TWIN DEFICIT AND CAPITAL MOBILITY UNDER DIFFERENT MONETARY POLICY REGIMES

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Abstract

The relationship between the government budget and the current account deficits has been explained to depend on the degree of capital mobility, exchange rate regimes and other important factors. One factor that has not received much attention is how different monetary policy regimes may affect the relationship through their effects on the transmission mechanism between the two deficits. We consider the theoretical bases for analyzing the twin deficit hypothesis within an IS-MP model as an alternative to the conventional IS-LM-BP model and the predictions of the models are tested using empirical data. Using, Canada, the U.K. and the U.S., we found that rules-based monetary policy, particularly inflation targeting, improves capital mobility and changes the relationship between the government budget deficit and the current account deficit. The changes however, we identify to be dependent on how well the policy rule is able to control the effects of inflation expectations.

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CHAPTER ONE

1. INTRODUCTION

Issues on the twin deficit hypothesis are vast both in theory and empirical research, creating a lot of debate both in academia and policy recommendations. The major concerns range from the transmission mechanisms and channels for the connection between budget deficits and current account deficits, to whether they are even related at all. The concept of the twin deficit hypothesis therefore brings out some relationships between economic variables like budget deficits, interest rates, exchange rates, inflation rates and current account deficits. The major connections that have received attention are the relationship between budget deficits and market interest rates; between trade deficits and exchange rates; between market interest rates and exchange rates; and between the central bank (policies) and twin deficits (Chen, 2007). These are attempts to deconstruct the twin deficit hypothesis and identify firmer grounds to prove its existence directly and indirectly through theory and empirical work as well understanding its dynamics under different policy alternatives.

How these variables are viewed, their linkages and how they may translate from one deficit to another have been done through the general equilibrium framework represented by the IS-LM model for a closed economy and the IS-LM-BP analytical framework for an open economy. The IS-LM framework is analyzed on the grounds that there exists an equilibrium in both the goods and money markets resulting from changes in interest rates and real income, culminating in one equilibrium for both parts of the economy. Shifts in the LM curve are the result of monetary policies that change money stock to effect changes in real output while fiscal policy is represented by shifts in the IS curve.

In analyzing the linkages between the variables aforementioned and policies in such a model, reference has been made to the degree of capital mobility affecting the effectiveness of monetary and fiscal policies. Pierdzioch (2002) for instance notes from the implication of the Mundell-Fleming model that monetary expansion brings about a depreciation of the exchange rate and stimulates aggregate demand when there is a flexible exchange rate system and capital is mobile internationally.

Miller and Russek (1989) also noted the significance of capital mobility in analyzing the effects of fiscal policy. To them, the effect of fiscal policy depends on various factors including major ones like the exchange rate, degree of capital mobility and the size of the country. They hint that the importance of these factors is inevitable in the analysis to the point where the literature (using the Mundell-Fleming model) often assumes high capital mobility and a country too small to affect world interest rates. Whenever these conditions are not satisfied, the short-run linkages are weakened.

Moreover, inflation and inflation expectations have been noted as important in affecting the outcome of fiscal policy and how the given policy can affect important variables such as the current account. Policy advocates have placed much weight on the cost of inflation and expectations in ways that make them feature greatly in modern policy debates. It has been argued that if high inflation is costly, and monetary policy can only have lasting effects on the rate of inflation (Ragan, 2005), inflation control should be the primary objective of monetary policy.

Modern economies do not conduct monetary policy in a manner that uses monetary aggregates to effect changes in output any longer, thus the LM curve fails to typify monetary policy. The important change in the conduct of monetary policy is that most central banks, including the Bank of Canada and the U.S. Federal Reserve, now pay little attention to monetary aggregates in conducting policy. Monetary policy is rule-based with most central banks following a real interest rate rule to check inflation and real GDP growth (such as the Taylor rule). The introduction of the MP curve as representative of monetary policy that is rule-based and more consistent has become inevitable (Romer, 2000).

The conduct of monetary policy that adheres to the use of tools and targets affects the twin deficit hypothesis in theory, in that monetary policy uses some of the variables affecting the deficits as policy tools and targets, hence can “artificially” check and suppress their association to ensure economic stability. In as much as an endogenous fiscal policy characterized by high fiscal discipline can prevent persistent external imbalances from arising, regardless of the monetary policy rule adopted by the Central Bank (Di Giorgio and Nisticò, 2007), effective monetary policy may short-circuit the channels through which one deficit translates into another.

On these premises, any form of distortion in the relationship between the channeling variables may also change the nature of the relationship between the twin deficits. Any effective monetary policy that checks changes in interest rates and inflation (even exchange rates) from responding to budget deficits, may as well be effective in checking the effects of the budget deficit on the current account. Rules-based monetary policy affects interest rates and in modern times has been used in Canada, New Zealand and Australia and others to stabilize interest rates through their quest to stabilize inflation. Though such policies do not directly affect exchange rates, the central banks are capable of influencing them through currency markets (Goodfriend, 2002). An independent monetary policy is not possible in a fixed exchange rate regime, so we restrict our attention to historical periods of flexible exchange rates for our empirical work.

The relationship between budget deficits and current account deficits needs to be reconsidered both in theory and empirical study, taking into consideration the monetary policy regimes that have existed in the countries studied here. This will help expand the knowledge on the mechanics of the twin deficit hypothesis, both in theory and empirically, as well as provide a form of assessment of the various monetary policy regimes that have operated under a flexible exchange rate regime.

We show empirically that capital mobility improves and the relationship between the two deficits changes as monetary policy is changed from discretionary to those guided rules. This is because, the transparency attribute of the latter makes it more credible, thus more able to deal with expectations and by that boost investor confidence. In Canada, inflation targeting as a monetary policy improves capital mobility and established a bi-directional relationship between the government budget balance and the current account balance. We found no relationship between them in the period when monetary policy was discretionary. However, we find that the conventional causality from the government budget balance to the current account balance in the period of discretionary monetary policy was short-circuited in the U.K. and changed to a reverse causality in the U.S. when monetary policy became those guided by rules.

1.1. BACKGROUND

The relationships between budget deficits and current account deficits in theoretical and empirical studies seem to display different behavior depending on whether one is considering short-run (Corsetti and Müller, 2006) or long run frequencies (Fidrmuc, 2003; Holmes, 2011) of time. This has led to many conflicting results. Florio and Ghiani (2015) ascribe these conflicting results to threshold effects behind both the long-run relationship and short-run dynamics or to structural breaks and regime shifts.

The nature of the two deficits and their relationship have been argued to depend upon factors such as the exchange rate regime, the degree of capital mobility and the size of the economy. It has been observed that the transmission mechanism of the twin deficits can vary across different exchange rate regimes (Leachman and Francis, 2002). Miller and Russek (1989) suggest that the twin deficits have no long-run relationship under flexible exchange rates. Abell (1991) has also emphasized the role of interest rates as the transmission mechanism connecting the two deficits. Other factors including the underlying tax system, trade patterns and barriers, and a complex host of internal and international forces that shape a country's economic status in the global setting (Nargelecekenler and Giray, 2013) may also affect how the two deficits may be related. Corsetti and Muller (2006) also point out that twin deficit hypothesis depends on how the economy is opened to trade and the persistence of the budget deficit.

A key factor that has not received much attention is the effect of monetary policies on the twin deficits through its effects on transmission mechanisms (interest rates, real GDP growth and inflation). Sims (1992) argues that responses to innovations (which include innovations of monetary policy) generate timing patterns that are at least partly immune to the effects of differencing, so that these innovations have persistent effects. Monetary policy innovations may affect the relationship between the two deficits when such policies target variables such as real output, inflation, interest rates and exchange rates that act as the connection between the two deficits. In this sense, whether monetary policy is "rule-based, more predictable and more systematic" or "discretionary, less predictable and more ad hoc" (Taylor, 2012) affects how increases in the government fiscal deficit may affect interest rates, exchange rates and output and how it may translate into the current account deficit.

Within the IS-LM-BP framework how an economy is linked to the international financial markets is critical in determining the strength of the twin-deficit hypothesis following a new monetary policy regime. Capital mobility and its effects on policy has been emphasized in the literature to illuminate its importance to policy. Lately, capital mobility has been thought of as being reflected in the behavior of the current account balance. Dooley *et al* (1987), define international capital mobility as the condition under which expected differentials in yields on physical capital in different countries are eliminated by net saving flows, as conventionally measured by current account imbalances.

In the IS-LM-BP model, the effectiveness of fiscal and monetary policies is determined by the degree of capital mobility. From this, how the government budget deficit will translate into the current account deficit will have much to do with the degree of capital mobility. A legitimate question that arises concerning capital mobility is whether it is resistant to the new monetary policy culture introduced by many advanced economies. If the monetary policy is based on rules to stabilize interest rates and inflation, among other important variables, then capital flows of an economy may also be modified one way or the other in response to, if not the policy itself, to the changes it brings to these variables.

Rules-based monetary policy typically includes expectations that has been cited as the prowess of this policy and the main idea behind its success in many economies.

Successfully modelling policy around inflations expectations affects the relationship between nominal and real variables, changing the responses of other economic actors to particular policies that ensue. Fiscal policy may have a Ricardian equivalence effect because of inflation expectations, among other factors. In that light, if monetary policy is able to stabilize inflation expectations, then the effect of fiscal policy may be different from outcomes argued by the Ricardian equivalence hypothesis.

The relationship between the government budget deficit and the current account deficit (the twin deficit hypothesis) may also have changed due to the effect of the new monetary policy regime on the degree of capital mobility, given that capital mobility determines the relationship between them. We now turn to a theoretical analysis of how this could work.

1.2. PROBLEM STATEMENT

The twin deficit hypothesis has been analyzed in the Mundell-Fleming framework using the IS-LM-BP model, with the assumption that monetary policy (represented by the LM curve) is discretionary and sets the quantity of money as the policy tool. The monetary sector is said to be in equilibrium when the demand for money is just equal to monetary balances for a particular level of output and interest rate. The locus of points of all interest rates and output levels that ensure equilibrium in the money market is the LM curve. In this model, monetary policy is used to increase output and employment partly through a resulting decrease in the rate of interest that stimulates consumption and investment spending. In the same way, the IS curve portrays all combinations of interest rates and output levels that ensure that the goods market is in equilibrium, expressed in the form of the equality between income and aggregate demand. A government policy to increase its spending is represented by a rightward shift in the IS curve that results in higher output and a higher interest rate.

The theoretical analysis of the twin deficit hypothesis carried out within the IS-LM-BP framework is done holding monetary policy (money supply) constant. By maintaining the monetary equilibrium, increases in the government deficit (higher spending not matched by an equal increase in tax collections) will eventually cause the current account to deteriorate. Higher income results in higher imports creating a trade deficit in the current account. The exchange rate appreciates or depreciates in a flexible exchange rate regime depending on how mobile capital is.

The notion of the monetary equilibrium condition has been criticized by Mundell (1965) as misleading. To him, the monetary equilibrium as represented by the LM curve is not stable because positive investment spending at the equilibrium implies a growing capital stock and rising output which requires a falling price level or an increasing interest rates to ensure monetary equilibrium. Hence a shift in the IS curve generates shifts in the LM curve that persist for some time.

In modern times, most advanced countries have moved away from discretionary monetary policy that is easily represented by shifts in the LM-curve. Such economies have refocused monetary policy towards controlling inflation by keeping inflation figures and variability to the barest minimum. Monetary policy is conducted by setting a short-run interest rate that captures the policy targets such as inflation and output growth. Conducting monetary policy in such a manner significantly affects the theoretical analysis carried out within the Mundell-Fleming Model.

The changes in monetary policy regimes within advance economies have called into question the predicted effects on key macroeconomic variables using the IS-LM-BP framework. Seccareccia and Sharpe (1994) find no evidence that rising Canadian government deficits have increased interest rates, inflation or exchange rates, while Foster (1994) and Smithin (1994) find no evidence that U.S. government deficits have raised interest rates or inflation. These findings are quite contrary to the predictions of the IS-LM-BP model and could be due to the move to rules-based monetary policy regimes.

It might be the case that rules-based policies targeted to stabilize these variables will break or at least reduce the linkages between the twin deficits since the transmission channels cannot work. In the Keynesian absorption theory espoused in the Mundell-Fleming model, an increase in the budget deficit will induce an increase in domestic absorption (domestic consumption and investment expenditure exceeds national output), hence import demand, causing an increase or a worsening of the current account deficit. Emphasis here is laid on the effects of income growth on import demand with secondary effects through interest rates. It is clear that the original Taylor rule that guides monetary policies of modern economies uses interest rates to stabilize inflation and income growth, so rules-based monetary regimes are incompatible with the standard Mundell-Fleming explanation of the twin deficit hypothesis.

Empirically, the effects of ignoring structural breaks in studies, especially in tests for causality relations, have been highlighted in recent times. Lutkepohl (1989) has demonstrated that Granger causality tests may provide quite incorrect inferences about causality relations in the presence of structural changes. He argues that, because the test is carried out under the assumption of parameter constancy, the linearity assumption in the regression equations of the VAR system can lead to the estimation of a mis-specified model.

The IS-LM framework has recently been replaced with the IS-MP model where the monetary policy is rules-based instead of some assumed monetary equilibrium. The analysis of the twin deficits should therefore be carried out in the IS-MP framework when monetary policy is rules-based in order to assess the theoretical variable linkages within modern monetary policy regimes. The predictions of the theory can then be tested empirically to estimate how the two deficits are related by considering countries that have adopted monetary policy rules at some time during the sample period, particularly inflation targeting. The monetary policy change from “black-box” discretionary policies aimed at fine-tuning the economy to clear, consistent and transparent policies following a specified rule may change the behavior of some of the variables that are affected by the policy.

1.3. RESEARCH QUESTIONS AND OBJECTIVES

We intend to explore the dynamics of the twin deficit hypothesis in relation to different monetary policy regimes and the connected idea of capital mobility. These illuminate two basic questions, forming the objectives that this study will undertake.

We intend to answer the question on whether the relationship between the current account balance and the budget deficit differs under different monetary policy regimes. This question is relevant firstly in light of the change in monetary policy culture of modern economies from discretionary to those that are guided by rules. This change affects important variables that helps connect the two deficits, hence at a cursory glance may seem to suggest that, the relationship may differ one way or the other.

In the literature, the relationship between these two deficits has received much attention in various respects, and suggesting different explanations for the different results arrived. Theoretically, some have tried to explore it in a “classical open economy” model (Mankiw 2002, chap. 5), while others have used micro-founded overlapping generations models (Obstfeld and Rogoff 1995,). Others have linked the differences in results to the intertemporal explanations of the current account behavior (Bagnai,2006)[1]; differences in exchange rate regimes (Leachman and Francis, 2002); components of government spending[2], and structural breaks, among others.

In addressing the issue of structural breaks, the methodology used in the literature has relied on either having an a priori argument regarding the time of the break (Leachman and Francis, 2002; Fidrmuc, 2003) or by relying on econometric testing for identifying the date of the structural change (Hatemi and Shukur, 2002; Bagnai, 2006). In whatever method is applied, the argument behind the structural change will still be subject to the interpretation of the author. One of the important structural breaks that we see relevant to the subject of the government budget deficit and the current account deficit is the monetary policy regime. This to our knowledge has not received much attention. In this regard, we intend

[1] Normandin (1999) for instance shows that the degree of persistence of the budget deficit affects the strength of the twin deficits relation while Kraay and Ventura (2002), show that the relation between national savings shocks and current account behavior is much stronger in the long than in the short run.

[2] This argument has more to do with how increase in government expenditure affects the exchange rate and later the current account balance. In theory generally, it is seen that, fiscal expansion will result in a real appreciation if skewed toward non-tradable goods be it tax or debt financed (Moreno Badia and Segura-Ubiergo, 2014). Much of the disagreement comes in with public investment, which several authors have expressed mixed relations (Balassa, 1964; and Samuelson, 1964; Galstyan and Lane, 2009; Chatterjee and Mursagulov, 2012).

to fill this gap by attempting to answer the question of whether different monetary policy regimes affect how the two deficits are related.

The analysis of the twin deficit hypothesis has also been done having capital mobility implicitly or explicitly assumed. This is because the current account deficit and the government budget deficit are seen to be connected through interaction among changes of internal and external macroeconomic variables. As Bagnai (2006) puts it, the two deficits cannot be twin without capital mobility. If we simply express the current account as the excess of national savings over investment (S-I), we see two sources of financial capital implicitly; internal source and external source. When a country's investment exceeds its domestic savings, the excess must be financed from the international capital market.

From this perspective, how the government budget deficit will translate into the current account deficit depends on the degree of capital mobility of the economy. This further implies that any given structural change that affects the degree of capital mobility will help explain the differences in how the two deficits may be related and vice versa.

It is true that several studies might have considered capital mobility in relation to fiscal and monetary policies. We see this as relevant regarding the measurement and testing procedure and its relation to the twin deficit hypothesis. The definition of capital mobility in the context of the Feldstein-Horioka criterion has been linked with time series data analysis following the nature of savings-investments relation and how these variables behave with time, hence we employ time series methods here to measure capital mobility.

We test for a unit root on the current account deficit so we can deduce whether the economy is opened to the international financial market. Previous studies have overlooked the effects of structural changes due to monetary policy innovations in their tests and analyses. Our unit root tests provide a more accurate inference of whether a given economy is integrated to the international capital markets.

1.4. RELEVANCE OF STUDY

Current account deterioration and increased external debt have become very important in recent times and has made the notion of current account sustainability gain policy significance in the context of recent episodes of macro-economic turbulence (Chinn and Prasad, 2003, p. 48). Miller and Russek (1989) argue that large trade deficits imply a transfer of wealth to foreigners and possibly a reduction in the living standards of future generations and imposing a burden on future generations (Hakro, 2009). Large current account deficits have also been considered as one of the main factors causing major currency crashes (Sebastian, 2000) and their associated problems. Budget deficits and current account deficits are argued to have the tendency of damaging the foreign exchange markets and causing high real interest rates, crises in international financial markets and low savings rates (Daly and Siddiki, 2009; Barro, 1989).

It is therefore natural for policy makers to treat the current account as an important macroeconomic indicator of policy decisions and the measurement of the economic performance in any open economy (Salop and Spitaller, 1980). Hence, studies into the dynamics of the current account and how various policies affect it and external debt is quite imperative. The linkages between fiscal policy and the current account stance have therefore been widely explored. Introducing how monetary policy may affect the linkages earlier mentioned is also equally important especially in this era where monetary policy is rule-based, targeting some very important variables acting as transmission channels.

