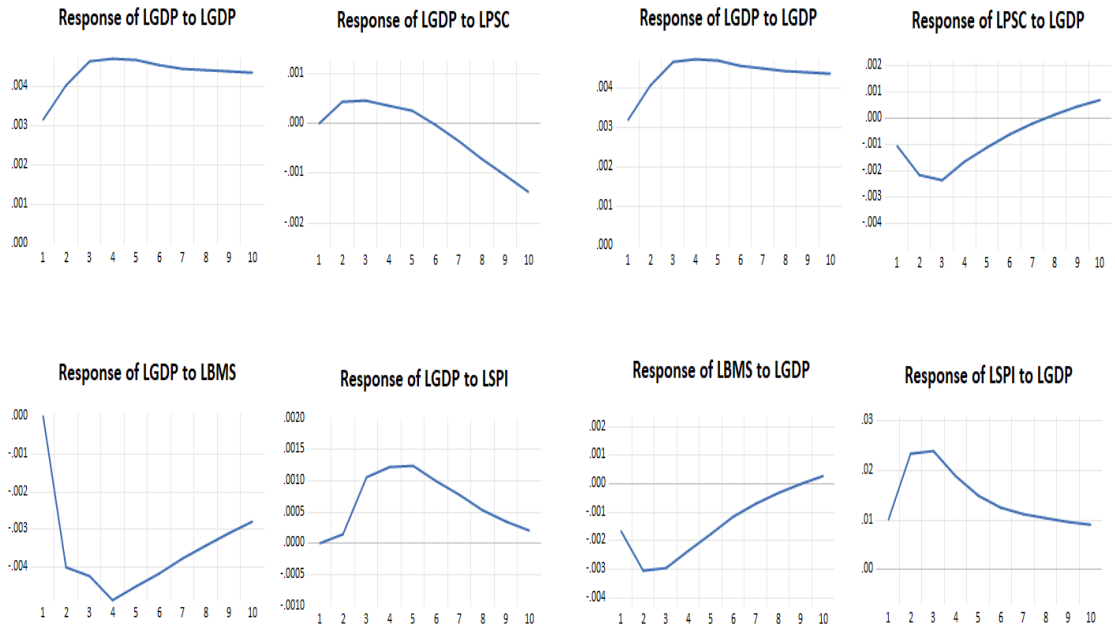


FIGURE 4.6: Impulse-response functions of USA

on stock price index. So, from the above analysis of impulse response functions, we can see that the transmission channel of financial development varies across countries.

4.4.3 Discussions

The long-run empirical results demonstrate that financial development has long-run significant positive impact on economic growth of Australia, China, South Africa, the UK and the USA. However, in China, South Africa and the UK both indirect financing of the financial intermediaries and financial market are playing effective role to influence the economic growth. So, both banking system and financial market is strong enough to these countries to increase the investment from the investors. Therefore, the findings of Nyasha and Odhiambo (2015) is partially supported by our result who finds that stock market development drives the development of the real sector in South Africa. The banking sector in South Africa also remains intensely capitalised and well managed, and banking supervision make substantial development by applying the international best practices. The

modern structure and international competitiveness of the South African financial system plays a significant role to impact the economic growth. Besides this, our findings of the UK is supported by Wesiah and Onyekwere (2021) who finds that both private sector credit and money supply drives the development of the real sector in the UK. However, the Chinese economy has performed amazingly well in the previous thirty-eight years. Since the end of 2020, the Chinese stock market is the third biggest in the world in terms of total market capitalization, following only the US and Japan equity markets. However, the performance of the market has been unsatisfactory, particularly in comparison with the growth of the economy. Morck, Yeung, and Yu (2000), Jin and Myers (2006) and Xiong and Yu (2011) find inefficiency in the formation of asset prices in the Chinese stock market.

Nonetheless, in Australia and the USA only the direct financing from the capital market are playing significant role in developing economic growth. So, the financial market is strong enough to these two countries to increase the investment from the investors. Hence, our findings for the USA are consistent with preceding studies of Rangvid (2006), Annika and Daniel (2015) and Hossain and Hossain (2015). On the other hand, our findings for Australia show disparity with the findings of Thangavelu, Jiunn, et al., 2004 that financial development has no long-run significant impact on economic growth of Australia whereas economic growth has positive impact on financial development which is supported by the findings of Thangavelu, Jiunn, et al. (2004).

From the impulse response functions we can observe that the shock in financial sector transmitted to real economy via different channels across countries. In Australia and the USA the financial shock transmitted through stock market only whereas in South Africa the financial shock transmitted through banks only. On the other hand, in China and the UK both the banks and stock market play active role to transmit the shock of financial sector to real economy. Besides this, from the impulse responses of output shock we find that real economic growth leads financial developments in Australia, China and South Africa which support the demand following hypothesis supported by Robinson (1952), Gurley and Shaw (1967) and Jung (1986). On the other hand, the USA and the UK partially follow the demand following hypothesis where economic growth leads to

development in financial market only. In our study we also look separately, the role of financial intermediaries and financial market to promote growth in the economies. Because, financial intermediaries and financial market based indicators can have different impact on economic growth (Levine et al. (2000); Beck and Levine (2002)).

From the causality analysis, we find both financial intermediaries and financial market based indicators cause economic growth in the UK and the USA showing mutually reinforcing role of them in the overall financial development. Our empirical results of short-run causality partially support the theoretical suggestion of Blackburn and Hung (1998) that there is a positive, two-way causal relationship between financial development and economic growth. Because, we find one way causality between financial development and economic growth in all the four countries except the UK. Besides this, our empirical results also show disparity to the findings of Levine (1998) and Rajan and Zingales (1998) who conducted a cross-sectional analysis. They concluded that only "supply leading" hypothesis is true for the industrialized economies and the "demand following" is very unlikely to occur. But, we find the evidence of "demand following" hypothesis for Australia, China and South Africa. So, we can say that a time-series modelling can give better findings. Our empirical results also support the conclusion of King and Levine (1993) and show that financial development is important for economic growth in the USA, as we find causality from financial development to economic growth.

4.5 Conclusion

This study examines the nexus between financial development and economic growth based on multivariate time series techniques and, in particular, on the ARDL Bound testing approach employing quarterly time series data for Australia, China, South Africa, the UK and the USA. The study employs ARDL bound test approach to examine the long-run and short-run relationship between financial development and economic growth. Besides this, we investigate the direction of causality between financial development and economic growth and estimate the impulse responses to analyse the dynamic relationship between the variables. In our study, we use real GDP index as the measurement

for economic growth. In addition, we used bank credit to private sectors, broad money supply and stock price index to measure the level of financial development. The results suggest that there exists significant long-run relationship between real GDP and the financial development variable. In Australia and the USA only market based financial intermediaries have significant long-run impact on economic growth whereas in China, South Africa and the UK both bank based and market based financial indicators have long-run impact on economic growth.