The interconnections among various policies and these variables are quite complex and need erudite studies that will be well informing to policies. Di Giorgio and Nisticò (2007) identify that any attempt by monetary policy alone to stabilize the dynamics of net foreign assets (NFA) would imply excessive volatility of the exchange rate, inflation and output. This excessive volatility in these variables may translate into the external balance and cause external debt to increase. Understanding the relationship between the fiscal deficit and the current account balance under different exchange rate and monetary policy regimes will assist policy makers to efficiently manage deficit financing and external debt. The possibility for policy-makers to influence the current account through fiscal adjustments depends on the Granger-causality (Florio and Ghiani, 2015), given how important variables such as the interest rate, exchange rate, inflation and output respond to particular exchange rate and monetary policies.

Moreover, for reasons of justifying monetary policy rules, considering these deficits under such monetary policy rules and comparing these results with former regimes will be a useful tool in policy recommendations. For example, if variables such as inflation and interest rates are stabilized by the use of monetary rules, then increases in budget deficits may not translate into current account deficits. The effect may at least be reduced if other transmission channels are assumed.

Chen (2007) points out that a better understanding of the effects of the monetary policy on the twin deficits is important in informing the government on how to manage deficit financing more efficiently and help the trade industry and international capital market better utilize interest rate information. Studies of this nature is necessary in policy recommendations regarding government fiscal policy and how it affects the external balance of the economy.

Murphy (1984) identifies the importance of capital mobility and its implications on economic issues and policies. To him, analyses of the current account and the exchange rate to questions about tax incidence and optimal saving have so much to do with the extent to which capital moves across national boundaries. Therefore, analyzing capital mobility, and its relation to policy is very relevant to inform policy choices.

Theories have shown the importance of capital mobility in assessing the effectiveness of fiscal and monetary policies, but how the degree of capital mobility may be affected by such policies (reverse causation) have not received much attention. If capital mobility is important in determining policy, then it is imperative to consider how it may also change depending on policy choices. This study investigates capital mobility as defined by theories and estimate how monetary policy guided by rules may alter a country's connection with the world capital markets.

This thesis will add to the existing literature on the impact of fiscal expansion on the current account. The existing theoretical and empirical literature dealing with the impact of budget deficits on trade deficits is inconclusive (Ghatak and Ghatak, 1996; Ricciuti, 2003). These conflicting results could be ascribed to threshold effects behind both the long-run relationship and short-run dynamics caused by structural breaks and regime shifts (Florio and Ghiani, 2015) that are highly conditional on country and econometric technique employed. Undertaking a study of such kind on countries with specific monetary policy tradition will extend the understanding of the specifics of the twin deficit.

In recent times, the twin deficit has been identified to be subject to structural breaks. However, considering the twin deficit hypothesis with structural breaks in monetary policy regimes has not been explored. Structural changes attributed to exchange rate regime swaps and changes in the structure of the economy have been identified and their impacts on the twin deficit have been investigated. However, the structural changes imposed by changes in the monetary policy regimes are yet to receive much attention. This study will help fill in that gap. The empirical study of the twin deficit under this new framework will help inform how different the two deficits may be related when monetary policy is conducted under different regimes as way of confirming what theory will predict.

1.5 THESIS ORGANIZATION

The remainder of the thesis is organized as follows. Chapter Two discusses relevant literature related to the topic. The discussion focuses on the twin-deficit hypothesis as opposed to the Ricardian equivalence hypothesis both in theory and empirical studies to ascertain how different works have attained different results and explained the results from different perspectives. The chapter also discusses some of the linkages between the current account deficit and the government budget deficit by way of considering the relevant factors that may enhance or short-circuit the relationships between the two deficits.

The theoretical and empirical models are developed in Chapter Three. The IS-MP model with different assumptions are developed in addition to the IS-LM-BP model to help conceptualize the relationship between the two deficits. The empirical model that underscores the twin-deficit hypothesis is developed through an aggregate demand framework. Moreover, the econometric estimation techniques as well as the data used for carrying out the study will be discussed in this same chapter.

In Chapter Four, the estimation results and findings will be discussed. Results will include the unit root tests, cointegration tests, as well as causality tests between the two deficits. Chapter Five will discuss the meaning and implications of the results found in Chapter Four. Chapter Six will offer policy recommendations derived from the study and suggest further areas of study. Moreover, the chapter will provide a summary and conclusion to end the study.

CHAPTER TWO

2. LITERATURE REVIEW

The twin deficit hypothesis and the Ricardian equivalence hypothesis have received wide attention in the economics literature. The two hypotheses are very much related. Put simply, if Ricardian equivalence holds, fiscal policy will have no effect on income growth and the twin deficit hypothesis will fail. The twin deficit hypothesis states that fiscal deficit worsens the current account balance of an economy through its impacts on interest rate and exchange rate (Fleming, 1962; Mundell, 1963).

The Ricardian equivalence hypothesis however argues that changes in government expenditure or changes in taxes have no real effects (Barro, 1989). Per the theory explaining the Ricardian equivalence hypothesis, government purchases and marginal tax rates matter, but the debt/tax mix is irrelevant (Seater, 1993). Underpinned by the permanent income hypothesis, the proponents of the Ricardian Equivalence hypothesis contend that, individuals will expect their tax obligations to change depending on government current spending in relation to its tax revenue and will therefore change their savings to meet future changes in taxes.

Some studies have also identified significant relationships between the fiscal deficit and the trade balance which are quite different from the postulation of the twin deficit hypothesis. There have been studies finding a feedback relation between the government budget deficit and current account deficit; whereas others identify reverse causality from the current account deficit to the government budget deficit.

Analysis of the twin deficits hypothesis with its transmission mechanism is specified in the Mundel-Fleming model, explaining that budget deficit through the conduit of the exchange rate, ends up deteriorating the current account balance. According to Smyth and Hsing (1995), trade deficits are caused by budget deficits through higher interest rates, that appreciates the exchange rate, which then widens the trade deficits.

Summers (1988) has referred to the reverse causality as current account targeting and suggests that fiscal policy could be used for some form of external adjustments. To Kearney and Monadjami (1990) however, reverse causality from trade to budget deficits can come about if there is a change in the expectations of inflation. Kim and Kim (2006) also explain this relationship as being the reactions to recession resulting from excessive trade deficits and its possible effect of a financial or solvency crisis in which a large injection of public funds may be needed to rehabilitate the struggling financial sector or to minimize the severity of a recession. Empirical works by Kearney and Monadjami (1990), Anoruo and Ramchander (1998) and Khalid and Teo (1999) identify such a relationship between the two deficits.

Other studies have identified a two-way direction between the fiscal deficit and current account deficit. This directional analysis has been expressed as “feedback” or bilateral relation. Islam’s (1998) Granger causality test revealed that there is a bilateral relation in Brazil. In tests performed on both developed and developing countries, Kouassi, Mougoue, and Kymn (2004) found a “feedback” relation between the deficits for Thailand.

The empirical works on the relationship between the two deficits are numerous and cannot agree on any one form of relationship. Some papers have refuted the causality between the fiscal and current account deficits [Laney (1984); Miller and Russek (1989), Dewald and

Ulan (1990), Enders and Lee (1990), Kim (1995), Bartlett (1999)], while others still argue about the direction of causality between the two. Darrat (1988); Abell (1990); Zietz and Pemberton (1990) and Bachman (1992) have supported the twin deficits hypothesis one way or the other, establishing that there are close linkages between the two deficits. Evans (1988), Miller and Russek (1989), Dewold and Ulan (1990), Enders and Lee (1990) and Kim (1995), maintain that there are no clear linkages between the two.

Kim and Roubini (2003) and Corsetti and Müller (2006) apply structural VAR techniques and find a "twin divergence" in the U.S. deficits. To them, a positive shock to the budget deficit/GDP ratio typically causes a significant improvement in the current account/GDP ratio. Monacelli and Perotti (2006) using the same VAR technique find evidence to support the twin-deficit hypothesis in the U.S., against the earlier findings of Kouassi *et al.* (2004). Bernheim (1988) investigated the budget deficit and balance of trade relationship for the U.S. and its five major trading partners, using yearly data for period from 1960 to 1984 in an OLS regression with current account surplus as an endogenous variable. After taking into account different shocks to the economies, particularly, the change in exchange rate regime after 1972, oil shocks and the large U.S. budget deficit that emerged after 1982, he identified that for the U.S., Canada, the U.K. and West Germany, a $1 increase in the budget deficit was associated with a $0.30 decline in the current account surplus. Applying causality tests using annual time series data from 1950 to 1994 for developed countries, Khalid and Guan (1999) found that rising budget deficits in developed countries caused a surge in the current account deficit in the U.S., France and Canada. They particularly identified that there is some weak support for bi-directional causality in the case of Canada.

Indirect methods of assessing the possible linkages between the two deficits have been considered by considering the strengths of the transmission mechanisms between them. This is done by analyzing how an increase in the government deficit may affect the exchange rate and how changes in the exchange rate affect the current account balance of a country. On theoretical bases of the Keynesian and real business cycle models, the former relationship has been considered by scholars like Corsetti and Pesenti (2001); Kollman (2010); Monacelli and Perotti (2010); Ravn, Schmitt- Grohe, and Uribe (2012).

Traditionally, the relationship between the exchange rate and the trade balance has been explained by the elasticity approach (Robinson, 1947; Metzler, 1948; Krueger, 1983), monetarist approach (Mundell, 1971; Dornbusch, 1973; Frenkel and Rodriguez, 1975) and the absorption approach (Laffer, 1977; Himarios, 1989). Some empirical works identify an exchange rate depreciation to have a positive impact on trade balances in the pattern of the J-curve [Gupta-Kapoor and Ramakrishnan (1999); Marcus Noland (1989) on the Japanese economy; Moffett (1989), Rose and Yellen (1989), Rose (1991), Marwah and Klein (1996), Shirvani and Wilbratte (1997), and Marquez (1991) on the U.S. economy; and Bahmani-Oskooee and Tatchawan Kantipong (2001) on Thailand]. Others still maintain that there is no relationship between the two (Rose (1991), Rose and Yellen (1989)). Marwah and Klein (1996) estimated that the impact of depreciation on the trade balances of the U.S. and Canada followed an S-pattern.

Various explanations have been put forth as reasons for these contradictory empirical findings regarding the twin deficit hypothesis and other related relationships explaining the transmission mechanisms. Some authors have distinguished between the components of government spending and have estimated the segregated impact of the components.

Moreno Badia and Segura-Ubiergo (2014) found that a fiscal expansion will result in a real appreciation if skewed toward non-tradable goods, be it tax or debt financed. Corsetti and Muller (2006) argue that the effect of an increase in the government budget deficit on the current account depends on how open the economy is to trade and how persistent the increase in the deficit is. They suggest that fiscal expansions have no effect on the trade balance and thus on the current account if the economy is not very open to trade and if fiscal shocks are not too persistent.

The conflicting results have also been attributed to the differences in the empirical methods, data measurement and sample set (Rosenweig and Tallman, 1993). Others still account the different results to the different relationships between the two deficits and the transmission mechanisms through which they are connected. Leachman and Francis (2002) argued that the transmission mechanism of twin deficits varies across exchange rate regimes. Miller and Russek (1989) observe that under fixed exchange rates, a fiscal stimulus generates higher real income or prices that worsens the trade deficit, while under flexible exchange rates a fiscal stimulus also worsens the trade deficit through an appreciation of the currency. Florio and Ghiani (2015) suggest that these conflicting results could be ascribable to threshold effects behind both the long-run relationship and short-run dynamics, or to structural breaks and regime shifts. These results suggest that any research to investigate the twin deficit hypothesis must take into consideration the various possible structural breaks that may affect the relationship. Fidrmuc (2003) studied the twin-deficit hypothesis in a sample of 18 OECD and transition economies by applying the Johansen (1988) cointegration test to quarterly data from 1970 to 2001. Conditional on a structural break in 1989, he showed that in a large number of countries, cointegration does not hold in the second subsample, suggesting no long-run relationship between the two deficits. In a cross-section setting, Obstfeld and Rogoff (1995) reached a similar result.

Daly and Siddiki (2009) studied 23 OECD countries and found that the admission of regime shifts substantially influences the empirical conclusions, finding a long-run relationship between budget deficits, real interest rates and current account deficits in 13 out of 23 countries, whereas the number of countries with apparent long-run relationships is dramatically reduced when regime shifts are not permitted.

Theoretical analyses of the twin deficit hypothesis have been carried out using the rudiments of the IS-LM-BP framework with the LM curve representing monetary policy. The IS-LM model augmented by the Phillips curve has been described as the best way to interpret discussions of economic policy in the press and among policy makers (Mankiw, 1990, p.1645) and also as the core practical macroeconomic tool that should be used (Solow, 1997; Blanchard, 1997 and Blinder (1997). Revier (2000) argues that the IS-LM model provides a useful framework in which to examine the determinants of the effectiveness of monetary and fiscal policy in generating a short-run change in the equilibrium level of GDP and so should form an important part of the economics curriculum in schools. Empirical work on the U.S. by Gali (1992) and Ahmed (2005) for India have results that support the predictions of the IS-LM-BP model.

It is generally acknowledged by the literature that the international mobility of capital plays a key role for the effectiveness (or not) of monetary policy (and fiscal policy) in open economies, as measured in terms of its short-run effects on output (Pierdzioch, 2002). The importance of capital mobility in the analysis of the twin deficit hypothesis within the IS-LM-BP framework cannot be neglected. Mundell (1963) highlights the theoretical and practical implications of capital mobility by looking at the extremely high degree of mobility that prevails when a country cannot maintain an interest rate different from the general prevailing abroad. Monetary policy then derives its importance as a domestic stabilizer from its influence on capital flows and the exchange rate. Fiscal policy is frustrated in its effects by these same considerations, making capital mobility very relevant in terms of how potent fiscal and monetary policies could be. In simple terms, within a flexible exchange rate system where capital is mobile internationally, a monetary expansion brings about a depreciation of the exchange-rate and, thereby, stimulates aggregate demand (Pierdzioch, 2002). Hence monetary policy is preferred to fiscal policy as a stimulative policy tool.

Sutherland (1996) and Senay (2000) have argued that this key result of the Mundell-Fleming analysis in principle also holds if one uses a modern micro-founded dynamic monetary general equilibrium macroeconomic model to study the output effects of monetary policy in open economies. The slopes of the IS and LM (that of BP as well) are very significant within the model in determining the effectiveness of fiscal and monetary policies, whether looking at the graphical exposition (Hall and Taylor, 1997; Revier, 2000) or demonstration through multivariate calculus (Dornbusch *et al*, 1998). The slope of the BP curve in relation to the slope of the LM has been used to portray the degree of capital mobility within the IS-LM-BP model[3]. Branson (1988) suggested that the increase in financial market integration since the 1970's had flattened the BP curve of the U.S., so that it had been flatter than the LM curve in the 1980's.

[3] See the third edition of Branson's text book; Macroeconomic Theory and Policy, p.423.

Changes in interest rates and exchange rates in relation to the two deficits have also been used to explain how open the capital market of an economy is to the rest of the world. Fountas and Tsoukis (2000) explain that the real interest rate may also be particularly important as an indicator of degree of openness. They argue that in a small open economy, the real interest rate is exogenous and therefore the long-run causality is expected to run from it to the current account; while in a large economy, the loanable funds market clears and the real interest rate is determined by the current account deficit.

Tang (2013) suggests that, the response of domestic investment and the trade balance to budget deficits depends on the degree of capital mobility and the exchange rate regime. Capital inflows put upward pressure on the real exchange rate, either through a nominal exchange rate appreciation or a rising domestic price level. Either way, the appreciation of the real exchange rate, as a result of a budget deficit, further contributes to the adverse trade balance (Miller & Russek, 1989, pp. 97-98). In this sense, once capital remains mobile, the exchange rate will be affected by an increase in the government budget deficit, which will help translate into a current account deficit.

Four different definitions have been employed to measure capital mobility; the covered interest parity, the uncovered interest parity, the real interest parity and the Feldstein-Horioka condition.[4] In recent years, measuring capital mobility has been linked to unit root tests of the current account balance. This connection was deduced from the work of Feldstein and Horioka (1980) on capital mobility that called for much attention of the subject matter in the economic literature[5]. The finding of their paper culminated in the

[4] See the work of Frankel (1992) for more details.

[5] For recent review see Coakley *et al*. (2003).

Feldstein and Horioka (1980) puzzle which is based on the idea that with international capital mobility, a shortfall in savings should not affect investment spending in a country since borrowing from international capital markets will make up for the shortfall. This implies that if changes in savings are accompanied by equivalent changes in investment spending, then the country is relatively closed to international capital movements.

Researchers began looking at the relationship between investment spending and savings by running regressions for the equation;

$$I/Y = \alpha + \beta\, S/Y + e \quad \text{...}(2.1)$$

In (2.1) I/Y is the investment spending to GDP ratio, S/Y is savings to GDP ratio and e is the error term. α and β are the regression coefficients.

A regression of the investment rate on the saving rate which yields a parameter value (β) which is statistically not different from one suggests international capital immobility. Feldstein and Horioka (1980) found β not statistically different from one using data for a group of OECD countries spanning from 1960 to 1974 and concluded that world capital markets are far from perfectly mobile. Several criticisms have been levelled against this result on statistical and theoretical grounds[6].

A number of studies committed to analyze this puzzle through empirical research after Feldstein (1983) extended the time period to 1960-1979, and showed that there is no significant change in the earlier results. Most of these studies used data on OECD countries confirming the results of Feldstein and Horioka (1980), with some marginally deviating

[6] See Dooley *et al*. (1987) and Sinn (1991).

from their results especially when the time periods were expanded. The works of Obstfeld (1986), Tesar (1991), Penati and Doley (1984), Leachman (1991), Sinn (1992) and Coakley *et al* (1994) are examples.

Gundlach and Sinn (1992) related the assessment of capital mobility to unit root tests of the current account balance of a country. They reasoned that if the ratio of the current account balance to GDP is found to be integrated of order one ($I(1)$), the existence of a stable long-term relationship between the saving and investment rates is unlikely. Therefore, inferences based on such a specification may be regarded as spurious. In that sense a country is necessarily linked to the international capital market if its current account balance is found to be $I(1)$.

The basis for the unit root method is that many theoretical studies [Obstfeld (1986), Murphy (1986), Cardia (1988), Tesar (1988), Baxter and Crucini (1990), and Leachman (1991)] suggest that over time both saving and investment rates are influenced by the same exogenous variables. Most of these authors identify business cycles as an exogenous source that might cause saving and investment rates to move in the same direction. This implies that saving and investment rates could be integrated and the current account balance would have to be $I(0)$ even if the country is linked to the international capital market, given that the current account balance is the difference between savings and investment spending.

The IS-LM-BP model under different degrees of capital mobility has had a substantial influence on policy makers and academics and remains a vital didactic element of most macroeconomic texts (Ahmed, 2005) amidst the various criticisms levelled against it. To Darity and Young (2004), the IS-LM-BP and its Mundell-Fleming variant came to “rule the roost” because it provided a mathematical and geometric framework for both policy analysis and pedagogy. They argued that these qualities were lacking in the earlier models that attempted to consider both internal and external equilibrium.[7]

The IS-LM-BP framework has been criticized as lacking microeconomic foundations, assumes price stickiness, has no role for expectations, and simplifies the economy's complexities to a handful of crude aggregate relationships. Colander (1995) has demonstrated that the framework is logically inconsistent, Mundell (1965) sees it as quite misleading and Walsh (2001) has criticized that it is not well suited for an analysis of inflation targeting. Romer (2000) has shown that it is unable to deal with a monetary policy that uses the interest rate as its operating target. To him, the tactical choices of the model reduces its merits, making some aspects of it difficult, inconsistent and unrealistic.

Inflation expectations have also been emphasized in the literature as an important phenomenon when analyzing policy. Failing to make recourse to inflation expectations has been argued as one of the flaws the IS-LM-BP model. Marimon and Sunder (1995) argued that the actual dynamics of an economy are the product of a complex interaction between the underlying stability properties of economic models and agents' behavior. In Friedman's proposals (1948, 1960) for economic stability, the relationship between economic policies and expectations is crucial for promoting economic stability. The role expectations play in policy have been explained from diverse positions in theory; some on assessing whether the intended outcomes of a given policy will be met or not; and to others in modern times,

[7] There were earlier attempts to look at both internal and external equilibrium like the Swan-Salter-Meade-Corden framework, the Polak-IMF framework and the Johnsonian-monetary approach framework. For more on the evolution of the open economy model, see Young, W., & Darity, W. A. (2004).

the ability of policy to drive expectations to particular ways to influence some economic variables.

Eggertson (2008) argues that policies designed to generate inflation expectations helped recovery from the Great Depression. On the other hand, Romer and Romer (2013) believe that it was monetary-policy-induced deflation expectations that caused the Great Depression in the first place. From this angle, whether expectations are to be considered as direct targets of policy or wheels on which to attain the long-term goals of policy, or considered as important economic phenomenon that can affect the efficacy of policy, there is common agreement that they matter in policy choices.

Higher inflation expectations might be capable of lowering real interest rates and stimulating interest-sensitive components of aggregate demand. Higher inflation expectations mean expected wealth gains for debtors and to the extent that debtors have on average higher propensities to spend out of wealth than creditors, increased inflation expectations might lead to higher current aggregate spending (Bachmann *et al*., 2015). In light of the importance of inflation expectations in policy, Feldstein (2002) introduced the notion of "unconventional" fiscal policy during liquidity traps, arguing that tax-induced inflation would give households an incentive to spend sooner rather than waiting until prices are substantially higher.

Others have argued that fiscal policy is typically only effective with a lag and can result in permanent deficits with higher nominal interest rates. Fiscal policy involving temporary tax cuts might result in low fiscal multipliers due to a high marginal propensity to save out of temporary tax cuts (D'Acunto *et al*., 2016). From this, there have been arguments to turn to the use of monetary policy. Krugman (1998), Eggertson and Woodford (2003), and Eggertson (2006) have advocated for central banks to promise higher future inflation as a means of expansionary policy during periods in which nominal interest rates have hit their lower bound. Farmer (2012) believes that the recent unconventional monetary policy operations have kept inflation expectations higher and that this constituted a successful stabilization policy in the wake of the 2008 crisis.

Bachmann *et al*. (2015) suggest that inflation functions as a tax on the holders of cash and other highly liquid assets and therefore a tax on economic activity. In that regard, higher expected inflation might depress spending by functioning like a tax. In response to this, there seem to be a universal acceptance that the mechanism to deal with inflation expectations should be left to monetary policy. Moreover, policy should rather aim to stabilize inflation expectations rather than steer them to particular ways.

Monetary policy in practice is gradually moving away from policy actions determined by the "discretion of authorities instructed to follow the right policy at the tight time for the right objective" to those "determined by relatively mechanical rules that are publicly promulgated" (Friedman, 1982, p. 100). Taylor (2011) suggested that following monetary policies at the discretion of authorities leads to economic performance that is decidedly worse. He argued that the American economy was remarkably stable from the mid-1980s until the early mid-2000s when monetary policy was rule-based, more predictable and more systematic.

Romer (2000) replaces the IS-LM model with the IS-MP model where the LM curve that determines the interest rate with an interest elastic money demand and an exogenously given (real) money stock is replaced with the MP curve which describes the interest rate setting of the monetary authority (Betz, 2015). The monetary policy assumed in this new model is that based on rules, particularly the interest rate rule by Taylor (1993). A real interest rate rule acts to make the real interest rate behave in a certain way as a function of macroeconomic variables such as inflation and output (Romer, 2000)[8].

Analyzing the twin deficit taking into consideration the structural changes that may have been imposed by the change in monetary policy regimes has yet to receive attention. In theory, policy effects have been modelled using the new framework of the IS-MP model (Romer, 2000; Betz, 2015). However formal consideration of the twin deficit within the framework is not profound within the literature.

[8] In most developed countries, real interest rates are used as policy instruments. For instance, in the US, the Federal Reserve uses the federal funds rate to target inflation and output. In Canada, the overnight rate is used to target inflation.

CHAPTER THREE

3. MODEL SPECIFICATION AND ECONOMETRICS METHODOLOGY

3.1. THEORETICAL MODEL

3.1.1. THE IS-LM-BP MODEL

In the Mundell-Fleming model (Figure 3.1), the linkage between the trade deficit and the budget deficit is clear. Increasing the budget deficit increases real income (Y) and the interest rate (r), which then increases imports and reduces exports because the local currency appreciates, hence deteriorating the current account. These two effects widen the trade deficits (Smyth and Hsing, 1995).

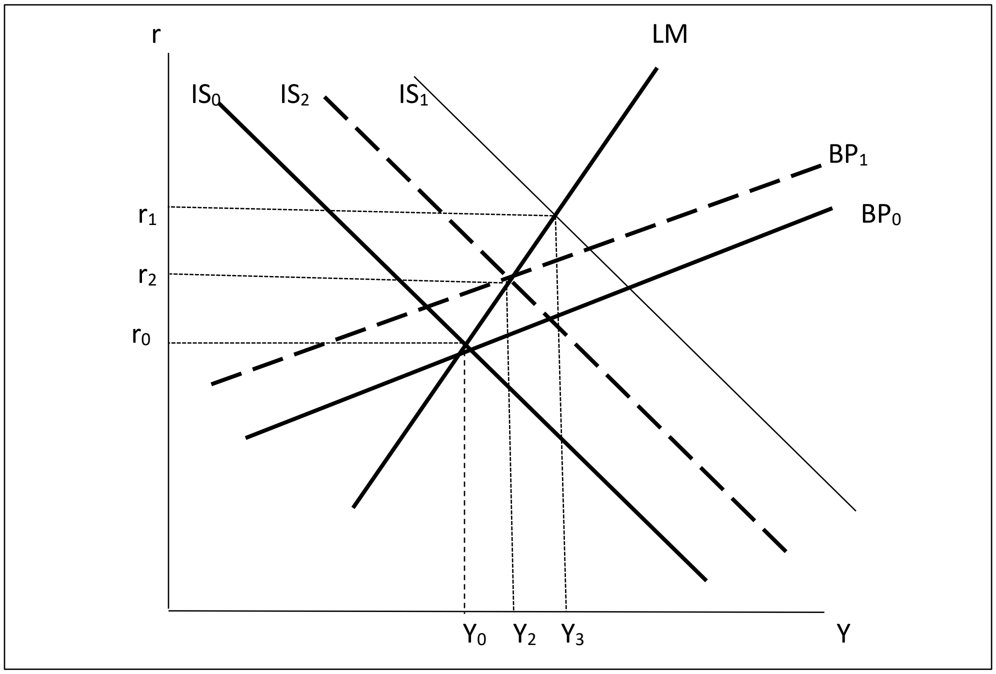


Figure 3.1: Mundell-Fleming Model in an IS-LM-BP diagram.
Fiscal expansion causes the IS curve to shift from IS_0 to IS_1. At the new intersection of IS and LM, income has increased, increasing imports and a trade deficit. The new internal equilibrium creates BOP surplus at higher interest rate. This means capital inflow will occur which causes the local currency to appreciate. Appreciation of the exchange rate shifts the IS curve to the left (lower net exports) and the BP curve to the left until all 3 curves intersect. The current account is further deteriorated by the appreciation of the local currency.

3.1.2 THE IS-MP MODEL

The analysis using the IS-MP model is different. The analysis is carried out considering monetary policy to follow a rule. Taylor (1993) suggested that monetary policy should follow a rule of the inform;

$$i_t = r_t^* + \emptyset_\pi(\pi_t - \pi_t^*) + \emptyset_y(y_t - y_t^*) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

In (3.1) i_t is a target short-term nominal interest rate like the federal funds rate in the U.S. or the overnight rate in Canada and r_t^* is the real interest rate. π_t^* and y_t^* are the targets of inflation and output respectively. π_t and y_t are the inflation and output measurements for a particular time period. $\emptyset_\pi$ and $\emptyset_y$ are the adjustment coefficients determined by the weight placed on the individual deviations from the policy targets. Taylor suggested that they should be 1.5 and 0.5 respectively and that π_t^* should be 2%.

From equation 3.1, the rule specifies that any deviation of inflation and/or output from target will cause the nominal interest rate to change. Components of the rule is determined by the objectives of the policy rule, so it has been suggested that exchange rate target could be added to stabilize exchange rates. In typical inflation targeting, the coefficient of adjustment for deviations in output is zero in equation 3.1, so that output deviations have no effect on the nominal interest rate.

This rule is criticized on grounds that it is not forward looking and has been developed to include expectations so that the rule is specified as;

$$i_t = r_t^* + \emptyset_\pi(E_t\pi_{t+1} - \pi_t^*) + \emptyset_y(E_t y_{t+1} - y_t^*) \ldots\ldots(3.2)$$

In (3.2) E_t is the conditional expectation of the variables formed in period *t* regarding their respective future values.

In a rules-based regime that targets only the inflation rate, the MP curve is completely elastic because $\emptyset_y$ is equated to zero. The MP curve will adjust upwards for any expectation of higher inflation. The targeting rule and the extent of the deviation of expected inflation from the optimal inflation will determine the magnitude of the shift.

In carrying out the analyses of the effects of a fiscal stimulus under inflation targeting, there are two main cases that we consider. The first case is if fiscal expansion causes output to increase but still below full employment and the second case is if output increases beyond full employment.

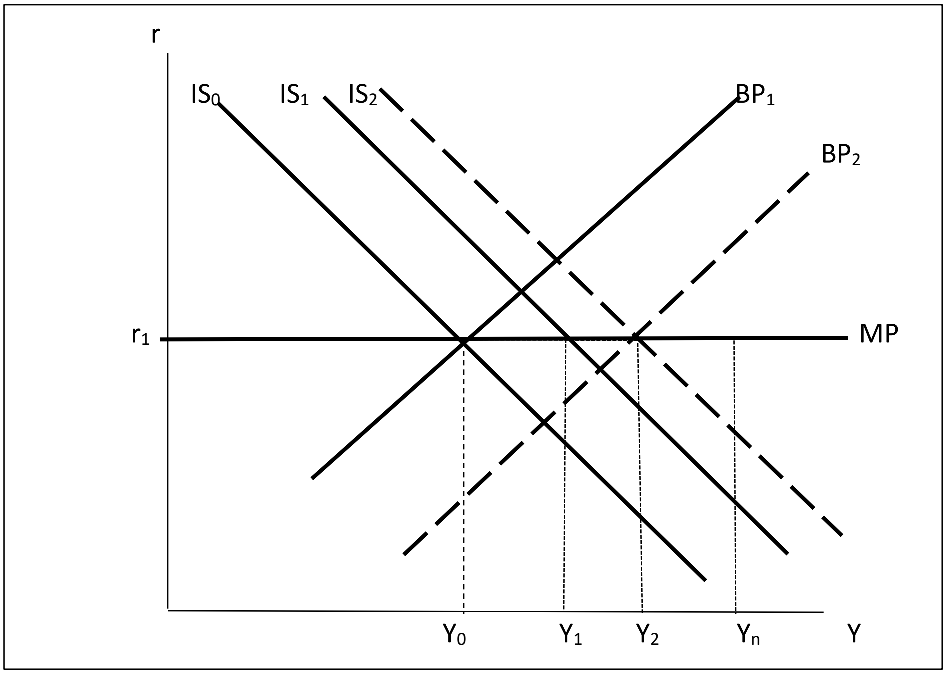


Figure 3.2: IS-MP diagram when policy targets only inflation, assuming increased output as a result of fiscal expansion does not exceed full employment out.

Fiscal expansion causes the IS curve to shift from IS_0 to IS_1. Though output increases, it is still below full employment Y_n, and so MP remains unchanged since there is no inflationary pressure. At the new intersection of IS and MP, income has increased, increasing imports and a trade deficit, while the interest rate is too low to be on the BP curve. This means capital inflow will occur, but not enough to maintain BP = 0, so BP < 0. The exchange rate then depreciates, shifting the IS curve to the right (higher exports) and the BP curve to the right until all 3 curves intersect. The current account is likely to improve because much effect on current account from the depreciation needs to be greater than in Figure 3.1 to ensure external balance.

3.1.2.1 IS-MP Model: when policy targets only inflation, assuming increased output as a result of fiscal expansion is below full employment output

In this case, the increased output being less than full employment output implies that monetary policy will not change, thus, the MP curve remains unchanged. The increased output will have a negative effect on net exports and put pressure on the local currency to depreciate. Depreciation will improve net exports and current account. In such a situation, current account is likely to improve as seen in Figure 3.2.

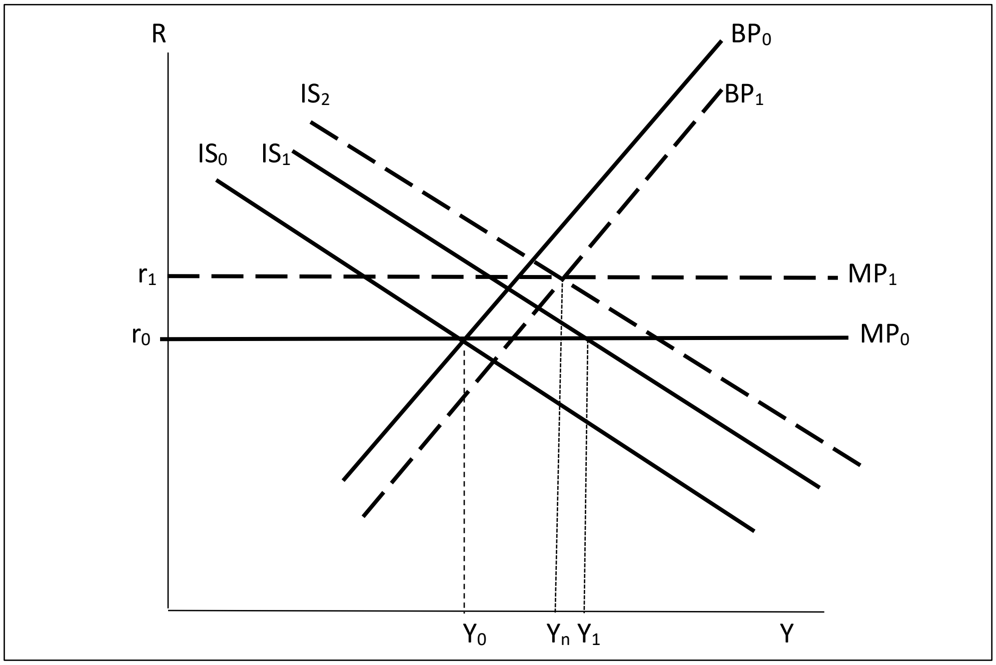


Figure 3.3: IS-MP diagram when policy targets only inflation, assuming increased output as a result of fiscal expansion exceeds full employment out (*"BOP deficit" effect dominates greatly)***.

Fiscal expansion causes the IS curve to shift from IS_0 to IS_1. At the new intersection of IS and MP, income has increased, increasing imports and a trade deficit, while the interest rate is too low to be on the BP curve. This means capital inflow will occur, but not enough to maintain BP = 0, so BP < 0. Inflationary pressures generated by the increased income causes adjustment of the monetary policy so that MP curves shifts upwards. Because the "BOP effect dominates greatly, the exchange rate depreciates, shifting the IS curve to the further right from IS_1 to IS_2 (higher exports) and the BP curve to the right from BP_0 to BP_1 until all 3 curves intersect. The current account is likely to improve.

3.1.2.2 IS-MP Model: when policy targets only inflation, assuming increased output as a result of fiscal expansion exceeds full employment output

With a fiscal stimulus, output increases more than full employment output creating inflationary pressure. The inflation pressure causes adjustment in the monetary policy so that MP curve shift upwards. These results of the fiscal expansion have three effects.