We find that the financial shock transmitted to real economy using different channels across countries, depending on the financial structure of the countries. In Australia and the USA the financial shock transmitted through stock market only whereas in South Africa the financial shock transmitted through banks only. On the other hand, in China and the UK both the banks and stock market play active role to transmit the shock of financial sector to real economy. Besides this, from the impulse response functions of output shock we find that, economic growth leads to bank-based financial development in Australia, China and South Africa only whereas market-based financial development in all the five countries.

Our study supports the assumptions of Arestis and Demetriades (1997) and Demetriades and Hussein (1996) that the nexus between financial development and economic growth varies country by country and applying time-series analysis is more significant compared to cross-sectional analysis. The overall implication of this study is that financial development can be used as a policy variable to enhance economic growth in China, South Africa, the UK and the USA whereas economic growth can be used as a policy variable to promote financial development in Australia only. Hence, further research using more efficient proxies for measuring financial development and also using some controls for other factors that have influence on the economic growth can provide more reliable evidence on the nexus between financial development and economic growth.

Appendix C

TABLE C1: Descriptive statistics for the economies

		lgdp	*lbms*	*lpsc*	*lspi*
Australia	Mean	4.296420	1.135299	4.573993	-8.189681
	Std dev	0.264856	0.249752	0.306128	0.172470
	Min	3.822098	0.790076	4.079231	-8.517740
	Max	4.700480	1.528206	4.966335	-7.797856
China	Mean	4.697288	1.858030	4.824983	-11.75238
	Std dev	0.016264	0.157644	0.136350	0.584507
	Min	4.673763	1.500652	4.616110	-12.80914
	Max	4.733563	2.179846	5.067016	-10.68974
South Africa	Mean	4.315218	0.896920	4.076081	-9.474166
	Std dev	0.239823	0.172040	0.145272	0.180653
	Min	3.929863	0.593941	3.808882	-9.963174
	Max	4.636669	1.149433	4.326778	-9.177262
UK	Mean	4.409643	1.407489	4.443748	-8.344931
	Std dev	0.179051	0.258387	0.132637	0.191091
	Min	4.077537	1.027130	4.229749	-8.764814
	Max	4.664382	1.813222	4.727388	-7.885012
USA	Mean	4.379842	-0.608277	3.899110	-12.24094
	Std dev	0.203981	0.140835	0.076095	0.198501
	Min	3.974058	-0.784878	3.756538	-12.67738
	Max	4.692265	-0.355927	4.060443	-11.95133

TABLE C2: Unit Root Test Results of the Variables

	lgdp	*lbms*	*lpsc*	*lspi*
Austria	$I(1)$	$I(1)$	$I(1)$	$I(1)$
China	$I(1)$	$I(1)$	$I(1)$	$I(1)$
South Africa	$I(1)$	$I(1)$	$I(1)$	$I(1)$
UK	$I(1)$	$I(1)$	$I(1)$	$I(1)$
USA	$I(1)$	$I(1)$	$I(1)$	$I(1)$

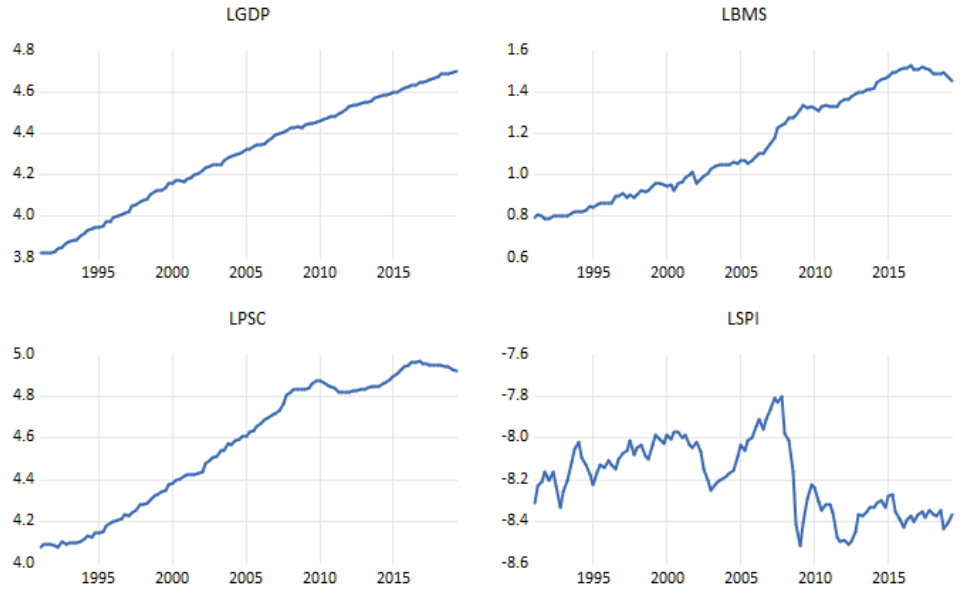


FIGURE C1: Historical representation of Australian data

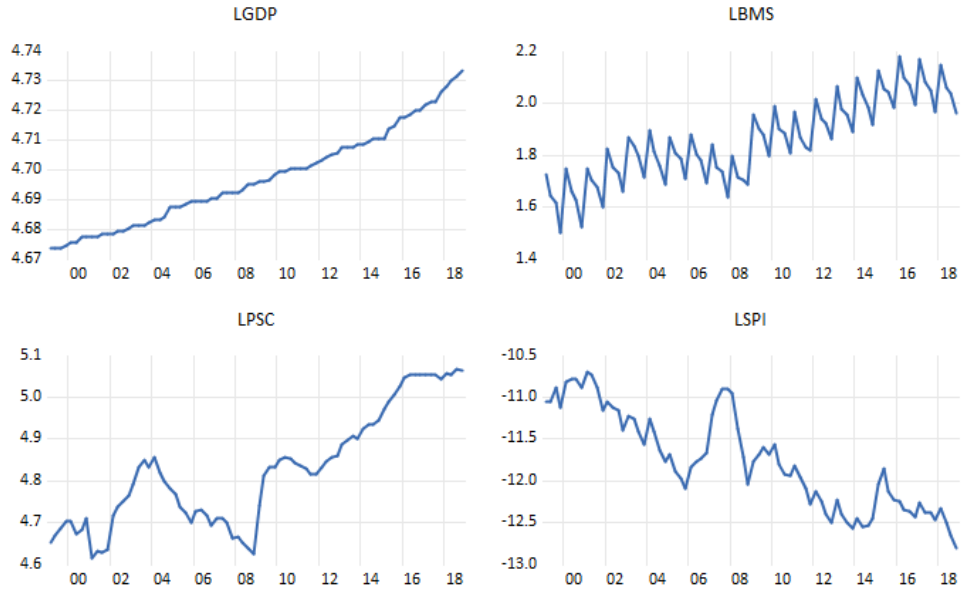


FIGURE C2: Historical representation of Chinese data

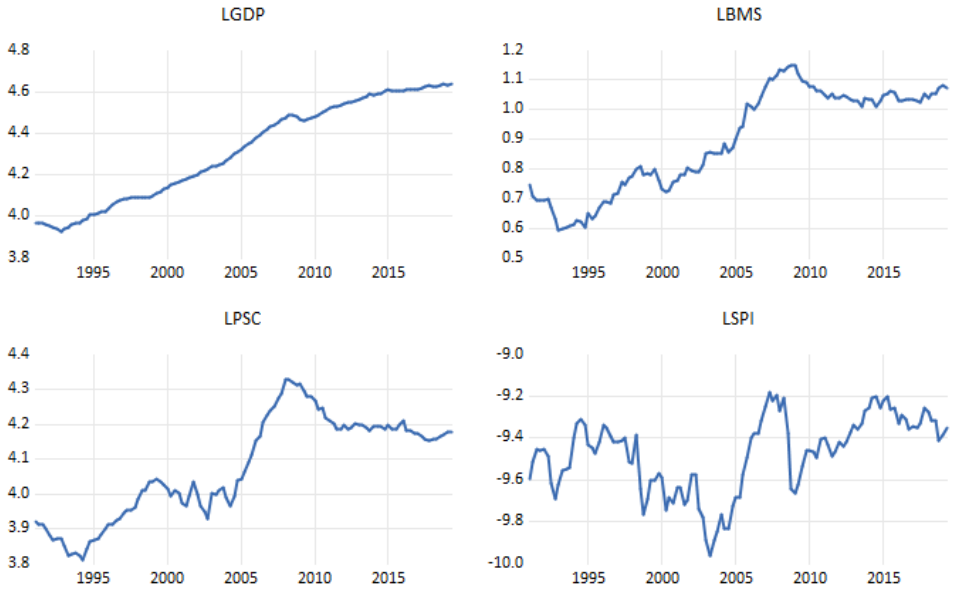


FIGURE C3: Historical representation of South African data

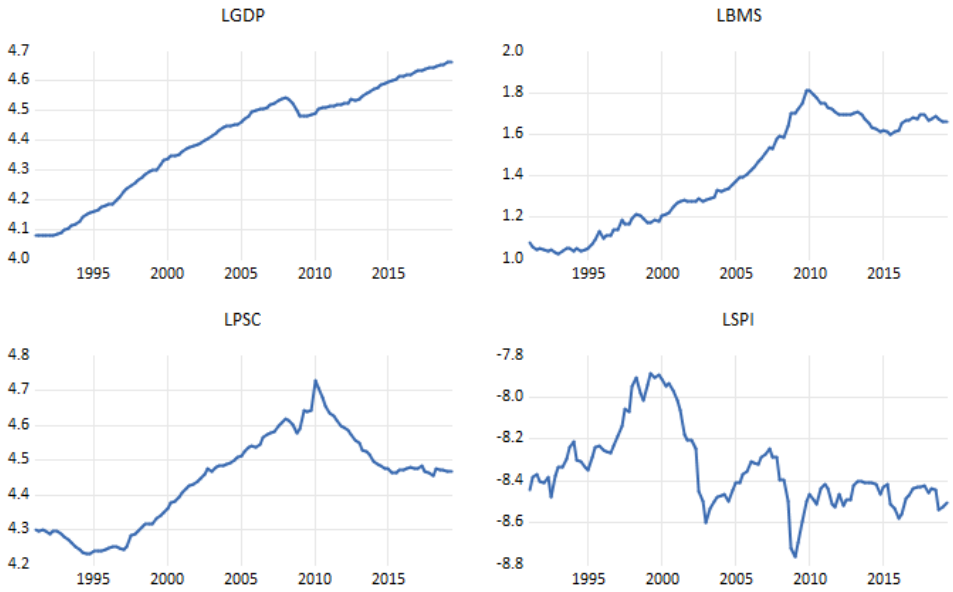


FIGURE C4: Historical representation of UK data

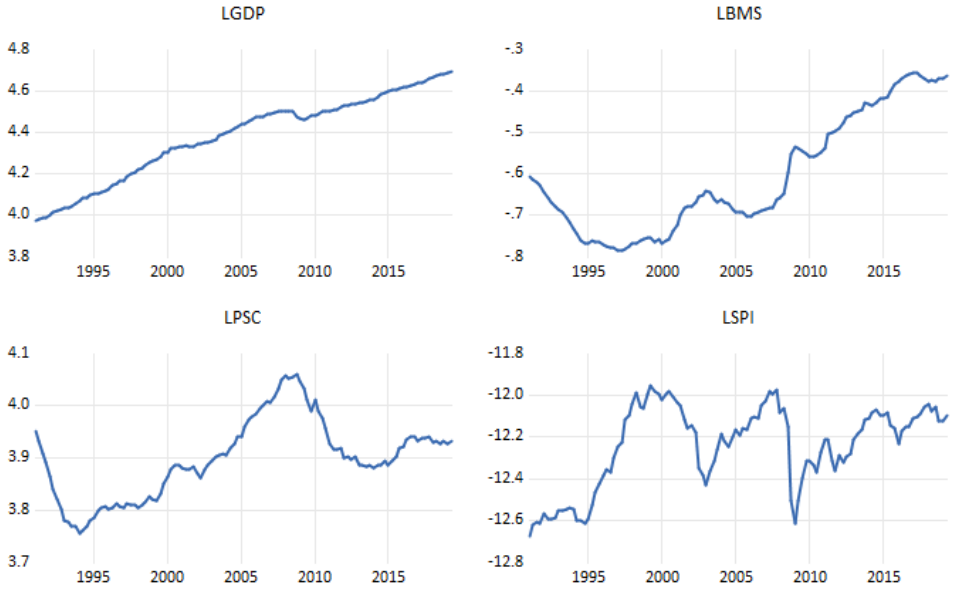


FIGURE C5: Historical representation US data

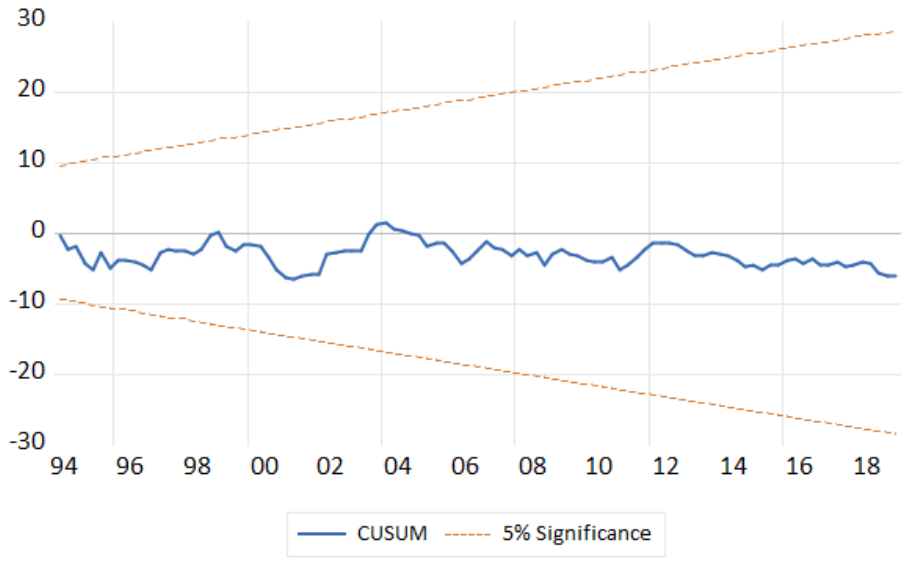


FIGURE C6: Stability test of the Australian Model

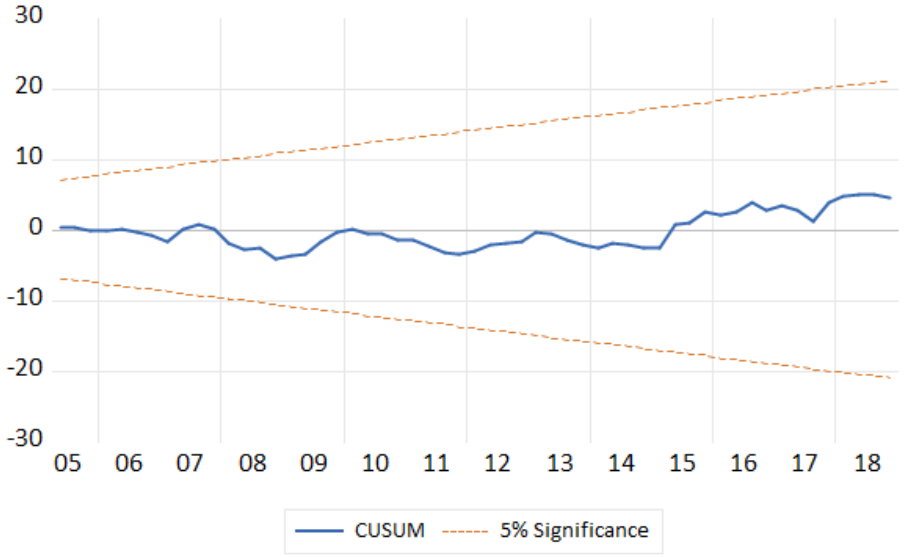


FIGURE C7: Stability test of the Chinese Model

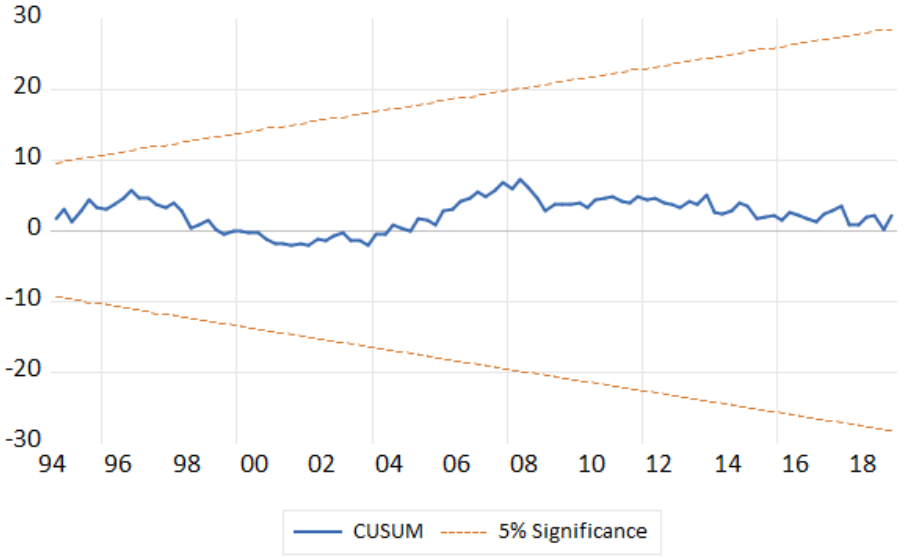


FIGURE C8: Stability test of the South African Model

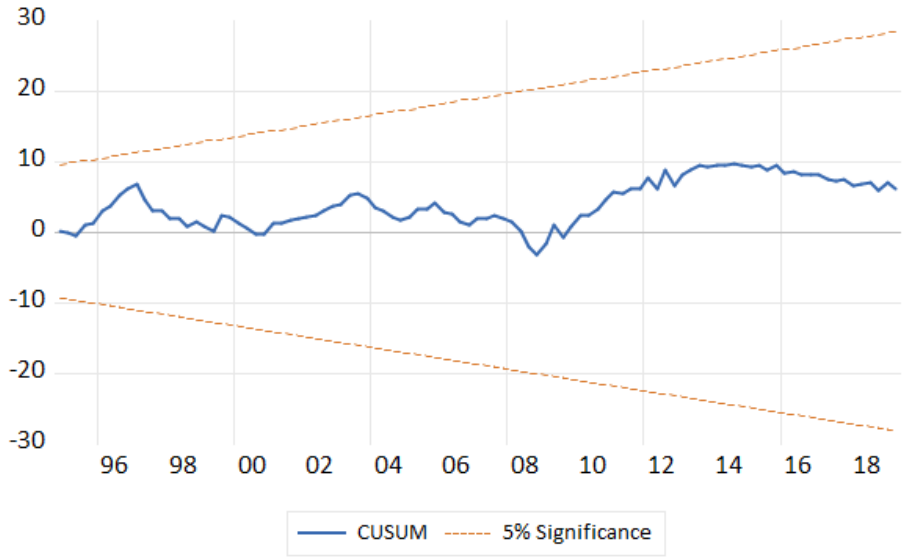


FIGURE C9: Stability test of the UK Model

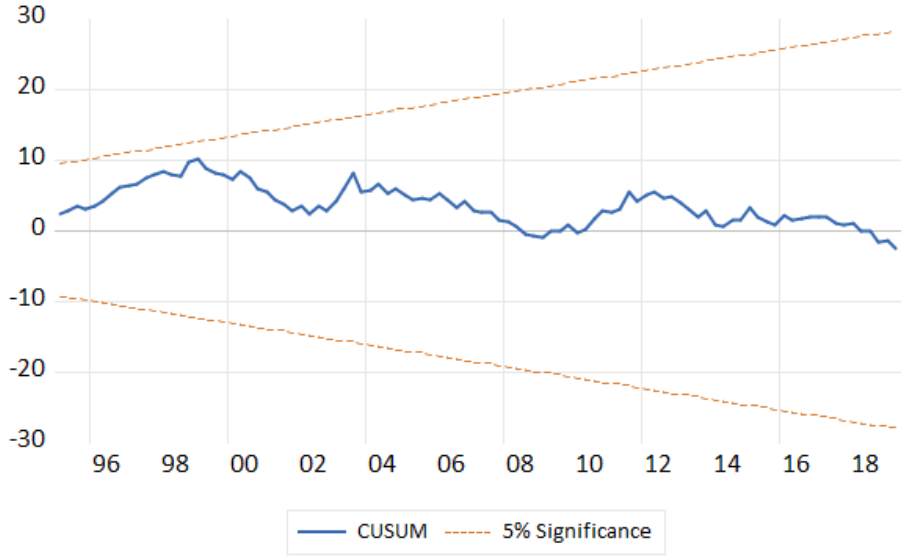


FIGURE C10: Stability test of the USA Model

TABLE C3: Diagnostic check

Diagnostic Test	Chi-statistic	F-statistic	Decision
	Australia		
Breusch-Godfrey LM Test	$\chi^2(2)$= 3.974 Prob. 0.14	F(2,99)=1.855 Prob. 0.16	No correlation
Breusch-Godfrey Hetero. Test	$\chi^2(8)$=9.212 Prob. 0.325	F(8,101)=1.154 Prob. 0.335	No heteroskedasticity
Ramsey RESET Test	$\chi^2(1)$= 1.692 Prob. 0.193	F(1,100)=1.551 Prob. 0.216	Model is well specified
	China		
Breusch-Godfrey LM Test	$\chi^2(2)$= 0.662 Prob. 0.72	F(2,53)=0.242 Prob. 0.78	No correlation