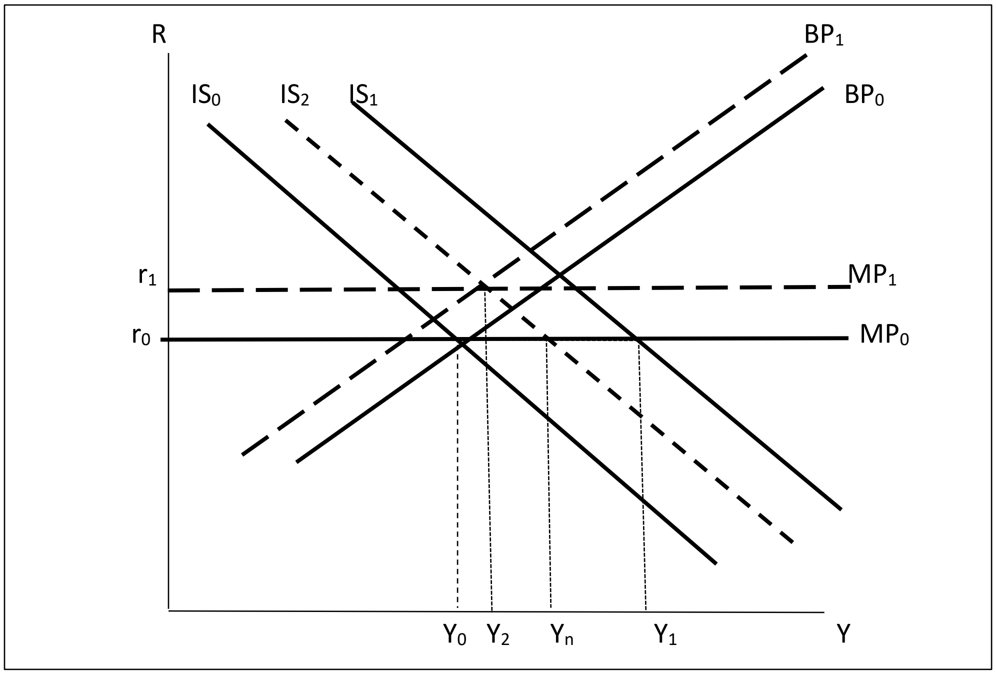


Figure 3.4: IS-MP diagram when policy targets only inflation, assuming increased output as a result of fiscal expansion exceeds full employment out (*"Reaction monetary policy" effect dominates)*.

Fiscal expansion causes the IS curve to shift from IS_0 to IS_1. At the new intersection of IS and MP, income has increased, increasing imports and a trade deficit, while the interest rate is too low to be on the BP curve. This means capital inflow will occur, but not enough to maintain BP = 0, so BP < 0. Inflationary pressures generated by the increase income causes adjustment of the monetary policy so that MP curves shifts upwards. The "reaction monetary policy" effect dominates, causing the exchange rate to appreciate. Resulting fall in net exports reinforced by "increased income" effect shifts the IS curve to the left from IS_1 to IS_2 and the BP curve to the left from BP_0 to BP_1 until all 3 curves intersect. The current account is likely to deteriorate.

A. "Increased income" effect

The increased income will cause imports to increase which causes deterioration in the current account. The increase in import also reduces aggregate demand in the domestic economy.

B. "Reaction monetary policy" effect

The inflationary pressure resulting from increasing government expenditure will cause the monetary policy to be adjusted upwards, from MP_0 to MP_1. The effect of this adjustment is an increase in the interest rate that puts pressure on investment spending to fall and on the currency to appreciate.

C. “BOP deficit” effect

Since the new internal equilibrium occurs below the BP curve, there is a BOP deficit which creates pressure on the local currency to depreciate.

Therefore, the currency will either depreciate or appreciate depending on which of the two latter effects dominates. If we assume a greater effect from currency depreciation because “BOP deficit” effect dominates greatly, then net exports increase shifting both the IS curve from IS_1 to IS_2 and BP curve from BP_0 to BP_1 as in Figure 3.3. Under such circumstance, the current account improves.

On the other hand, if the appreciation pressure from the “reaction monetary policy” dominates, the currency appreciates causing net exports to fall. In this case, the reduction in the current account from the “increased income” effect is reinforced by this effect causing the current account to deteriorate more, as in Figure 3.4. This results in the IS curve to shift from IS_1 to IS_2 and the BP curve from BP_0 to BP_1.

3.2. EMPIRICAL MODEL

The theoretical foundation of the twin deficit hypothesis arises from a national income accounting definition of an open economy.

$$Y^n = C + I + G + X - M + NFI \qquad (3.2.1)$$

In (3.2.1) Y^n, C, I and G are national income, private consumption, investment spending and government expenditure respectively. (X-M) represents the difference between exports and imports and NFI is net foreign income.

The current account is the sum of X-M and NFI;

$$CA = (X - M) + NFI \qquad (3.2.2)$$

$$Y^n = C + I + G + CA \qquad (3.2.3)$$

Solving for CA from equation (3.2.3);

$$CA = Y^n - C - I - G \qquad (3.2.4)$$

Total saving within the economy (S^T) is the sum of private savings (S^p) and government savings (S^g = T-G, where T= tax collections), which in turn is national income less consumption and government expenditure.

$$S^T = S^p + S^g = Y^n - C - G \qquad (3.2.5)$$

Substituting (3.2.5) into (3.2.4)

$$CA = (S^p + S^g) - I \qquad (3.2.6)$$

$$CA = (S^p - I) + S^g \qquad (3.2.7)$$

To Feldstein and Horioka (1980), if private savings and investment are strongly correlated, the budget deficit (S^g) and the current account deficit will tend to move together, supporting the twin-deficits hypothesis. Private savings (S^p) is normally considered to be a stationary variable and not cointegrated with CA and I; so, to capture the effects of capital mobility (Florio and Ghiani, 2015), current studies use the model;

$$CA_t = \beta_0 + \beta_1 BB_t + \beta_2 INV_t + \varepsilon_t \qquad (3.2.8)$$

In (3.2.8) CA, BB and INV are the current account balance, the government budget balance and investment spending respectively and ε is the error term. We express CA, BB and INV as ratios of GDP, thus the model to be used will be,

$$ca = \beta_0 + \beta_1 bb_t + \beta_2 inv_t + e_t \qquad (3.2.9)$$

The lower case show the variables expressed as ratios of GDP, e_t is timewise heteroscedastic (non-constant variance) error term. The error term is heteroscedastic because GDP is changing over time.

From equation (3.2.9), we expect $\beta_1 > 0$, and $\beta_2 < 0$ to be consistent with the twin deficit hypothesis. Increasing the budget deficit and increasing investment spending causes the current account deficit to fall according to (3.2.6).

3.3. ESTIMATION TECHNIQUES

3.3.1. UNIT ROOT TESTS

In addition to the standard Augmented Dickey-Fuller (ADF) test that assumes no structural breaks, the Perron (1989) unit root test will also be used in the presence of structural breaks. Gregory *et al*. (1996) have shown that the power of the conventional ADF test falls sharply in the presence of a structural break. The additional test assumes an exogenous structural break to test if changes in the monetary regimes have impacts on the structure of the economy. This approach is related to the Zivot and Andrews (1992) test that uses three models to test for a unit root: shift in the intercept, shift in the slope, and shift in both the intercept and slope. The Perron (1997) test however differs from the Zivot and Andrews (1992) test by the inclusion of a one-time shock dummy variable. Again, the Zivot and Andrews (1992) test chooses the breakpoint where the t-statistic for the hypothesis test $\alpha=1$ is minimized or where the t-statistic on the change on the slope on the break term is the minimum. We however assume an a priori breakpoint at the time when monetary policy is changed from discretionary to those guided by rules.

To avoid power loss, we will use the model with a shift in both intercept and slope. Sen (2003) has shown that using the other models when the break is as in this model will result in greater power loss than when this model is used and the break is in the form of the others. The regression model can therefore be written as;

$$y_t = \gamma + \alpha y_{t-1} + \beta t + \theta DU_t + \mu DT_t + \sum_{j=1}^{k} \rho_i \Delta y_{t-j} + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.3.1)$$

In (3.3.1) Δ is the first difference operator, DU and DT are indicator dummy variables for the mean and trend shift, respectively; DU = 1 and DT= t – TB if t > TB; 0 otherwise. TB denotes the time at which the structural break occurs. The date of a structural break will be exogenously determined a priori based on the time of the change in the monetary policy regime. Finally t= 1,…,T denotes an index of time, and e_t is a white noise disturbance. The lag length will be determined using the Akaike Information Criterion (AIC)[9]. The asymptotic distribution of the minimum t-statistic and critical values are provided by Perron (1992).

The unit root test will not only be useful in the cointegration analysis, but as mentioned earlier, will help evaluate the degree of capital mobility of the economies being considered.

3.3.2 COINTEGRATION ANALYSES

The long-run relation between the budget deficit and the current account deficit (as well as investment spending) will be tested using the cointegration estimator proposed by Gregory

[9] See more on the information criteria from appendix A.

and Hansen (1996), which tests the null hypothesis of non-cointegration against the alternative of cointegration in the presence of a structural break.

We define the standard model (Model 1) for the testing the twin deficit (in general) as;

<u>Model 1:</u>

$y_t = \mu_1 + \alpha_1 x_t + \alpha_2 z_t + e_t , \ t = 1, 2, 3, \dots n$……………………………………(3.3.2)

In (3.3.2) y_t is the dependent variable and x_t and z_t are the explanatory variables. Engle and Granger (1987) describe cointegration as a useful model for long run equilibrium. Tests for cointegration that follow Engle and Granger (1987) presume that the cointegrating vector is time-invariant (Daly and Siddiki, 2009). However, structural breaks may alter the equilibrium such that there are new long run relationships. Figures 3.5 to 3.7, suggest that the cointegrating vector may not be time invariant. Gregory and Hansen (1996) define a dummy variable that will introduce the structural break;

$$\varphi_{t\tau} = \begin{cases} 0, & if\ t \leq [n\,\tau] \\ 1, & if\ t > [n\,\tau] \end{cases}$$

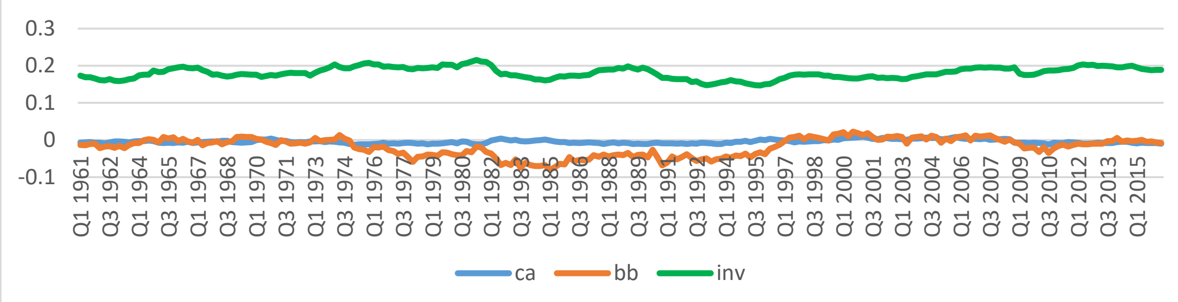
The unknown parameter $\tau \in (0, 1)$ denotes the (relative) timing of the change point, and [ ] denotes the integer part.

They propose three models to capture the structural changes;

Model 2: Level shift

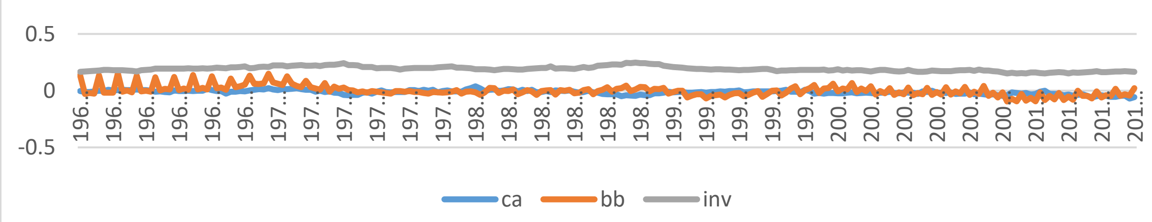
$$y_t = \mu_1 + \mu_2\varphi_{t\tau} + \alpha_1 x_t + \alpha_2 z_t + e_t \,, \; t = 1, 2, 3, \ldots n \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3.3)$$

Figure 3.5- Canadian Federal government budget and Trade balances and investment (1961-2015)



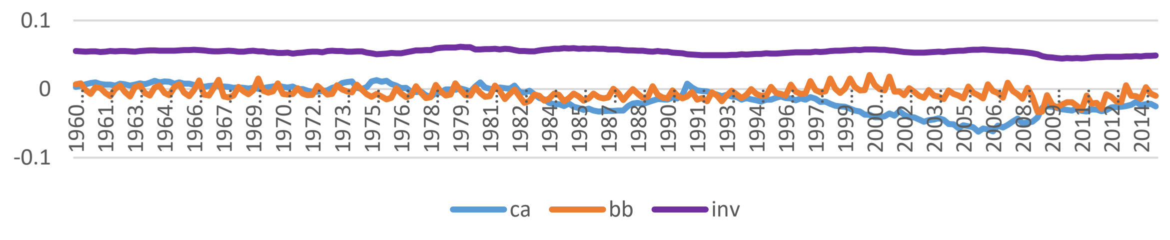
Source: Statistics Canada. The series include the government budget balance (bb), the current account balance (ca) and investment spending (inv) all expressed as ratio to GDP from 1961Q1 to 2016Q2 obtained from CANSIM databased.

Figure 3.6- UK government budget and Trade balances and investment (1960-2016)



Source: Office of National Statistics. The series include the government budget balance (bb), the current account balance (ca) and investment spending (inv) all expressed as ratio to GDP from 1960Q1 to 2016Q1.

Figure 3.7- Federal and Trade balances and investment (1960-2014)



Source: Federal Reserve Bank of St. Louis. The series include the government budget balance (bb), the current account balance (ca) and investment spending (inv) all expressed as ratio to GDP from 1961Q1 to 2014Q4.

This is the simplest case of a parallel shift of the equilibrium equation. Here μ_1 denotes the intercept before the shift and $\mu_1 + \mu_2$ denotes the intercept at the time of the shift.

Model 3: Level shift with trend

$$y_t = \mu_1 + \mu_2\varphi_{t\tau} + \beta t + \alpha_1 x_t + \alpha_2 z_t + e_t \,, \; t = 1, 2, 3, \dots n \ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.3.4)$$

In this model, a time trend is added to allow for the possibility of the series to be trend-stationary.

Model 4: Regime shift

$$y_t = \mu_1 + \mu_2\varphi_{t\tau} + \beta t + \alpha_1 x_t + \alpha_2 z_t + \alpha_3\varphi_{t\tau}x_t + \alpha_4\varphi_{t\tau}z_t + e_t \,, \; t = 1, 2, 3, \dots n \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.3.5)$$

This model of regime shift allows the equilibrium relation to rotate as well as shift in a parallel fashion. Here α_1 represents the cointegrating coefficients before the regime shift and α_3 represents the change in the slope after the regime shift. In Model 1, the null hypothesis will be tested by estimating (3.3.2) with OLS and testing for a unit root of the regression errors. Failure to reject a unit root suggest that a cointegrating relationship is found. With knowledge on the time of the regime shift (in terms of shift in monetary policy regimes), the same procedure will be used for testing the additional models by construction of the φ vector.

The test statistic used is ADF^*, which is the cointegrating ADF statistic calculated using the OLS residuals in the estimates of Models 2, 3 and 4. The critical values for these models are provided by Perron (1996). For Model 1, the modified Mackinnon (1991) critical values are used instead of the critical values used in the Engle and Granger method.

3.3.3 CAUSALITY ANALYSES

We estimate the causality between the budget deficit, current account deficit and investment spending to study the short-run relationships between them. Many tests of Granger-type causality have been advanced and used to test the direction of causality between economic variables; Granger (1969), Sims (1972) and Gweke *et al* (1983), which are based on null hypotheses formulated as no restrictions on the coefficients of the lags of a subset of the variables.

The usual strategy used in testing economic hypothesis about time-series variables are conditioned on the estimation of a unit root, a cointegrating rank and a cointegrating vector(s). For instance, Sims test is used when the series have unit roots but are not cointegrated, while the Engle and Granger (1987) test is based on an error-correction model

(ECM) that is useful if the series are cointegrated. Toda and Yamamoto (1995) suggest that these tests may suffer from severe pre-test biases. The power of the various unit root tests is known to be very low against the alternative hypothesis of (trend) stationarity, while tests for cointegrating ranks are very sensitive to the values of the nuisance parameters in finite samples. Toda and Phillips (1991) identified that the Granger causality test in ECM's suffer from nuisance parameter dependencies asymptotically.

We therefore resort to the procedure developed by Toda and Yamamoto (1995) which is robust to the integration and cointegration properties of the process so as to avoid the possible pre-test biases. This method is applicable whether the VAR's may be stationary (around a deterministic trend), integrated of an arbitrary order, or cointegrated of an arbitrary order (Toda and Yamamoto, 1995). This method uses a Modified Wald statistic for testing the significance of the parameters of a VAR model.

With our three time-series, we specify the model in the form of equations 3.3.6 to 3.3.8 where k is the maximum lag order selected by Akaike's information criterion (AIC) and Schwarz's Bayesian information criterion (SBIC), and d is the maximum order of integration of the series. We augment the number of lags by the maximum order of integration. However, the hypothesis of no Granger causality is tested using the coefficients of the first k lagged values of the other explanatory variables in the respective equations. In this way, the procedure utilizes a modified Wald test statistic (MWALD) that restricts the parameters of the k-th optimal lag order of the vector autoregressive, making the MWALD statistic have an asymptotic chi-square distribution when VAR ($k + d$) is estimated. ε_{it} is an error term assumed to be i.i.d.

$$x_t = \gamma_1 + \sum_{j=1}^{k+d} \alpha_{1j} x_{t-j} + \sum_{j=1}^{k+d} \beta_{1j} y_{t-j} + \sum_{j=1}^{k+d} \delta_{1j} z_{t-j} + \varepsilon_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots. (3.3.6)$$

$$y_t = \gamma_2 + \sum_{j=1}^{k+d} \alpha_{2j} x_{t-j} + \sum_{j=1}^{k+d} \beta_{2j} y_{t-j} + \sum_{j=1}^{k+d} \delta_{2j} z_{t-j} + \varepsilon_{2t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3.7)$$

$$z_t = \gamma_3 + \sum_{j=1}^{k+d} \alpha_{3j} x_{t-j} + \sum_{j=1}^{k+d} \beta_{3j} y_{t-j} + \sum_{j=1}^{k+d} \delta_{3j} z_{t-j} + \varepsilon_{3t} \ldots\ldots\ldots\ldots\ldots\ldots. (3.3.8)$$

Testing the null hypothesis of no Granger causality from equation 3.3.6 for example will be will testing the hypothesis that $H_0 = \beta_{1j} = \beta_{1j+1} = \cdots = \beta_{1k} = 0$ which is the test of no causality from y_t to x_t and $H_0 = \delta_{1j} = \delta_{1j+1} = \cdots = \delta_{1k} = 0$ is the null hypothesis of no causality from z_t to x_t.

3.4 DATA

We use time-series data from three developed economies that have experienced changes in monetary policy regimes over the course of the sample: Canada, the United Kingdom and the United States. The availability of quarterly data limited the number of countries that could be included in the sample. The countries selected, besides having experienced changes in how monetary policy is conducted, must also have a sufficiently long time-series to provide meaningful econometric results.

We use three series in our analysis; government budget balance, current account balance and investment spending. The government budget balance is the difference between federal government revenue and expenditures for a given quarter. It is in deficit when it is negative and in a surplus when positive. The current account balance is taken from the balance of payments. A current account surplus is recorded as positive while a deficit is recorded as negative. The last series is investment spending, which for the scope of our study is limited to Gross Fixed Capital Formation (GFCF).

For Canada, we use quarterly data spanning from 1961Q1 to 2016Q2 from Statistics Canada (CANSIM database) Table 380-0080 - Revenue, expenditure and budgetary balance - General governments, quarterly (dollars); Table 380-0064 - Gross domestic product, expenditure-based, quarterly; Table 380-0002 and Table 380-0068 - Gross fixed capital formation, quarterly; Table 376-0005 and Table 376-0105- Balance of international payments, current account, seasonally adjusted, quarterly and supplemented with National Income and Expenditure Accounts: Data Tables (1961Q1 to 2012Q2).

Quarterly Data from 1960Q1 to 2014Q4 for the U.S. were retrieved from the Federal Reserve Bank of St. Louis (FRED) database. They include data from the U.S. Bureau of Economic Analysis named Federal government budget surplus or deficit (-) [M318501Q027NBEA]; Gross Domestic Product [GDP]; and Balance on Current Account, NIPA's [NETFI]. Data on investment retrieved from FRED is Gross Fixed Capital Formation in United States [USAGFCFQDSMEI].

The Office of National Statistics provides quarterly data for the U.K spanning from 1960Q1 to 2016Q1. U.K. Quarterly National Accounts data tables provide data on Gross Fixed Capital Formation and Gross Domestic Product (GDP): Business Investment; Public

Sector Finances time series dataset (PUSF), for the government budget balance and the Balance of Payments time series dataset (PNBP) provided data for the current account.

CHAPTER FOUR

4. EMPIRICAL RESULTS

4.1. UNIT ROOT TESTS

4.1.1. AUGMENTED DICKEY FULLER TEST

The test procedure for the twin deficit hypothesis performs an ADF test on the time-series of the current account balance, the government budget balance and investment spending all expressed as ratios to GDP, initially with the assumption that there is no structural break (Model 1 in 3.3.2). The number of lags (k) for this test was selected based on the AIC[10]. The tables below show the results of the ADF test for Canada, the U.K. and the U.S.[11]

Table 4.1.1.1 ADF Test for Canada (1961Q1 – 2016Q2)

Variable	k	t-stat	10%	5%	1%
ca	0	-3.042**	-2.572	-2.882	-3.470
bb	1	-1.803	-2.572	-2.882	-3.470
inv.	1	-2.524	-2.572	-2.882	-3.470

Table 4.1.1.2; ADF Test for U.K. (1960Q1 – 2016Q1)

Variable	k	t-stat	10%	5%	1%
ca	1	-2.666*	-2.572	-2.882	-3.469
bb	5	-2.354	-2.572	-2.882	-3.470
inv.	0	-1.957	-2.572	-2.882	-3.469

Table 4.1.1.3; ADF Test for U.S. First Sample (1960Q1 – 2002Q4)

Variable	k	t-stat	10%	5%	1%
ca	0	-0.423	-2.575	-2.885	-3.486
bb	4	-2.476	-2.576	-2.886	-3.488
inv.	0	-1.638	-2.575	-2.885	-3.486

[10] Check the appendix for more information of the information criteria used in the selection of the lags. Table A.1 to Table A.4 show the maximum lag chosen by the AIC and BIC. The one marked by * shows the lag that is selected

[11] (*), (**) and (***) signifies rejection of unit root at 10%, 5% and 1%

Table 4.1.1.4; ADF Test for U.S. Second Sample (1993Q1 – 2013Q4)					
Variable	k	t-stat	10%	5%	1%
ca	0	-1.533	-2.587	-2.904	-3.534
bb	4	-1.424	-2.588	-2.907	-3.539
inv.	1	-1.073	-2.587	-2.904	-3.535

From Tables 4.1.1.1 to 4.1.1.4, we fail to reject a unit root for bb and inv at any of the significance levels. However, we do reject a unit root for ca at the 10% and 5% significance levels for Canada and the U.K. respectively. This implies if we fail to consider our priori argument of structural break, ca for Canada is trend stationary. Similarly, from Table 41.1.2, bb and inv for the U.K. have a unit root while a unit root is rejected at the 10% significance level for ca. In this sense, the ca of both Canada and the U.K. appears to have been generated by an $I(0)$ process. All series for the US in both samples have a unit root at the conventional significance level[12].

4.1.2. PERRON UNIT ROOT TEST WITH A STRUCTURAL BREAK

We next use the unit root test with structural breaks proposed by Perron (1989). The break is exogenous based on an a priori argument regarding whether the introduction of the new monetary policy regime will have any structural effect on the variable generating process of the current account and investment spending. The government budget balance is exempted from the test because we expect fiscal policy to be independent of monetary policy.

The null hypothesis for this test is that the time series has a unit root against the alternative that the process is a trend-stationary. Model 2 (3.3.1) is tested for a unit root with shift in

[12] The U.S. data was split into two; 1960Q1 – 2002Q4 and 1993Q1 – 2013Q4, to avoid the complications in dealing with multiple structural breaks when considering the Perron (1989) unit root test.

intercept and slope, using the null hypothesis $H_0: \alpha = 1$. The critical values used are presented by Perron (1989).

For all unit root tests, the break signifies when monetary policy was changed from discretionary to rules-based, except for the second sample of the U.S. where the break is when monetary policy was switched from the Taylor rule to discretionary in 2003.

The lag length k is selected on the basis of a t-test following the procedure of Perron and Vogelsang (1992) and Gregory and Hansen (1996). We set the maximum lag to 6 and then reduced it until the last lag of the first difference included in the regression was significant at 5% using the normal critical values.

We performed this test on Canada with an exogenous break point at 1991Q1 when inflation targeting was adopted as a rule of conducting monetary policy. For ca, the earlier results from Table 4.1.1.1 changed significantly after introducing the break. From Table 4.1.2.1, we failed to reject a unit root ($\alpha = 1$)[13] based on the critical values provided in Table 4.1.2.7, suggesting that the current account balance is nonstationary. We also could not reject that $\beta = 0$ and $\mu = 0$.

Our result on the test on investment spending suggests that, allowing for a structural break, investment is integrated of order zero at the 10% significance level but has a unit root at the 5% significance level. From Table 4.1.2.2, the additional conditions of $\beta = 0$ and $\mu = 0$ are not fully satisfied because, we found μ to be significant at the 5% significance level.

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[13] The equation (3.3.1) is transformed by subtracting the first lag of y from both sides of the equation so that the equation becomes $\Delta y_t = \gamma + \alpha^* y_{t-1} + \beta t + \theta DU_t + \mu DT_t + \sum_{j=1}^{k} \rho_i \Delta y_{t-j} + e_t$, so that $\alpha^* = 1 - \alpha$. In this way testing the null hypothesis $H_0: \alpha = 1$ is the same as $H_0: \alpha^* = 0$

However, these additional conditions are not sufficient conditions to overturn the necessary condition of the null hypothesis.

Table 4.1.2.1 Perron Unit Root Test with Structural Break for Canada (Current Account) (1961Q1 – 2016Q2)

Current account (4 lags)		t-stat
$\boldsymbol{\alpha}^*$	-0.09	-2.75
	(0.03266)	
$\boldsymbol{\gamma}$	-0.000278	-0.64
	(0.00043)	
$\boldsymbol{\beta}$	-4.33e-06	-0.76
	(5.67e-06)	
$\boldsymbol{\theta}$	0.00113*	1.93
	(0.00058)	
$\boldsymbol{d}$	-0.00007	-0.03
	(0.0021)	
$\boldsymbol{\mu}$	-6.57e-06	-0.73
	(9.05e-06)	

(*), (**) and (***) shows statistical significance at 10%, 5% and 1% significance level.

Table 4.1.2.2 Perron Unit Root Test with Structural Break for Canada (Investment) (1961Q1 – 2016Q2)

Investment (3lags)		t-stat
$\boldsymbol{\alpha}^*$	-0.10031*	-4.16
	(0.02414)	
$\boldsymbol{\gamma}$	0.01863***	4.27
	(0.00436)	
$\boldsymbol{\beta}$	-1.84e-06	-0.18
	(0.00001)	
$\boldsymbol{\theta}$	-0.00291**	-2.12
	(0.00137)	
$\boldsymbol{d}$	0.0012	0.31
	(0.00388)	
$\boldsymbol{\mu}$	0.00005**	2.57
	(0.00002)	

(*), (**) and (***) shows statistical significance at 10%, 5% and 1% significance level.

We use a breakpoint at 1992Q4 in relation to the time inflation targeting was adopted by the U.K. The Perron (1989) test suggests that the current account for the U.K. is an $I(0)$ at the 5% significance level, rejecting the null hypothesis of a unit root. Assessing the additional conditions suggested by Perron (1989) appears to confirm this result since β and μ are both significant 5% and 10% respectively from Table 4.1.2.3.

Table 4.1.2.4 shows that U.K. investment has a unit root even in the presence of a structural break and satisfies all of the conditions for the null hypothesis of a unit root.

In the case of the United States, it is hard to identify the kind of regime of monetary policy guiding the Fed. Though one of the key aspects of inflation-targeting is its transparency to the public, there have been assertions that the monetary policy by the Fed has followed a Taylor rule from 1992 until the early 2000s. Goodfriend (2004) argues that the Fed has gradually and implicitly adopted inflation-targeting for some time over the last two decades.

Table 4.1.2.3 Perron Unit Root Test with Structural Break for U.K. (Current Account) (1960Q1 – 2016Q1)

Current account (1 lag)		t-stat
$\boldsymbol{\alpha}^*$	-0.23754**	-4.73
	(0.05024)	
$\boldsymbol{\gamma}$	0.00158	0.98
	(0.00161)	
$\boldsymbol{\beta}$	-0.00005**	-2.05
	(0.00002)	
$\boldsymbol{\theta}$	0.00468*	1.83
	(0.00255)	
$\boldsymbol{d}$	-0.00056	-0.06
	(0.00905)	
$\boldsymbol{\mu}$	-0.00008*	-1.92
	(0.00004)	

(*), (**) and (***) shows statistical significance at 10%, 5% and 1% significance level.

We therefore break the data for the U.S. into two sub-samples: 1960 to 2002 (first sample) and 1992 to 2013 (second sample) so that we could have a break in each series to avoid the complications of dealing with multiple breakpoints. This also helps in empirically assessing the claims of the Fed's use of the Taylor rule by comparing the U.S. results to those of Canada and the U.K. where the use of the rules is explicit and transparent.

Table 4.1.2.4 Perron Unit Root Test with Structural Break for U.K. (Investment) (1960Q1 – 2016Q1)

Investment (3 lags)		t-stat
$\boldsymbol{\alpha}^*$	-0.08062	-2.75
	(0.02936)	
$\boldsymbol{\gamma}$	0.01687***	2.98
	(0.00566)	
$\boldsymbol{\beta}$	-3.02e-06	-0.21
	(0.00001)	
$\boldsymbol{\theta}$	-0.00189	-1.10
	(0.00171)	
$\boldsymbol{d}$	0.00076	0.14
	(0.00555)	
$\boldsymbol{\mu}$	-0.00002	-0.52
	(0.00003)	

(*), (**) and (***) shows statistical significance at 10%, 5% and 1% significance level.

In the first sample, the break is assumed to be at 1992Q4, which is the period just after Taylor had presented his case for monetary policy guided by rules. The break in the second sample is imposed at 2003Q2 when the Fed is believed to have abandoned the Taylor rule. This sampling split will assist in determining whether there were any changes in the time-series process when the Fed switched back to monetary policy by discretion.

The current account in both samples that included the structural breaks appears to have a unit root based on the failure to reject at the 5% significance level in Table 4.1.2.5. Although β in the first sample is significant at the 10% significance level, its magnitude is very small. In addition to the increase in magnitude of β in the second sample and becoming more significant, the coefficient μ is also significant at a high level of confidence.

The results in Table 4.1.2.6 suggest that investment spending in both samples contains a unit root, although μ is significant only in the second sample. Although β coefficient for the time trend is statistically significant in Table 4.1.2.5, its magnitude is negligible and should not be indicative of a trend stationary series.

Table 4.1.2.5 Perron Unit Root Test with Structural Break for U.S. (Current Account) (1960Q1 – 2002Q4) and (1993Q1 – 2013Q4)

Current account	First sample (0 lags)	t-stat	Second sample (0 lags)	t-stat
$\boldsymbol{\alpha}^*$	-0.08204	-2.67	-0.19996	-3.27
	(0.03077)		(0.06123)	
$\boldsymbol{\gamma}$	0.00091	1.36	-0.00144	-1.29
	(0.00067)		(0.00112)	
$\boldsymbol{\beta}$	-0.00002*	-1.87	-0.0002**	-2.77
	(0.00001)		(0.00007)	
$\boldsymbol{\theta}$	0.00069	0.55	-0.00301*	-1.66
	(0.00126)		(0.00182)	
$\boldsymbol{d}$	0.00198	0.60	0.00443	1.24
	(0.00331)		(0.00358)	
$\boldsymbol{\mu}$	-0.00007	-1.49	0.00043***	3.46
	(0.00005)		(0.00013)	

(*), (**) and (***) shows statistical significance at 10%, 5% and 1% significance level.

Table 4.1.2.6 Perron Unit Root Test with Structural Break for U.S. (Investment)
(1960Q1 – 2002Q4) and (1993Q1 – 2013Q4)

Investment	First sample (2 lags)	t-stat	Second sample (3 lags)	t-stat
$\boldsymbol{\alpha}^*$	-0.04092	-1.72	-0.09129	-3.23
	(0.02382)		(0.02825)	
$\boldsymbol{\gamma}$	0.00237*	1.79	0.00465***	3.24
	(0.00132)		(0.00143)	
$\boldsymbol{\beta}$	-1.69e-06	-1.02	0.00001	1.36
	(1.65e-06)		(9.20e-06)	
$\boldsymbol{\theta}$	0.00029	0.91	7.85e-06	0.03
	(0.00031)		(0.00024)	
$\boldsymbol{d}$	-0.00048	-0.67	0.00021	0.39
	(0.00073)		(0.00055)	
$\boldsymbol{\mu}$	-6.04e-06	-0.54	-0.00004**	-2.22
	(0.00001)		(0.00002)	

(*), (**) and (***) shows statistical significance at 10%, 5% and 1% significance level.

Table 4.1.2.7 Critical values for Perron unit root test with structural break. λ shows the relative time of the break in relation the length of the series.

λ	10%	5%	1%
0.5	-3.96	-4.24	-4.90
0.6	-3.95	-4.24	-4.88

4.2. COINTEGRATION

From the unit root tests, we identified most of the series as *I*(1) when the structural breaks are ignored. Including the structural break changes the results of the test on the current account of Canada to *I*(0), and reinforces the fact that current account of the U.K. is *I*(0) at the 5% significance level. These results suggest that random shocks that drive apart domestic investment and savings are temporary so that there is little reliance on foreign savings.

4.2.1. STANDARD MODEL

We estimate four models to determine if the three series are cointegrated in any form. We first estimate the standard model as;

$$ca_t = \mu_1 + \alpha_1 bb_t + \alpha_2 inv_t + \varepsilon_t , \qquad t = 1, 2, 3, \dots n \dots \dots \dots \dots \dots \dots . (4.2)$$

In this model, we assume there is no structural break in the cointegration relation among ca, bb and inv. This model captures the long-run relation between the variables and is thought of as the long run equilibrium (Engle and Granger, 1987). Using this model implies that the estimated parameters are time invariant (Gregory and Hansen, 1996).

The testable hypotheses that $\boldsymbol{\alpha_1} > 0$ and $\boldsymbol{\alpha_2} < 0$ imply that increasing the government budget deficit and/or increasing domestic investment should cause the current account to deteriorate, based on the predictions of the Mundell-Fleming model and the national income accounting identify in (3.3.6). The same procedure applied in selecting the lag length in testing for a unit root with a structural break will be applied here.

From Table 4.2.1, the coefficient of bb is positive and negative for inv, agreeing with our expectations. The estimates of the coefficients of bb and inv are both statistically significant for Canada and the U.S. second sample. In the case of the U.K., inv is not significant in explaining the variation in the current account balance. For the first sample of the U.S., bb is insignificant while the coefficient $\boldsymbol{\alpha_2}$ is close to unity.

Table 4.2.1 Cointegration Analysis- Model 1

ca	CANADA (1961Q1 – 2016Q2)		U.K. (1960Q1 – 2016Q1)		U.S. FIRST SAMPLE (1960Q1 – 2002Q4)		U.S. SECOND SAMPLE (1993Q1 – 2013Q4)	
	estimate	t-stat	estimate	t-stat	estimate	t-stat	estimate	t-stat
μ_1	0.02231***	6.65	-0.01937*	-1.78	0.04665**	2.00	0.11666***	4.99
	(0.00336)		(0.01091)		(0.02332)		(0.0234)	
α_1	0.10109***	8.81	0.12435***	4.67	0.07648	0.52	0.65744***	4.06
	(0.01147)		(0.02661)		(0.14716)		(0.16211)	
α_2	-0.1373***	-7.52	0.03392	0.60	-0.98276**	-2.33	-2.75911***	-6.40
	(0.01825)		(0.05671)		(0.42093)		(0.43133)	

(*), (**) and (***) shows statistical significance at 10%, 5% and 1% significance level.