Breusch-Godfrey Hetero. Test	$\chi^2(17)$=15.18 Prob. 0.583	F(17,55)=0.849 Prob. 0.632	No heteroskedasticity
Ramsey RESET Test	$\chi^2(2)$= 8.181 Prob. 0.02	F(2,53)=3.142 Prob. 0.06	Model is well specified
	South Africa		
Breusch-Godfrey LM Test	$\chi^2(4)$= 18.71 Prob. 0.19	F(4,96)=4.920 Prob. 0.11	No correlation
Breusch-Godfrey Hetero. Test	$\chi^2(9)$=18.81 Prob. 0.03	F(9,100)=2.29 Prob. 0.02	Heteroskedasticity
Ramsey RESET Test	$\chi^2(2)$= 4.074 Prob. 0.13	F(2,98)=1.849 Prob. 0.2	Model is well specified
	UK		
Breusch-Godfrey LM Test	$\chi^2(2)$= 4.404 Prob. 0.1106	F(2,97)=2.022 Prob. 0.1378	No correlation
Breusch-Godfrey Hetero. Test	$\chi^2(10)$=10.632 Prob. 0.386	F(10,99)=1.059 Prob. 0.400	No heteroskedasticity
Ramsey RESET Test	$\chi^2(2)$= 3.251 Prob. 0.196	F(2,97)=1.454 Prob. 0.06238	Model is well specified
	USA		
Breusch-Godfrey LM Test	$\chi^2(2)$= 4.883 Prob. 0.089	F(2,96)=2.251 Prob. 0.111	No correlation
Breusch-Godfrey Hetero. Test	$\chi^2(10)$=11.122 Prob. 0.348	F(10,98)=1.113 Prob. 0.36	No heteroskedasticity
Ramsey RESET Test	$\chi^2(1)$= 0.927 Prob. 0.335	F(1,97)=0.829 Prob. 0.365	Model is well specified

TABLE C4: Wald test: Output of causality from financial development to economic growth

Null hypothesis	Australia	China	South Africa	UK	USA
lpsc does not causes *lgdp*	0.445	0.349	2.076	2.729**	1.835
lbms does not causes *lgdp*	1.651	1.221	0.091	1.087	90.794***
lspi does not causes *lgdp*	1.072	1.381	0.340	2.408*	13.72***