These results may not be reflective of a long run relationship because the second part of the Engel and Granger (1987) cointegration analysis suggests that there is no cointegration between ca, bb and inv in any of the countries and samples considered. From the results in Table 4.2.4, we fail to reject unit root of the residuals for Canada, the U.K. and the U.S. for both samples. However, we temper our judgement as the cointegration test in this section does not include any structural breaks.

4.2.2. MODEL WITH STRUCTURAL BREAK

Gregory and Hansen (1996) noted that cointegration may hold over some fairly long period of time and then shift to a new long-run equilibrium. We therefore argue that the introduction of inflation targeting as a monetary policy regime may have changed the relationship existing between ca, bb and inv. We investigate this by considering three additional models advanced by Gregory and Hansen (1996). Though their methodology treats the single structural break as endogenous, they noted that if the timing of the regime shift is known a priori, the same approach can be applied.

4.2.2.1. Level shift

The second model incorporates a level shift in the cointegrating relationship modelled as a change in the intercept, so that the model becomes

$$ca_t = \mu_1 + \mu_2\varphi_{t\tau} + \alpha_1 bb_t + \alpha_2 inv_t + \varepsilon_t , \qquad t = 1, 2, 3, \dots n \dots\dots\dots\dots (4.3)$$

Table 4.2.2.1 Cointegration Analysis- Model 2

	CANADA (1961Q1 – 2016Q2)		UK (1960Q1 – 2016Q1)		US FIRST SAMPLE (1960Q1 – 2002Q4)		US SECOND SAMPLE (1993Q1 – 2013Q4)	
	estimate	t-stat	estimate	t-stat	estimate	t-stat	estimate	t-stat
μ_1	0.01995***	5.45	0.04948***	3.65	0.1184***	6.80	0.13363***	9.26
	(0.00366)		(0.01355)		(0.01742)		(0.01443)	
α_1	0.09311***	7.46	0.08516***	3.48	0.45604***	4.21	0.18635*	1.74
	(0.01249)		(0.02449)		(0.10826)		(0.10735)	
α_2	-0.1275***	-6.64	-0.2797***	-4.21	-2.1415***	-6.88	-2.9374***	-11.09
	(0.01921)		(0.06641)		(0.31123)		(0.26498)	
μ_2	0.00097	1.59	-0.02134***	-7.36	-0.0262***	-12.99	-0.02185***	-11.63
	(0.00061)		(0.0029)		(0.00202)		(0.00188)	

(*), (**) and (***) shows statistical significance at 10%, 5% and 1% significance level.

The results of the cointegration regressions with a level shift are reported in Table 4.2.2.1. The intercept shift at the time of the break, $\varphi_{t\tau}$ is not statistically significant for Canada, however it is significant for the U.K. and for both U.S. samples. The long run effect of inv on ca is not time-invariant, but has actually changed following the introduction of inflation targeting in the U.K.

For the U.S., μ_2 is significant and causes α_1 to be significant as well. The results for the U.S. first sample suggests that the effect of bb on ca changed after the Fed was suspected to be conducting monetary policy based on rules. In the second sample, the significance of μ_2 reduces the magnitude and significance of the impact of bb on ca.

4.2.2.2. Level shift with Trend

The third model adds a time trend to the model level shift so that it becomes;

$$ca_t = \mu_1 + \mu_2 \varphi_{t\tau} + \beta t + \alpha_1 bb_t + \alpha_2 inv_t + \varepsilon_t , \qquad t = 1, 2, 3, \dots n \dots \dots . . (4.4)$$

Introducing a time trend into the model causes significant changes in the results for all the countries and samples as reported in Table 4.2.2.2. For Canada, the coefficients of bb and inv increase from those in Model 2, and they both become more significant based on their larger t-statistics. Moreover, the level shift (change in intercept) also become significant even at the 1% significance level. This indicates that the structural break is better conceived in such a model than the previous model.

The U.K. and the U.S. first sample seem to display more similarities as we introduce the time trend. The dummy variable providing the change in intercept and bb both become insignificant in the model.

4.2.2.3. Regime Shift

In the last model, we allow the slope vector to also change.

$$ca_t = \mu_1 + \mu_2\varphi_{t\tau} + \beta t + \alpha_1 bb_t + \alpha_2 inv_t + \alpha_3\varphi_{t\tau} bb_t + \alpha_4\varphi_{t\tau} inv_t + \varepsilon_t ,$$

$$t = 1, 2, 3, \ldots n \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (4.5)$$

In the regime shift model reported in Table 4.2.2.3, bb becomes statistically insignificant for all countries and samples. The time trend for Canada, unlike for the others, is insignificant. Moreover, α_3 is only significant in the case of Canada.

Table 4.2.2.2 Cointegration Analysis- Model 3

	CANADA (1961Q1 – 2016Q2)		UK (1960Q1 – 2016Q1)		US FIRST SAMPLE (1960Q1 – 2002Q4)		US SECOND SAMPLE (1993Q1 – 2013Q4)	
	estimate	t-stat	estimate	t-stat	estimate	t-stat	estimate	t-stat
$\boldsymbol{\mu_1}$	0.03253***	7.70	0.0439***	3.63	0.10993***	8.71	0.16172***	11.85
	(0.00422)		(0.0121)		(0.01262)		(0.01364)	
$\boldsymbol{\alpha_1}$	0.13418***	9.44	0.01136	0.48	0.0481	0.57	0.24171**	2.58
	(0.01421)		(0.02388)		(0.08499)		(0.09384)	
$\boldsymbol{\alpha_2}$	-0.20902***	-8.71	-0.17451***	-2.87	-1.7563***	-7.72	-3.32957***	-13.75
	(0.024)		(0.06078)		(0.22741)		(0.24217)	
$\boldsymbol{\mu_2}$	-0.00665***	-4.21	0.00389	0.93	-0.00419*	-1.82	-0.00899***	-3.03
	(0.00158)		(0.0042)		(0.0023)		(0.00296)	
$\boldsymbol{\beta}$	0.00006***	5.19	-0.00022***	-7.63	- 0.00023***	-12.40	-0.00032***	-5.20
	(0.00001)		(0.00003)		(0.00002)		(0.00006)	

(*), (**) and (***) shows statistical significance at 10%, 5% and 1% significance level.

Table 4.2.2.3 Cointegration Analysis- Model 4

	CANADA (1961Q1 – 2016Q2)		UK (1960Q1 – 2016Q1)		US FIRST SAMPLE (1960Q1 – 2002Q4)		US SECOND SAMPLE (1993Q1 – 2013Q4)	
	estimate	t-stat	estimate	t-stat	estimate	t-stat	estimate	t-stat
μ_1	0.01836*** (0.00423)	4.34	0.07715*** (0.01363)	5.66	0.09771*** (0.01378)	7.09	0.0799** (0.03144)	2.54
α_1	-0.00168 (0.01944)	-0.09	0.03187 (0.02815)	1.13	0.07503 (0.10189)	0.74	0.19942 (0.14333)	1.39
α_2	-0.12943*** (0.02347)	-5.52	-0.36702*** (0.07158)	-5.13	-1.54119*** (0.24718)	-6.24	-1.729*** (0.60153)	-2.87
μ_2	0.01669*** (0.00576)	2.90	-0.15489*** (0.03546)	-4.37	0.06951** (0.03462)	2.01	0.11938** (0.0456)	2.62
β	-8.88e-06 (0.00001)	-0.70	-0.00014*** (0.00003)	-4.00	-0.00022*** (0.00002)	-11.54	-0.00053*** (0.00009)	-5.94
α_3	0.25086*** (0.0259)	9.69	-0.04688 (0.04955)	-0.95	0.12085 (0.203)	0.60	0.05175 (0.18853)	0.27
α_4	-0.06087* (0.03296)	-1.85	0.82352*** (0.18215)	4.52	-1.36987** (0 .6391)	-2.14	-2.25114*** (0.79571)	-2.83

(*), (**) and (***) shows statistical significance at 10%, 5% and 1% significance level.

Table 4.2.2.4 T-stat of the ADF Test on the Residuals

Country	Standard model	Level shift	Level shift with trend	Regime shift
Canada	-3.75 (0)*	-3.03 (4)	-3.04 (4)	-4.932 (0)
UK	-3.040 (1)	-2.238 (3)	-4.42 (1)	-4.886 (1)
US1	-0.20 (0)	-2.096 (4)	-2.432 (0)	-2.51 (0)
US2	-1.489 (4)	-2.847 (0)	-2.698 (0)	-2.451 (0)

(*), (**) and (***) shows statistical significance at 10%, 5% and 1% significance level.

Table 4.2.2.5 Critical Values for all the Four Models

	Standard model	Level shift	Level shift with trend	Regime shift
1%	-4.36	- 5.44	- 5.80	- 5.91
5%	-3.78	- 4.92	- 5.29	- 5.50
10%	-3.48	- 4.69	- 5.03	- 5.23

Comparing the t-stat from Table 4.2.2.4 to the critical values in Table 4.2.2.5, Canada is the only country that shows evidence of cointegration at the 10% significance level, however at the conventional significance level of 5%, there is no cointegration of any form between ca, bb and inv; meaning there is no long run equilibrium for the three series in any of the countries under study. This is consistent with some of the results of in the literature.[14]

4.3. GRANGER CAUSALITY

From the previous analyses, we do not have enough evidence to support any long run equilibrium for the variables of ca, bb and inv for Canada, the U.K and the U.S. In this case an error correction model cannot be estimated and Granger causality cannot be tested from this procedure. Moreover, from the onset the characteristics of the series show that their respective generating processes may be far from $I(1)$. Therefore, analyzing them from such procedures will not provide any meaningful results.

Toda and Yamamoto (1995) point out that the power of the pretests for a unit root(s) and cointegration in the economic time series are known to be very low against the alternative hypothesis of (trend) stationarity. This implies that testing some economic hypothesis conditioned on the estimation of a unit root, a cointegrating rank, and a cointegrating vector(s) may suffer from severe pretest biases. We found from the previous estimation results that some of the variables may be not integrated and not cointegrated. We therefore need a testing procedure which is robust to the integration and cointegration properties of the process so as to avoid the possible pretest biases[15].

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[14] See the works of Daly and Siddiki (2009)

[15] An error-correction model assumes a long-run equilibrium so that the regression errors are stationary and revert to zero asymptotically. Since we could not find a cointegrating regression for each country, we cannot

Against this backdrop, we break the data into pre-rule and post-rule and estimate a VAR for each. This adopts the approach suggested by Toda and Yamamoto (1995) to estimate out the Granger-causality among the variables. Their procedure is applicable whether the VAR's may be stationary, integrated of an arbitrary order, or cointegrated of an arbitrary order. This makes it possible to test linear or nonlinear restrictions on the coefficients by estimating a VAR in levels and applying the Wald test criterion (Toda and Yamamoto, 1995). We do by using the model;

$$ca_t = \gamma_1 + \sum_{j=1}^{k+d} \alpha_{1j}\, ca_{t-j} + \sum_{j=1}^{k+d} \beta_{1j}\, bb_{t-j} + \sum_{j=1}^{k+d} \delta_{1j}\, inv_{t-j} + \varepsilon_{1t} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4.6)$$

$$bb_t = \gamma_2 + \sum_{j=1}^{k+d} \alpha_{2j}\, ca_{t-j} + \sum_{j=1}^{k+d} \beta_{2j}\, bb_{t-j} + \sum_{j=1}^{k+d} \delta_{2j}\, inv_{t-j} + \varepsilon_{2t} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4.7)$$

$$inv_t = \gamma_3 + \sum_{j=1}^{k+d} \alpha_{3j}\, ca_{t-j} + \sum_{j=1}^{k+d} \beta_{3j}\, bb_{t-j} + \sum_{j=1}^{k+d} \delta_{3j}\, inv_{t-j} + \varepsilon_{3t} \quad \ldots\ldots\ldots\ldots\ldots (4.8)$$

We first determine the maximum lag for the VAR estimation based on Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC), and the Hannan and Quinn information criterion (HQIC). From Table C.1 to Table C.4 in the appendix, the maximum lag for Canada in both samples is 2 and 4 lags for the U.K. in both samples. The full sample for the U.S. was split into three sub-samples; 1960Q1 to 1992Q4

assume a long-run equilibrium and the error-correction model is not appropriate. Instead we utilize a procedure that forces no structure on the regression errors.

when monetary policy was discretionary; 1993Q1 to 2003Q4 when monetary policy was suspected to be based on rules; and 2004Q1 to 2012Q3 when monetary policy was reverted to that guided by the discretion of the Fed. The maximum lag selected by the criteria is 4 for the first and second samples and 2 for the third sample as shown in Table C.5 to Table C.7

We determined the order of integration of the series in all samples to specify the maximum number of supplementary lags to the VAR as the Toda and Yamamoto (1995) procedure stipulates. The additional lags are added to the VAR as exogenous variables so that we can test linear or nonlinear restrictions on the first k coefficient matrices using standard asymptotic theory. From Table B.1 to Table B.7 in the Appendix, the highest order of integration for Canada and the U.K. in both samples is 1 since all variables display $I(1)$ generating characteristics, except ca in the first sample for both countries which are $I(0)$ in character. All series in the first two samples for the U.S. display $I(1)$ features and so the VAR was estimated for these two samples adding one additional lag. In the last sample for the U.S., the results suggest that inv is an $I(2)$ series, so we add two more lags in estimating the VAR.

The order of integration for the series was done by the usual ADF test in level, first and second differences when necessary. The lags for the test were selected based on the Akaike's information criterion that are also reported in Tables A.5 to A.11 in the appendix. For the ADF test for the first difference of the series, the AIC in most cases chose one lag less than that at the level. This is because the autocorrelation reduces by a unit as we move from level to the difference. The VAR results are reported in Tables D.1 to D.7 in the appendix. Table 4.3.1 to Table 4.3.7 show the results of the Null hypothesis of no Granger Causality between ca, bb and inv.

From comparing results in Table 4.3.1 and Table 4.3.2, bb does not Granger-cause ca in the period before inflation targeting in Canada. However, bb does Granger-cause ca after monetary policy was conducted based on rules in Canada. We also find that ca Granger-causes bb in the post-rule sample but not in the pre-rule sample, implying that, there is a feedback relationship between ca and bb as far as Granger causality is concerned.

Table 4.3.1 Granger causality- Canada First Sample

Dependent variable	Explanatory variable	df	Chi-sqare	prob	decision
	bb	2	1.0358	0.596	Fail to reject H0
ca	inv	2	4.2351	0.120	Fail to reject H0
	all	4	5.5841	0.232	Fail to reject H0
	ca	2	2.996	0.224	Fail to reject H0
bb	inv	2	7.3805	0.025	Reject H0
	all	4	16.804	0.002	Reject H0
	ca	2	4.2413	0.120	Fail to reject H0
inv	bb	2	0.36105	0.835	Fail to reject H0
	all	4	4.7595	0.313	Fail to reject H0

Table 4.3.2 Granger causality- Canada Second Sample

Dependent variable	Explanatory variable	df	Chi-sqare	prob	decision
	bb	2	9.4728	0.009	Reject H0
ca	inv	2	0.20027	0.905	Fail to reject H0
	all	4	10.187	0.037	Reject H0
	ca	2	8.5644	0.014	Reject H0
bb	inv	2	12.671	0.002	Reject H0
	all	4	22.424	0.000	Reject H0
	ca	2	6.654	0.000	Reject H0
inv	bb	2	0.23072	0.891	Fail to reject H0
	all	4	18.008	0.001	Reject H0

inv on the other hand does not Granger-cause ca in any of the samples for Canada. Past values of ca are found to contain information that help to explain the values of inv in the post-rule sample. In terms of the relationship between bb and inv, we observe that inv Granger-causes bb, but not the other way round in both samples. This implies that the relationship between inv and bb is not affected by how monetary policy is conducted in Canada.

Table 4.3.3 Granger causality- U.K. First Sample

Dependent variable	Explanatory variable	df	Chi-sqare	prob	decision
ca	bb	4	10.582	0.032	Reject H0
	inv	4	14.775	0.005	Reject H0
	all	8	19.904	0.011	Reject H0
bb	ca	4	1.1362	0.888	Fail to reject H0
	inv	4	3.5759	0.466	Fail to reject H0
	all	8	6.028	0.644	Fail to reject H0
inv	ca	4	1.1017	0.894	Fail to reject H0
	bb	4	1.9848	0.739	Fail to reject H0
	all	8	3.2597	0.917	Fail to reject H0

Table 4.3.4 Granger causality- U.K. Second Sample

Dependent variable	Explanatory variable	df	Chi-sqare	prob	decision
ca	bb	4	6.0799	0.193	Fail to reject H0
	inv	4	2.7067	0.608	Fail to reject H0
	all	8	11.754	0.163	Fail to reject H0
bb	ca	4	7.8178	0.098	Fail to reject H0
	inv	4	5.5591	0.235	Fail to reject H0
	all	8	13.011	0.111	Fail to reject H0
inv	ca	4	4.4652	0.347	Fail to reject H0
	bb	4	15.443	0.004	Reject H0
	all	8	23.009	0.003	Reject H0

The results for the U.K., are summarize in Table 4.3.3 and Table 4.3.4. We found that bb Granger-causes ca only in the period before inflation targeting was introduced. At a conventional 5% significance level, ca does not have enough past information to help explain the variation in bb. However, at the 10% significance level, we identify ca to Granger-cause bb in the second sample.

We fail to reject the null of no Granger-causality from ca to inv in the period after inflation targeting was introduced in the U.K. There is however evidence of Granger-causality from inv to ca in the periods when monetary policy was discretionary. inv does not Granger-cause bb in any of the samples but bb Granger-causes investment in the second sample.

The results for the U.S. are summarized in Table 4.3.5, Table 4.3.6 and Table 4.3.7. Among the three samples, we reject the null of no Granger-causality from bb to ca only in the first sample, when monetary policy was well known to be discretionary. We note that ca appears to Granger-cause bb in the second sample when the Fed was suspected to be following a particular kind of monetary rule.

Table 4.3.5 Granger causality- U.S. First Sample

Dependent variable	Explanatory variable	df	Chi-sqare	prob	decision
ca	bb	4	18.984	0.001	Reject H0
	inv	4	2.4102	0.661	Fail to reject H0
	all	8	23.949	0.002	Reject H0
bb	ca	4	1.7888	0.775	Fail to reject H0
	inv	4	9.4129	0.052	Fail to reject H0
	all	8	11.428	0.179	Fail to reject H0
inv	ca	4	0.44715	0.978	Fail to reject H0
	bb	4	10.586	0.032	Reject H0
	all	8	14.027	0.081	Fail to reject H0

We fail to reject the null of no Granger-causality from bb to inv and vice versa in all samples except the third sample, where we identify a causality from inv to ca. We reject the null at the 5% significance for the second and third samples when considering the Granger-causality from inv to bb, but also reject the null hypothesis in the first sample at 10% significance level. There is also evidence to support Granger-causality from bb to inv in the first two samples.

Table 4.3.6 Granger causality- U.S. Second Sample

Dependent variable	Explanatory variable	df	Chi-sqare	prob	decision
	bb	4	5.5011	0.240	Fail to reject H0
ca	inv	4	3.2275	0.521	Fail to reject H0
	all	8	13.281	0.103	Fail to reject H0
	ca	4	13.576	0.009	Reject H0
bb	inv	4	31.294	0.000	Reject H0
	all	8	47.409	0.000	Reject H0
	ca	4	6.5819	0.160	Fail to reject H0
inv	bb	4	15.395	0.004	Reject H0
	all	8	27.308	0.001	Reject H0

Table 4.3.7 Granger causality- U.S. Third Sample

Dependent variable	Explanatory variable	df	Chi-sqare	prob	decision
	bb	2	0.9353	0.626	Fail to reject H0
ca	inv	2	17.135	0.000	Reject H0
	all	4	19.751	0.001	Reject H0
	ca	2	0.53284	0.766	Fail to reject H0
bb	inv	2	16.04	0.000	Reject H0
	all	4	22.758	0.000	Reject H0
	ca	2	1.9917	0.369	Fail to reject H0
inv	bb	2	3.9663	0.138	Fail to reject H0
	all	4	6.1959	0.185	Fail to reject H0

CHAPTER FIVE

5. IMPLICATION OF RESULTS

5.1. UNIT ROOTS

We can make inferences concerning the degree of international capital mobility from the unit root tests of the current account balances (relative to GDP) for the respective countries. As mentioned in the previous chapter, Horioka and Feldstein (1980) suggested that domestic investment and savings need not be strongly correlated if domestic borrowers have easy access to foreign savings. The upshot of this is that a high degree of capital mobility is reflected in a very elastic BP curve in the Mundell-Fleming Model and strengthens the case for a twin-deficit effect.

In carrying out the ADF test for the current account without considering the monetary policy structural break, we identified the current account balance for both Canada and the U.K. to be integrated of order zero $I(0)$ at the 5% and 10% significance levels respectively. Being trend-stationary suggests that shocks to the current account balance in Canada and the U.K. are not permanent, rather, they tend to dissipate rather quickly over time.

Using the Horioka-Feldstein argument and the subsequent procedure of Gundlach and Sinn (1992), the finding of an $I(0)$ current account balance suggests that the Canadian economy has a limited reliance on the international financial markets. Gundlach and Sinn (1992) demonstrated that if the investment-GDP ratio is linearly associated to the savings-GDP ratio, and the current account balance is the difference between domestic savings and investment, the current account balance can be written as;

$$CA/_Y = -\alpha + (1 - \beta)\, S/_Y - \varepsilon \quad (5.1)$$

If the current account balance is $I(0)$, then shocks to domestic investment and savings are quickly dissipated (assuming a stationary error term). Foreign savings is then not a necessity to finance domestic investment in the long-run. On the other hand, if the current account balance is $I(1)$, then domestic investment is partially financed by foreign savings in the long-run.

For the U.K., the evidence supporting the claim of $I(0)$ of the current account is only at the 10% significance level, giving some room to accept some level of financial integration. These results are based on the assumption that there is no policy break, but since the break is statistically significant on the series for both countries, it becomes difficult to rely on the results and any inference from them.

We applied the Perron (1989) unit root test with a structural break to test for a unit root on the current account balance and investment spending. Contrary to the results from the normal ADF test of the current account for Canada without a structural break, we could not find evidence to reject the null hypothesis of a unit root, implying that the series was generated by an $I(1)$ process. Making the inference from Gundlach and Sinn (1992), there is some degree of capital mobility and reliance on the international financial markets that distorts the stable relationship between domestic savings and investment spending.

Having identified the specific structural breaks, it is useful to analyze the pre-break and post-break characteristics of the series with emphasis on the current account. The current account for Canada before the introduction of inflation targeting was found to be integrated of order zero ($I(0)$) implying by inference that the economy was not so much linked to the international market. However, the post-break current account was found to contain a unit root at the 5% significance level, suggesting that the degree of capital mobility increased following the introduction of inflation targeting as the monetary rule. This could have strengthened the twin-deficit effect.

We found similar results for the unit root results for the U.K. series. The ADF test ignoring the break rejected a unit root at the 10% significance level in the current account balance, but could not reject a unit root at the 5% significance level, suggesting an $I(1)$ series. After taking into consideration the structural break, the unit root test results from Table 4.1.2.3 suggest that the U.K. current account balance is integrated of order zero ($I(0)$) over both periods.

Based on these contradicting results, the data for the U.K. were split into pre- and post-break samples to assess the data generating features of the individual series. Unlike the investment spending and government budget balance, the results for the current account balance for the two samples were different. The current account does not contain a unit root ($I(0)$) in the pre-break sample and demonstrates $I(1)$ features in the post-break sample. These results, like Canada, suggest that the degree of capital mobility has improved with the introduction of inflation targeting and that conditions are stronger for the twin-deficit effect.

The unit root tests for the U.S. pre-and post-break samples were more consistent. The ADF and Perron (1989) tests provide similar results concluding that the series of ca_t, bb_t and inv_t contain unit roots, implying that there is some degree of capital mobility and a reliance on foreign savings in the U.S. economy. These results did not change even when we resampled the series into three periods; a first period when monetary policy was discretionary; a second period when it was suspected to be guided by rules and; and a third period when it went back to discretionary policy. However, the time-series properties of the government budget balance and investment spending changed in the last sample. We found evidence that bb_t is an $I(0)$ process and inv_t is an $I(2)$ process. These results call into question the appropriateness of modelling the twin-deficit hypothesis in the most recent sample period.

The 2008 financial crisis and the subsequent U.S. government response could account for this significant change in the data generating process of these two series. Since the U.S. economy was the core of the crisis, the Treasury Department and the Fed used quantitative easing and new financial regulations to ameliorate the impact of the crisis on the economy. The same policy response might also account for the changes in the results for Canada and the U.K., although the Canadian economy was less affected by the crisis.

Moreover, relying only on the data generating process of the current account balance is not sufficient to arrive at strong conclusions regarding capital mobility. Gundlach and Sinn (1992) have pointed out that their test is not strong enough to conclude that a country is shut off from the international capital market if its current account balance is found to be $I(0)$. Harberger (1980) argued that the correlation between saving and investment rates will grow as the unit of observation increases in size, implying that size of the economy influences the saving-investment relation of the economy and any inference made from it.

Even though shifts in saving and investment behavior do have a significant effect on the current account for large countries (Von Furstenberg (1980) and Sachs (1981, 1982)), there are other factors that might influence the way such series were generated therefore making inference of the investment-saving relationship from the current account erroneous.

5.2. COINTEGRATION

Engle and Granger (1987) described cointegration as the long-run relationship between $I(1)$ series. We applied the two-stage test for cointegration by Engle and Granger (1987) to assess whether a long-run relationship exists between the current account balance, government budget balance and investment spending. Our rationale to proceed with cointegration testing was based on one of the unit root tests (either the usual ADF or Perron) confirming the presence of a unit root in each of the series. Our procedure initially ignored any structural breaks and then incorporated structural breaks in different forms.

Canada and the two samples for the U.S. revealed coefficients that are consistent with the twin-deficits hypothesis when any structural breaks were ignored: a positive coefficient on bb_t and a negative coefficient on inv_t. However, the results for the U.K. were not consistent with the twin-deficits hypothesis because the coefficient of inv_t was estimated to be positive and statistically insignificant. The second stage of the cointegration analysis suggested that there is no stable equilibrium for the three series for each country at a 5% significance level, although the results identified a long-run relationship for Canada at the 10% significance level. This result is puzzling because the unit root test on the current account balance for Canada when the break was ignored rejected a unit root, implying that the results may be spurious as Engle and Granger (1987) noted.

When the identified structural breaks were incorporated, the magnitude and significance of the coefficients changed from one model to another. In Tables 4.2.2.1 to Table 4.2.2.4 we find cases where the impact of the bb_t changed, in the last model becoming statistically insignificant. Similar to the results of the model without the break, we found no cointegration between the variables ca_t, bb_t and inv_t, implying that there is no long run relationship between them and a failure of the twin-deficit hypothesis in the long-run. The results suggest that any long-run drift between the current account and the budget balance is finance by foreign savings.

Miller and Russek (1989) argue that the twin deficits have no long-run relationship under flexible exchange rates and our results confirm this argument. Again, it is argued that advanced economies have sophisticated domestic capital markets[16] capable of financing a fiscal deficit, so the long-run relationship between the twin deficits is non-existent. Canada, the U.K. and the U.S. have sophisticated ways of financing government budget deficits domestically and through international borrowing, short-circuiting the long-run relationship between the government budget deficit and the current account deficit. How these results can be reconciled with the IS-LM-BP and IS-MP models will be discussed in the next section.

5.3. CAUSALITY ANALYSIS

We performed Granger-causality analysis using the methodology advanced by Toda and Yamamoto (1995) after we divided the sample into pre- and post-rule subsamples. The causality analysis helps explain whether one series has past information that can be used to explain changes in another series. To be able to explain the effect of the new monetary policy regime on the relationship between the series for the countries under study, the causality analysis was done using the pre-rule and post-rule time frame for Canada and the U.K., and three periods for the U.S.

[16] See Khalid and Guan (1999).

5.3.1. CANADA

We found no causality between ca_t and bb_t in any way using the first sample for Canada; implying that there is no clear linkage between the current account balance and the government budget balance for Canada when monetary policy was discretionary. This affirms the Ricardian equivalence hypothesis since there is no long run nor short run relationships between the two deficits. Increasing the government budget deficit therefore has no effect on the current account deficit, which could be explained by the fact that consumers are forward looking and make adjustments in their consumption-saving decisions to accommodate for any future changes in taxes. In that sense, the IS-curve in Figure 3.1 may not shift to the right at all because the increase in government expenditure (deficit) is countered by a decrease in private consumption and investment spending.

The Ricardian equivalence results in the first sample could be as a result of how the economy failed to consider inflation expectations from fiscal policy. Reactions of the public to government changes in the budget deficit may be informed by what levels of inflation are expected after the government policy. For instance, if the private sector expects inflation to rise following an increase in the budget deficit, they expect their real incomes to fall and may in response plan more saving to smoothen their consumption behavior. This results in Ricardian tendencies to the fiscal policy.

In the first sample for Canada, we did find causality from inv_t to bb_t, suggesting that investment spending has some past information to explain the changes in the government budget balance. Therefore, in periods before the introduction of inflation targeting in Canada, the government budget balance was influenced by past levels of investment spending. It is possible that government included investment spending in their reaction function that determined fiscal policy.

Contrary to the results for the first subsample for Canada, the second subsample reveals some linkages between the variables. Not only did we find causality from inv_t to bb_t; we found that bb_t Granger-causes ca_t and ca_t Granger-causes bb_t. Moreover, we found causality from ca_t to inv_t. With these results, we found a bi-directional relationship between the current account balance and the government budget balance for Canada in the period after the introduction of inflation targeting. This feedback linkage between the two deficits may be as a result of the monetary policy guided by rules. Shocks to either of the two deficits have short run effects on the other.

The causality from bb_t to ca_t suggests that changes in the current account deficit may be explained by past changes in the government budget balance, supporting the conventional twin deficit hypothesis at least in the short run. This finding is consistent with the theoretical IS-MP model developed in section 3.3.1 in chapter three. From Figure 3.3, the interplay of the "Increased income" effect, "Reaction monetary policy" effect and "BOP deficit" effect causes an increase (decrease) in the government budget deficit to increase (decrease) the current account deficit.

There is also evidence of current account targeting as explained by Summers (1988). Khalid and Guan (1999) have indicated that in economies where trade plays a relatively more important role, domestic developments are dictated by the foreign balance to a certain extent. In this sense this relationship between the two deficits could be explained by the fact that efforts were made by government to forestall the effects of the financial crisis in Canada as explained by Kim and Kim (2006). They argue that excessive current account deficits may create a financial crisis or insolvency. Rehabilitating the troubled financial sectors of such an economy may require large injections of public funds. This explanation does not seem sufficient for the reverse causation between the government budget deficit and the current account deficit observed in Canada.

One of the advantages of inflation targeting as a monetary policy is how it models inflation expectations and makes monetary policy more transparent, making the targets more credible. Such policies can effectively lower inflation expectations, especially when the policy is sharp enough to reduce inflation consistently below its target for some time. Kearney and Monadjami (1990) use this argument to explain the case of reverse causation as in the case of Canada, illustrated in Figure 5.1. A decrease in expected inflation would lead to a currency appreciation and decrease net exports. The trade deficit will have the usual multiplier-type decrease in output and consequently reduce tax revenues, resulting in budget deficits.

This explanation could be linked to the relationship between current account balance and investment spending. We found that the current account balance contains past information that can help explain changes in investment spending, implying that investment spending responds to changes in the current account balance. Since investors expect a trade deficit to cause a decrease in output, hence income, their profitability is expected to fall. Investment spending therefore responds to changes in the current account balance due to expected changes in the profitability of investment.

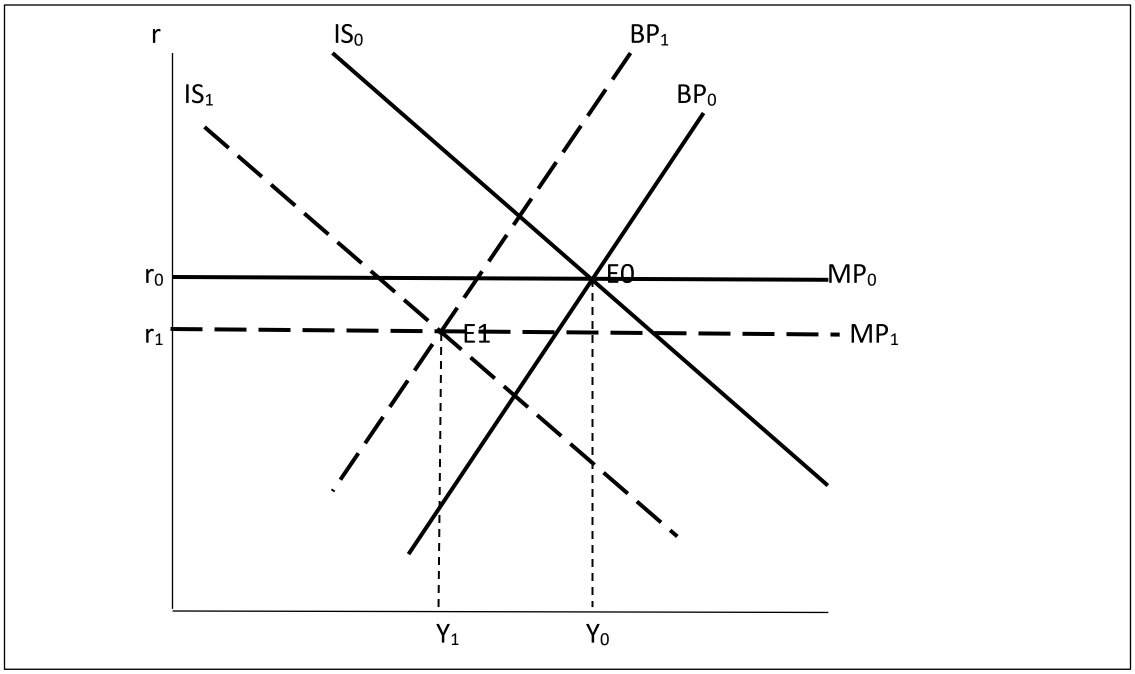

Figure 5.1: IS-MP diagram: effects from fall in inflation expectations.
Fall in inflation expectations causes the local currency to appreciate, causing net exports to fall. The fall in net exports causes the BP curve to shift from BP0 to BP_1 and the IS from IS_0 to IS_1. Monetary policy in response to the decrease in inflation expectations causes the MP curve to shift from MP_0 to MP1 decreasing income from Y_0 to Y_1.

5.3.2. UNITED KINGDOM

The relationship between the current account balance and the budget balance are quite different for the U.K. compared to Canada. We found causality from bb_t to ca_t in the period before inflation targeting, but not in the period after it was implemented. This result for the first subsample supports the predictions of the Mundell-Fleming model (illustrated in Figure 3.1) against the Ricardian equivalence postulation. In the period after the new monetary policy, the connection between the two deficits is not clear.

We also found that there is no causality from the current account balance to the government budget balance in either of the two sample periods. This suggests that there is only a weak evidence (10% significance level) for current account targeting in the U.K. in the post-rule period. The possible explanation is that the U.K. economy is very open to the international financial markets, thus making targeting the current account very difficult. In a well-integrated market, expectations of inflation are formed based on international and domestic conditions, weakening or short circuiting the view of Kearney and Monadjami (1990) on reverse causation.

Again, the results suggest that investment spending Granger-causes the current account balance in the pre-rule period, but not in the period after the adoption of the rule. This supports the relationship between the two deficits obtained in the period before inflation targeting. The fact that past information of investment spending helps to explain changes in the current account implies that changes in domestic investment causes an adjustment in the inflow of capital from outside the economy, causing the current account to change. This is understood in terms of degree of capital mobility that is needed to have a causality running from the government budget deficit to the current account deficit.

These results question the extent to which the new monetary policy has been successful in dealing with expectations. Table 4.3.4 shows that the government budget balance Granger-causes investment spending in the period after the policy. Firms' expectations of inflation and interest rates condition their expected real revenues and profitability of investment, thus affecting investment spending. These expectations cause changes in private saving to offset changes in public saving, breaking the link between the two deficits (Florio and Ghiani, 2015).