Note: The table represents the F-statistics. '*', '**', '***' indicates rejection of the null hypothesis at the 10%, 5% and 1% level of significance respectively.

TABLE C5: Wald test: Output of causality from economic growth to financial development

Null hypothesis	Australia	China	South Africa	UK	USA
lgdp does not causes *lpsc*	0.717	1.505	1.446*	0.208	0.846
lgdp does not causes *lbms*	0.011	1.097	11.862***	2.345*	0.108
lgdp does not causes *lspi*	4.103**	4.576**	0.171	2.075	1.218

Note: The table represents the F-statistics. '*', '**', '***' indicates rejection of the null hypothesis at the 10%, 5% and 1% level of significance respectively.

TABLE C6: The direction of causality between financial development and economic growth

Country	FD causes EG	EG causes FD	Direction
Australia	No	Yes	One way
China	No	Yes	One way
South Africa	No	Yes	One way
UK	Yes	Yes	Two way
USA	Yes	No	One way

TABLE C7: Lag Selection for Australia (lgdp)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	210.2602	NA	0.001195	-3.891702	-3.791195	-3.850966
1	407.9985	376.8220*	2.92e-05	-7.603746	-7.478112*	-7.552825*
2	409.2475	2.356619	2.91e-05	-7.608444	-7.457683	-7.547340
3	409.2937	0.086288	2.96e-05	-7.590448	-7.414560	-7.519159
4	411.0642	3.273736	2.92e-05	-7.604985	-7.403971	-7.523513
5	413.1602	3.835986	2.86e-05*	-7.625663*	-7.399522	-7.534007
6	413.3245	0.297674	2.90e-05	-7.609896	-7.358628	-7.508056
7	413.4250	0.180169	2.95e-05	-7.592925	-7.316530	-7.480901
8	413.9240	0.884995	2.98e-05	-7.583472	-7.281950	-7.461263

TABLE C8: Lag Selection for Australia (lbms)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	186.5008	NA	0.001871	-3.443411	-3.342904	-3.402675
1	306.9409	229.5179*	0.000197*	-5.696998*	-5.571364*	-5.646078*
2	306.9483	0.013910	0.000200	-5.678269	-5.527508	-5.617165
3	307.0338	0.159721	0.000204	-5.661015	-5.485127	-5.589726
4	307.0385	0.008740	0.000208	-5.642236	-5.441222	-5.560764
5	307.0615	0.042190	0.000212	-5.623803	-5.397662	-5.532147
6	307.5241	0.837761	0.000214	-5.613662	-5.362394	-5.511821
7	309.1772	2.963134	0.000211	-5.625985	-5.349590	-5.513960
8	309.3131	0.241074	0.000215	-5.609681	-5.308160	-5.487473

TABLE C9: Lag Selection for Australia (lpsc)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	174.9877	NA	0.002325	-3.226183	-3.125676	-3.185447
1	346.2549	326.3770	9.36e-05	-6.438771	-6.313137	-6.387851
2	346.5921	0.636231	9.48e-05	-6.426265	-6.275505	-6.365161
3	355.0218	15.74609*	8.24e-05	-6.566449	-6.390561*	-6.495161*
4	356.4200	2.585277	8.18e-05	-6.573961	-6.372947	-6.492489
5	357.5345	2.039741	8.16e-05*	-6.576122*	-6.349981	-6.484466
6	357.7049	0.308790	8.29e-05	-6.560470	-6.309203	-6.458630
7	359.3553	2.958124	8.19e-05	-6.572741	-6.296346	-6.460716
8	359.4036	0.085829	8.34e-05	-6.554786	-6.253264	-6.432577

TABLE C10: Lag Selection for Australia (lspi)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	82.71935	NA	0.013259	-1.485271	-1.384764	-1.444535
1	160.5549	148.3280	0.003111	-2.934997	-2.809363	-2.884077
2	168.3957	14.79405*	0.002734*	-3.064070*	-2.913309*	-3.002966*
3	168.4026	0.012851	0.002786	-3.045332	-2.869444	-2.974044
4	168.5496	0.271934	0.002832	-3.029239	-2.828224	-2.947766
5	169.4782	1.699402	0.002836	-3.027890	-2.801749	-2.936234
6	169.8466	0.667403	0.002870	-3.015974	-2.764707	-2.914134
7	170.4645	1.107480	0.002892	-3.008764	-2.732370	-2.896740
8	170.8678	0.715293	0.002925	-2.997506	-2.695984	-2.875298

TABLE C11: Lag Selection for China (lgdp)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	268.7473	NA	4.14e-05	-7.253351	-7.127846	-7.203335
1	416.1770	274.6636*	7.50e-07	-11.26512	-11.10824*	-11.20260*
2	417.3363	2.127990	7.47e-07*	-11.26949*	-11.08123	-11.19446
3	417.8396	0.910004	7.58e-07	-11.25588	-11.03625	-11.16835
4	417.8448	0.009245	7.79e-07	-11.22862	-10.97761	-11.12859
5	418.3207	0.834501	7.90e-07	-11.21427	-10.93188	-11.10173
6	418.3207	2.16e-06	8.13e-07	-11.18687	-10.87311	-11.06183
7	418.5801	0.440565	8.30e-07	-11.16658	-10.82144	-11.02903

TABLE C12: Lag Selection for China (lbms)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	89.26069	NA	0.005483	-2.368352	-2.241871	-2.318000
1	91.09488	3.413629	0.005358	-2.391524	-2.233423	-2.328584
2	94.39820	6.056090	0.005027	-2.455506	-2.265783	-2.379977
3	101.2042	12.28862	0.004279	-2.616783	-2.395441	-2.528666
4	134.7049	59.55671	0.001735	-3.519579	-3.266616	-3.418874
5	176.3760	72.92448	0.000561	-4.649333	-4.364750	-4.536039
6	178.9014	4.349390*	0.000538*	-4.691707*	-4.375503*	-4.565825*
7	179.2670	0.619502	0.000548	-4.674085	-4.326261	-4.535615
8	179.3324	0.108902	0.000563	-4.648122	-4.268677	-4.497064

TABLE C13: Lag Selection for China (lpsc)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	107.2430	NA	0.003327	-2.867860	-2.741379	-2.817507
1	175.4506	126.9419	0.000514	-4.734738	-4.576636	-4.671797
2	178.0829	4.825997	0.000492	-4.780081	-4.590359*	-4.704552
3	179.3565	2.299435	0.000488	-4.787679	-4.566337	-4.699562
4	181.5559	3.910047*	0.000472*	-4.820996*	-4.568033	-4.720291*
5	182.2419	1.200530	0.000477	-4.812274	-4.527691	-4.698981
6	182.4862	0.420784	0.000487	-4.791283	-4.475080	-4.665402
7	182.5003	0.023964	0.000501	-4.763898	-4.416074	-4.625429
8	182.7134	0.355169	0.000512	-4.742040	-4.362596	-4.590982

TABLE C14: Lag Selection for China (lspi)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-14.08472	NA	0.096771	0.502353	0.628835	0.552706
1	41.60263	103.6404	0.021186	-1.016740	-0.858638	-0.953799
2	42.41247	1.484705	0.021302	-1.011458	-0.821735	-0.935929
3	42.89703	0.874891	0.021614	-0.997140	-0.775797	-0.909023
4	45.46745	4.569632	0.020698	-1.040762	-0.787799	-0.940057
5	45.97329	0.885227	0.020992	-1.027036	-0.742453	-0.913742
6	53.74624	13.38675*	0.017401*	-1.215173*	-0.898970*	-1.089292*
7	54.26781	0.883778	0.017644	-1.201884	-0.854060	-1.063414
8	55.15399	1.476963	0.017713	-1.198722	-0.819278	-1.047664

TABLE C15: Lag Selection for South Africa (lgdp)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	133.0283	NA	0.005132	-2.434496	-2.333989	-2.393760
1	396.8840	502.8193	3.60e-05	-7.394038	-7.268404	-7.343117
2	408.9755	22.81421*	2.92e-05*	-7.603312*	-7.452551*	-7.542208*
3	409.0129	0.069728	2.97e-05	-7.585148	-7.409261	-7.513860
4	409.2207	0.384302	3.02e-05	-7.570202	-7.369187	-7.488729
5	409.6216	0.733671	3.05e-05	-7.558897	-7.332756	-7.467241
6	409.6459	0.044043	3.11e-05	-7.540488	-7.289220	-7.438648
7	409.7006	0.098008	3.17e-05	-7.522652	-7.246257	-7.410628
8	410.1602	0.815296	3.20e-05	-7.512457v -7.210936	-7.390249	

TABLE C16: Lag Selection for South Africa (lbms)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	238.4327	NA	0.000732	-4.381920	-4.282001	-4.34141
1	274.8080	69.35110	0.000378	-5.043141	-4.918242	-4.992508
2	276.3910	2.988441	0.000374	-5.054038	-4.904159	-4.993279
3	279.5129	5.835298*	0.000359*	-5.093699*	-4.918841*	-5.022814*
4	279.8334	0.593120	0.000364	-5.080999	-4.881161	-4.999987
5	280.6524	1.500252	0.000365	-5.077616	-4.852798	-4.986478
6	281.6465	1.802340	0.000365	-5.077505	-4.827708	-4.976240
7	282.8486	2.156970	0.000364	-5.081282	-4.806505	-4.969891

TABLE C17: Lag Selection for South Africa (lpsc)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	221.6854	NA	0.000963	-4.107271	-4.006764	-4.066535
1	294.1410	138.0759*	0.000250*	-5.455491*	-5.329857*	-5.404571*
2	294.8587	1.354145	0.000252	-5.450165	-5.299404	-5.389060
3	295.1666	0.575133	0.000255	-5.437106	-5.261219	-5.365818
4	295.2291	0.115525	0.000259	-5.419417	-5.218403	-5.337945
5	295.4517	0.407355	0.000263	-5.404749	-5.178608	-5.313092
6	295.8045	0.639075	0.000267	-5.392538	-5.141270	-5.290697
7	297.3395	2.751464	0.000264	-5.402633	-5.126238	-5.290608
8	299.4633	3.766611	0.000258	-5.423835	-5.122314	-5.301627

TABLE C18: Lag Selection for South Africa (lspi)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	45.74059	NA	0.026638	-0.787558	-0.687051	-0.746822
1	130.8992	162.2835	0.005444	-2.375457	-2.249824	-2.324537
2	133.4625	4.836314*	0.005286*	-2.404953*	-2.254192*	-2.343849*
3	134.4473	1.839589	0.005288	-2.404666	-2.228779	-2.333378
4	135.0057	1.032462	0.005333	-2.396334	-2.195320	-2.314862
5	135.0954	0.164186	0.005426	-2.379159	-2.153017	-2.287502
6	135.8942	1.446902	0.005447	-2.375363	-2.124095	-2.273522
7	135.9092	0.026820	0.005550	-2.356777	-2.080382	-2.244753
8	136.2773	0.652824	0.005618	-2.344854	-2.043333	-2.222646

TABLE C19: Lag Selection for UK (lgdp)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	134.9186	NA	0.004952	-2.470163	-2.369656	-2.429427
1	411.9897	528.0034	2.71e-05	-7.679051	-7.553417	-7.628131
2	427.0210	28.36091	2.08e-05	-7.943792	-7.793032*	-7.882688
3	427.0211	0.000162	2.12e-05	-7.924926	-7.749039	-7.853638
4	431.1056	7.552563*	2.00e-05*	-7.983125*	-7.782111	-7.901653*
5	431.2613	0.284822	2.03e-05	-7.967193	-7.741052	-7.875537
6	432.0403	1.411141	2.04e-05	-7.963025	-7.711757	-7.861185
7	432.1099	0.124763	2.08e-05	-7.945470	-7.669076	-7.833446
8	432.7298	1.099455	2.09e-05	-7.938299	-7.636777	-7.816090

TABLE C20: Lag Selection for UK (lbms)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	114.6659	NA	0.007256	-2.088036	-1.987529	-2.047300
1	277.9190	311.1050*	0.000340	-5.149416	-5.023782*	-5.098496*
2	279.0761	2.183043	0.000339*	-5.152379*	-5.001618	-5.091274
3	279.7990	1.350438	0.000341	-5.147151	-4.971264	-5.075863
4	280.6525	1.578131	0.000342	-5.144387	-4.943373	-5.062915
5	281.9089	2.299523	0.000340	-5.149225	-4.923084	-5.057569
6	282.0723	0.295948	0.000345	-5.133440	-4.882172	-5.031600
7	282.1492	0.137745	0.000352	-5.116022	-4.839628	-5.003998
8	282.9144	1.357214	0.000353	-5.111593	-4.810071	-4.989384

TABLE C21: Lag Selection for UK (lpsc)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	137.8519	NA	0.004685	-2.525507	-2.425000	-2.484771
1	302.9371	314.5963	0.000212	-5.621454	-5.495821*	-5.570534
2	305.1361	4.149054	0.000207	-5.644077	-5.493316	-5.582973
3	305.2703	0.250712	0.000211	-5.627742	-5.451854	-5.556453
4	309.3567	7.555889*	0.000199*	-5.685975*	-5.484960	-5.604502*
5	309.3607	0.007330	0.000203	-5.667182	-5.441041	-5.575526
6	309.3629	0.004032	0.000206	-5.648356	-5.397088	-5.546516
7	309.3784	0.027790	0.000210	-5.629781	-5.353386	-5.517757
8	310.0400	1.173453	0.000212	-5.623396	-5.321875	-5.501188

TABLE C22: Lag Selection for UK (lspi)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	52.19975	NA	0.023582	-0.909429	-0.808922	-0.868693
1	160.3709	206.1374	0.003122	-2.931526	-2.805892	-2.880606
2	166.3544	11.28969*	0.002842*	-3.025555*	-2.874794*	-2.964451*
3	166.3554	0.001756	0.002896	-3.006705	-2.830817	-2.935417
4	166.3939	0.071305	0.002949	-2.988564	-2.787550	-2.907092
5	166.5784	0.337582	0.002996	-2.973177	-2.747036	-2.881521
6	166.7874	0.378635	0.003041	-2.958253	-2.706985	-2.856413
7	166.9761	0.338307	0.003088	-2.942946	-2.666551	-2.830922
8	167.0063	0.053450	0.003146	-2.924647	-2.623125	-2.802439

TABLE C23: Lag Selection for USA (lgdp)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	215.1081	NA	0.001091	-3.983171	-3.882664	-3.942435
1	413.0727	377.2533*	2.65e-05*	-7.699484*	-7.573850*	-7.648564*
2	413.2392	0.314175	2.70e-05	-7.683758	-7.532997	-7.622654
3	413.4942	0.476431	2.73e-05	-7.669703	-7.493815	-7.598414
4	414.4430	1.754360	2.74e-05	-7.668736	-7.467722	-7.587264
5	415.2617	1.498256	2.75e-05	-7.665314	-7.439173	-7.573658
6	416.8208	2.824051	2.72e-05	-7.675864	-7.424596	-7.574023
7	416.9055	0.151863	2.77e-05	-7.658594	-7.382200	-7.546570
8	417.4248	0.921083	2.79e-05	-7.649525	-7.348004	-7.527317

TABLE C24: Lag Selection for USA (lbms)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	199.0488	NA	0.001477	-3.680166	-3.579658	-3.639429
1	339.8410	268.3021	0.000106	-6.317754	-6.192120	-6.266834
2	358.1598	34.56393*	7.62e-05*	-6.644525*	-6.493765*	-6.583421*
3	358.1777	0.033348	7.76e-05	-6.625994	-6.450107	-6.554706
4	358.1864	0.016028	7.91e-05	-6.607290	-6.406276	-6.525818
5	358.2137	0.050043	8.06e-05	-6.588938	-6.362797	-6.497282
6	358.5142	0.544280	8.17e-05	-6.575739	-6.324472	-6.473899
7	358.5198	0.010111	8.32e-05	-6.556978	-6.280583	-6.444954
8	358.5686	0.086452	8.47e-05	-6.539030	-6.237508	-6.416821

TABLE C25: Lag Selection for USA (lpsc)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	214.8994	NA	0.001095	-3.979233	-3.878726	-3.938497
1	351.2682	259.8728	8.51e-05	-6.533363	-6.407729*	-6.482443
2	352.7651	2.824163	8.44e-05	-6.542737	-6.391976	-6.481633
3	354.5553	3.344063	8.31e-05	-6.557647	-6.381760	-6.486359
4	354.5752	0.036710	8.47e-05	-6.539154	-6.338140	-6.457682
5	357.7812	5.867571*	8.12e-05*	-6.580777*	-6.354635	-6.489120*
6	358.0559	0.497694	8.24e-05	-6.567093	-6.315825	-6.465253
7	358.4485	0.703704	8.33e-05	-6.555632	-6.279238	-6.443608
8	358.8793	0.763950	8.42e-05	-6.544892	-6.243370	-6.422683

TABLE C26: Lag Selection for USA (lspi)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	98.82044	NA	0.009785	-1.789065	-1.688558	-1.748329
1	162.9644	122.2367	0.002973	-2.980461	-2.854827	-2.929541
2	168.4702	10.38815*	0.002731*	-3.065475*	-2.914714*	-3.004371*
3	169.1058	1.187351	0.002750	-3.058600	-2.882713	-2.987312
4	169.1609	0.101815	0.002799	-3.040771	-2.839757	-2.959299
5	169.2628	0.186590	0.002848	-3.023827	-2.797686	-2.932171
6	169.4122	0.270540	0.002894	-3.007777	-2.756509	-2.905937
7	169.4561	0.078785	0.002947	-2.989738	-2.713344	-2.877714
8	169.4776	0.038136	0.003003	-2.971276	-2.669755	-2.849068

Chapter 5

Conclusion

This thesis contributes to our understanding of how different policy actions transmitted to the real economy in varied contexts. The three self-contained chapters construct three different models and analyse implications of monetary policy, fiscal policy and financial development shocks on macroeconomic variables in context of developing, emerging and developed countries.

The first chapter investigates the monetary policy transmission mechanism in Bangladesh during the floating exchange rates regime. In addition, the chapter analyses the impact of exchange rate and oil price shocks on macroeconomic variables. A vector error correction model is constructed to find the long run relationship between the variables. The estimated model finds that the responses of macroeconomic variables to monetary policy shock are free of both price puzzle and liquidity puzzle. Besides this, the monetary policy shock has significant impact on inflation, but very small effect on output. However, both interest rate and exchange rate channels play an important role to transmit the shock in the real economy of Bangladesh. So, the existing monetary policy framework in Bangladesh can efficiently influence the price level, not the output. Besides this, external shocks are also playing a significant role in the movement of domestic macroeconomic variables.

The second chapter examines the macroeconomic impacts of fiscal policy in 10 European Union member countries under the same monetary regime. The chapter studies an important policy question if expansionary fiscal policy is really effective to stabilize

the economies. If yes, the question is to what extent and how it differs between countries in the Euro-zone. However, the chapter studies the effect of government spending and tax shocks on macroeconomic variables on the countries separately and compare the differences in impact across countries. Besides this, the chapter estimates the size and sign of fiscal multipliers and compares them. A structural VAR model is employed to estimate the model using quarterly time series data in Austria, Belgium, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Portugal, and Spain. The estimated model finds that a positive government spending shock has expansionary macroeconomic effects in Finland and France and contractionary effects in Austria, Belgium, Germany, Netherlands, Portugal and Spain. In addition, the increase in government spending does not produce significant effects on aggregate output in Ireland and Luxembourg. Besides this, an increase in government tax revenues has permanent recessionary effects for Belgium, Finland, France and Germany as output decreases due to a fiscal shock. In addition, government tax revenue shock has a non-Keynesian effect on Luxembourg, Ireland, Netherlands and Portugal. Fiscal policy shock using tax revenue remain almost unresponsive in Spain and Austria. In addition, the estimated fiscal multipliers are ranges between 0 to 1 on impact and negative for high debt countries.

Considering the policy importance to know the numerous channels through which financial development transmitted to real economy the third chapter analyses the nexus between financial development and economic growth for five different countries. To find the short-run and long-run relationship between the variables an auto-regressive distributed lag model is estimated using quarterly time series data for Australia, China, South Africa, the UK and the USA. The results suggest that market based financial intermediaries have significant long-run impact on economic growth in Australia and the USA, while both bank-based and market-based financial indicators have long-run impact on economic growth in China, South Africa and the UK. The paper also finds the existence of a unidirectional causality between financial development and economic growth for Australia, China, South Africa and the USA and bidirectional causality in the UK. Besides this, the financial shock transmitted to real economy using different channels across

countries, depending on the financial structure of the countries. The financial shock transmitted through stock market only in Australia and the USA, whereas the financial shock transmitted through banks only in South Africa. On the other hand, both the banks and stock market play active role in China and the UK to transmit the shock of financial sector to real economy.

In general, the findings of this thesis have significant policy implications for macroeconomic policy makers. It recommends that both monetary policy and fiscal policy play important roles in the determination of the price level and output. This finding also suggests that the policy authorities should contemplate applying a model that obviously account for both monetary and fiscal stances. Besides this, the financial sector should be strong enough to pass these policy actions effectively to the economy.

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