The results of the U.K. may also be explained by some of the challenges in adopting inflation targeting as a new monetary policy regime. The secession of the Pound sterling from the European Exchange Rate Mechanism (ERM) in 1992 posed significant challenges in adopting the new rules-based monetary policy[17]. The measurement of inflation in the U.K. to assist in monetary policy has had some challenges. The Office of National Statistician acknowledged in 2003 that the Retail Prices Index excluding mortgage interest payments (RPIX) inflation rate was not an appropriate measure of inflation, resulting in a switch to the use of the Consumer Price Index (CPI). These two measures of inflation are different in terms of formulae and coverage, capable of affecting the monetary policy target rate. This could have contributed to the weak relationship between the two deficits.

5.3.3. UNITED STATES

There are different relationships between the government budget deficit and the current account deficit for the different periods under study for the United States. In the first period when monetary policy is thought to be discretionary, there is Granger-causality from bb_t to ca_t supporting the case of the conventional twin deficit hypothesis as explained within the Mundell-Fleming model in Figure 3.1. Moreover, we found that the government budget balance Granger-causes investment spending. These findings are consistent with the predictions of the IS-LM-BP model and the findings of Gali (1992).

We did not find causality from bb_t to ca_t in the second period when the Fed was suspected to be following some sort of Taylor monetary rule. Instead there is causality from the current account balance to the government budget balance. The reverse causation between the two deficits may be explained by the new monetary policy guided by rules. Like the Canadian case explained in Figure 5.1, the suspected policy rule caused inflation expectations to fall, resulting in noted currency appreciation and a subsequent decrease in

[17] Haldane (2000) for instance explains that the exit from the ERM caused inflation expectations to rise over the next two decades resulting in a loss of credibility.

net exports and income. The decrease in income caused tax revenues to fall creating an increasing budget deficit.

The U.S. case is special in different ways. In the first place, the use of monetary policy tools and targets have been a subject of concern in the U.S. The use of the CPI as a measure of inflation has been questioned in addition to the kind of monetary rule the Fed used. Transparency has been outlined as one of the fundamental features of monetary policy guided by rules that is needed to insure the success of the policy. This is because transparency makes the policy credible and makes modelling inflation expectations easier and more accurate. From 1992 to 2003 when the Fed was said to have followed a monetary policy rule, the rule was only known to the Fed and this caused the private sector to speculate the nature of the rule that was being followed.

The U.S. Fed assigns and emphasizes other objectives to monetary policy besides the core mandate of inflation targeting. The Federal Reserve Act specifies that monetary policy should seek "to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates."[18] Though modern monetary policy seeks to control inflation, the Fed's primary mandate is to use monetary policy to maximize employment while keeping inflation and interest rates in check. Thus, the kind of rule followed by the Fed may be different from the usual inflation targeting that has been adopted by other modern economies. In view of this, much more needs to be known about the monetary rule used by the Fed to explain the results of the previous chapter.

[18] See Federal Reserve Act, Section 2A, http://www.federalreserve.gov/aboutthefed/section2a.htm.

The Fed's monetary policy objective as stated above makes the MP curve different from that of inflation targeting. The MP curve is therefore no longer perfectively elastic, but is drawn like that in Figure 5.2. The net effect on the current account deficit will depend on the size of the initial current account decrease from increased income, and the subsequent current account increase due to an increase in the interest rate target (to check the income growth beyond potential).

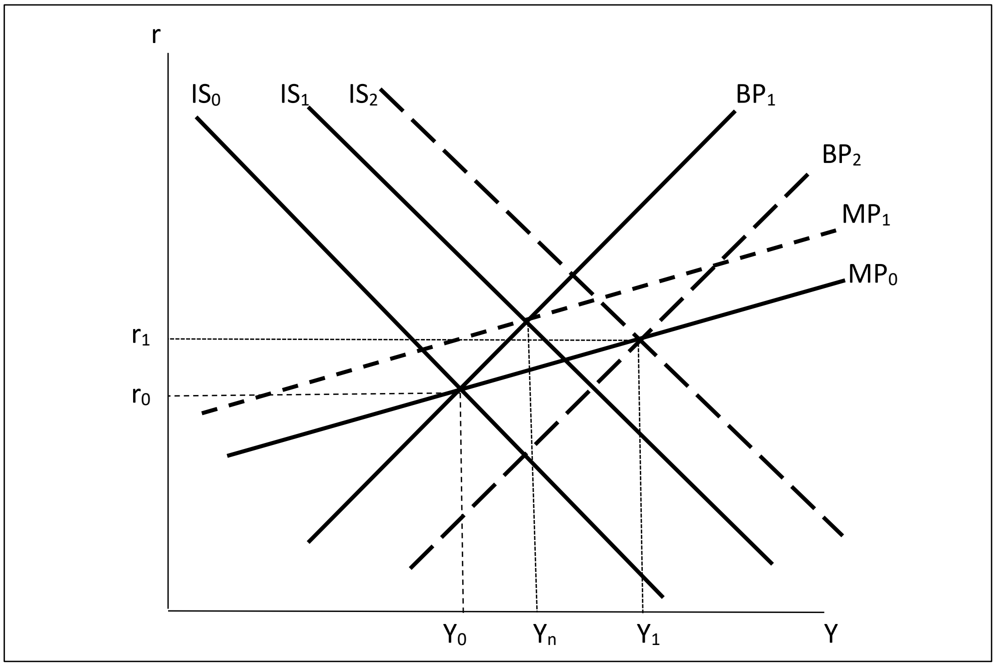

Figure 5.2: IS-MP diagram: when policy targets both inflation and output growth, assuming increased output as a result of fiscal expansion exceeds full employment output.

Fiscal expansion causes the IS curve to shift from IS_0 to IS_1. At the new intersection of IS and MP, income has increased, increasing imports and a trade deficit, while the interest rate is low to be on the BP curve. This means capital inflow will occur, but not enough to maintain BP = 0, so BP < 0. The exchange rate then depreciates, shifting the IS curve to the right (higher exports) and the BP curve to the right until all 3 curves intersect. The current account could still be in a deficit, but it is matched by a surplus in the capital account so BP = 0. This will depend on the net effect from initial current account decrease from increased income and the subsequent increase due to an increase in the target interest rate.

CHAPTER SIX

6. SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

6.1. SUMMARY

The twin-deficit hypothesis and Ricardian equivalence hypothesis have received much attention in the economic literature. We have provided theoretical explanations and empirical results to explain the relationship between the government budget deficit and the current account deficit. These explanations work through various transmission mechanisms and are dependent on different factors including the exchange rate regime, the degree of capital mobility, the size of the economy, and the tax system among others.

The traditional paradigm to model the relationship between the two deficits has been the IS-LM-BP framework of the Mundell-Fleming model. Amidst many criticisms, the usefulness of this framework greatly depends on how easy it presents the mechanics of the economy into graphical representations, summing up the complexities into movements of curves to reach some form of equilibrium. Each of the curves represents a specific aspect of the economy based on certain assumptions: the IS curve represents the interest rate and output combinations that ensure equilibrium in the goods markets; the LM shows the combinations of interest rate and output combination that ensure equilibrium in the money market, while; the BP represents the combinations of the interest rate and output that ensure external equilibrium.

A key criticism levelled against the Mundell-Fleming model as a representation of the economy is how it fails to capture the expectations of actors of the economy, especially with regards to inflation. The role of inflation expectations has been cited as a reason for the failure of policies from achieving intended outcomes. The upshot of this is that there is a yawning gap between the prediction of the theory and reality. In response to this, monetary policy in modern economies has been committed to dealing with inflation and inflation expectations. This is underpinned by the idea of the neutrality of money, explaining that monetary policy has no real effect in the long-run. The new monetary policy regime therefore calls for a reconsideration of the framework of the IS-LM-BP model since the LM curve fails to typify the new monetary policy regime.

We therefore develop an IS-MP model with a BP curve to analyze the relationship between the government budget balance and the current account balance as an alternative to the IS-LM-BP framework. The predictions of the model from an increase in the government deficit depends upon whether the increase in output is below or exceeds full employment output. The model incorporates inflation expectations which affects the monetary policy (MP) curve.

We use data from three modern economies: Canada, the U.K. and the U.S., to test the predictions of each model. These countries were selected based on the facts that they have each switched monetary policy from discretionary to policy guided by rules and have a long data span to aid in the empirical analysis. Our empirical method first considered the data generating process of the government budget balance (bb_t), the current account balance (ca_t) and investment spending (inv_t) by performing unit root tests on the series. Initially we ignored any structural breaks in the series and later imposed a structural break at the time of the change in monetary policy regime.

The ADF unit root test found that almost all the series for the three countries contained a unit root except for the current account balance of Canada and the U.K., which rejected the presence of a unit root at the 5% (but not at 1%) and 10% significance levels respectively. Before imposing the structural break, the Perron (1989) test suggested that the current account balance and investment spending of Canada and the U.S. contained a unit root. However, the U.K. current account balance was found to be trend-stationary, integrated of order zero ($I(0)$) at the 5% significance level.

Based on these puzzling results, we further investigated the pre-and post-break features of the series by breaking the data into two periods based on the monetary policy structural breaks. The results for the U.S. were more consistent, showing that the pre- and post-break features of the series do not differ greatly in the first two samples. There were some changes for the test on investment spending and the government budget balance within the third sample. The ADF test suggested that the government budget balance for the U.S. third sample is integrated of order zero ($I(0)$) while investment spending is integrated of order two ($I(2)$). The results for Canada and the U.K. showed that the pre- and post-break series of the government budget balance and investment spending contained unit roots. However, the ADF test rejected the null hypothesis of a unit root at the 5% significance level for the pre-break current account series. The inferences from the Horioka-Feldstein argument and the subsequent procedure of Gundlach and Sinn (1992) suggest that the degree of capital mobility increases within the Canadian and U.K. economies following the introduction of inflation targeting as a new monetary policy regime.

Motivated by the results of the unit root tests, we tested for cointegration between the series to ascertain whether there is any long-run equilibrium between the series. The test was conducted by initially ignoring the monetary policy break and then considering the break in various forms. The results suggest that there is no long-run relationship between the government budget balance, the current account balance and investment spending for the three countries. The evidence for the twin-deficit hypothesis is little to none when the monetary policy regimes are taken into account.

Following the results for the cointegration analysis, we employed the procedure espoused by Toda and Yamamoto (1995) to assess the short-run relationship between the series. Because the break was found to be statistically significant for all three countries, we performed the Granger-causality tests on the pre-and post-break samples.

We found no relationship between the government budget deficit and the current account deficit for the pre-break sample for Canada, suggesting evidence for a Ricardian equivalence hypothesis effect of the fiscal deficit. We estimated bi-directional causality between the two series for the post-break sample, suggesting evidence for the IS-MP model developed in Figure 3.4. Contrary to the results for Canada, the results for the U.K. and the U.S. suggest causality from the government budget balance to the current account balance in the pre-break sample but not in the post-break sample. The change in monetary policy regime appears to have weakened the twin-deficit hypothesis for the reasons given in the previous chapter, including: persistent fall in inflation expectations as a result of the policy, wrong measurement of policy tools and targets, lack of transparency of policy rule and other challenges associated with implementing the policy rule.

6.2. CONCLUSION

We identified that changing the monetary policy regime from discretionary to inflation targeting affects the data generating features of the current account. By inference this demonstrates that the degree of capital mobility is enhanced by inflation targeting as a monetary policy. This is because inflation targeting can deal with the effects arising from changes in inflation expectations, which in turn boosts investor confidence causing a regular inflow of foreign savings to finance domestic investment.

The improvement in capital mobility is a prerequisite for effective fiscal policy and how the policy affects external balance. This implies that inflation targeting as a monetary policy regime enhances the effectiveness of fiscal policy and how it can be used to affect changes in the external balance of an economy. However, the effectiveness of inflation targeting in doing this depends on how well it deals with inflation expectations.

Introducing inflation targeting during times of high and volatile inflation could result in a persistent fall in inflation expectations, short-circuiting the link from fiscal policy to external equilibrium or even creating reverse causality from changes in the external balance to output, and thus the government budget balance and public debt. From Figure 5.1, fall in inflation expectations causes the local currency to appreciate, resulting in a fall in net exports and income. The monetary policy rule must be accurate and credible enough to curtail the effects of inflation expectations and not cause changes in the expectations of private actors.

6.3. POLICY RECOMMENDATIONS

The outcome of the empirical studies suggests that, monetary policy guided by rules improves capital mobility thereby guaranteeing a regular inflow of foreign savings to finance domestic investment. Our empirical results suggest that a move to a rules-based monetary policy alleviates the burden of the twin-deficit effect for an effective fiscal policy. Hence, if policy is aimed at attracting foreign capital, inflation targeting helps to boost investor confidence by its ability to control inflation and its volatility. Controlling inflation variability puts inflation expectations in check which is a powerful incentive for investment.

Moreover, in as much as inflation targeting helps control the effects of inflation expectations, the effectiveness of fiscal policy is enhanced within the economy. If government intends to use fiscal policy to effect changes in the external balance and debt, monetary policy should be geared towards controlling inflation expectations and improving capital mobility. Though monetary policy guided by rules is believed to help achieve other objectives, such as ensuring higher output and employment, the emphasis should be laid on its ability to control inflation if it is to be coordinated with fiscal policy.

For inflation targeting to accomplish these objectives, the right tools and targets must be included in the policy rule. The appropriate measurement of inflation should be used as well as the appropriate short-term interest rate, capable of effecting changes in response to inflationary or deflationary pressures. The policy rule should be transparent and known to the public to avert any form of speculation regarding the form of the policy rule being used. These efforts will assist the monetary policy authority to build a credible monetary rule which will affect the expectations of actors of the economy.

6.4. WEAKNESSES OF THE STUDY

The methods and results in this study are not without their weaknesses. The scope of the study is limited by available data to make many generalizations about the outcome. With only three advanced economies included in our sample, making generalizations about policy is highly limited especially when reference is made to developing countries who might have different economic outlooks.

Moreover, the study does not consider other potential factors that may be relevant to the changes in the data generating process and the relationships existing between the series. The size of the economy for instance has been explained to affect the degree of capital mobility, while factors including the tax system and trade openness might affect the effectiveness of fiscal policy. These unconsidered factors may also account for the results of the study and can only be properly captured by developing structural models of the economies, rather than relying on purely time series methods.

6.5. FURTHER AREAS OF RESEARCH

The study could be expanded using a greater number of countries to be more certain about the results. These countries could also include developing countries to verify whether the level of economic development has a role in explaining the effects of inflation targeting on fiscal policy. Moreover, efforts to control for other factors like the size of the economy could be done to isolate the effects of inflation targeting on fiscal policy.

Again, the study could be expanded using models with structural equations to assess how changes in monetary policy regime affect the economy through its impact on important variables. The VAR approach used here does not impose any restrictions implied by structural models and uses only a few macroeconomic variables. Research into the how different variables included in the policy rule may produce different results will be useful in accessing which variables should be emphasized in the rule.

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APPENDIX

A: LAG SELECTION PROCEDURE FOR UNIT ROOT TESTS

The values of the AIC, SBIC and HQIC respective and evaluated using the following formulae.

$$AIC = -2\left(\frac{LL}{T}\right) + \frac{2t_p}{T};\ SBIC = -2\left(\frac{LL}{T}\right) + \frac{ln(T)}{T}t_p \text{ and } HQIC = -2\left(\frac{LL}{T}\right) + \frac{2ln\{ln(T)\}}{T}t_p$$

where T is the number of observations, t_p is the total number of parameters in the model and LL is the log likelihood given by; $LL = -\left(\frac{T}{2}\right)\left\{ln\left(\left|\hat{\Sigma}\right|\right) + K\ln(2\pi) + K\right\}$, where K is the number of equations, and $\hat{\Sigma}$ is the maximum likelihood estimate of $E[u_t u'_t]$ where u_t is the $K\times 1$ vector of disturbances. For more studies, see the works of Hamilton (1994, 295–296) and Lutkepohl (2005, 147).

Table A.1: Lag selection criteria for Canada

K	ca	bb	inv
0	-2113.284*	-1506.733	-1820.132
1	-2100.749	-1515.252*	-1825.897*
2	-2088.705	-1505.583	-1820.428
3	-2076.997	-1496.319	-1813.748
4	-2068.535	-1488.552	-1804.365
5	-2058.091	-1478.728	-1793.211
6	-2046.39	-1469.293	-1785.482

Table A.2: Lag selection criteria for the U.K.

K	ca	bb	inv
0	-1460.69	-788.6434	-1693.6*
1	-1462.088*	-823.5809	-1686.806
2	-1456.562	-822.5762	-1676.803
3	-1448.444	-1193.533	-1668.162
4	-1440.031	-1279.496	-1658.715
5	-1430.456	-1282.019*	-1649.546
6	-1423.293	-1273.593	-1640.463

Table A.3: Lag selection criteria for the U.S.-First Sample			
K	ca	bb	inv
0	-1477.491*	-1194.285	-1996.164*
1	-1466.218	-1193.32	-1988.942
2	-1455.453	-1209.877	-1980.494
3	-1445.552	-1367.599	-1966.394
4	-1434.065	-1384.425*	-1954.05
5	-1423.13	-1383.114	-1950.936
6	-1412.763	-1371.829	-1937.307

Table A.4: Lag selection criteria for the U.S.-Second Sample			
K	ca	bb	inv
0	-700.1116*	-534.2998	-981.4794
1	-688.7888	-526.8465	-993.3018*
2	-678.3613	-526.6944	-986.7227
3	-667.7319	-584.373	-977.0382
4	-657.6387	-590.8255*	-964.7989
5	-646.289	-588.4191	-949.4899
6	-639.4676	-583.7033	-934.3999

Table A.5: Lag selection criteria for Canada- Pre-Break Sample			
K	ca	bb	inv
0	-1150.877*	-805.6739*	-957.8819*
1	-1140.6	-804.6018	-956.1879
2	-1129.081	-795.4812	-948.2259
3	-1118.312	-786.592	-941.5243
4	-1112.592	-781.5849	-931.5136
5	-1102.392	-771.7885	-920.6672
6	-1091.147	-762.3109	-912.5959

Table A.6: Lag selection criteria for Canada- Post-Break Sample			
K	ca	bb	inv
0	-951.9668*	-696.6838	-860.6534*
1	-941.0073	-700.2562*	-857.7427
2	-928.5358	-690.1412	-848.6841
3	-916.9398	-681.4011	-837.2875
4	-904.4523	-675.1512	-835.0327
5	-892.2193	-670.9929	-824.265
6	-880.8115	-661.14	-818.3861

Table A.7: Lag selection criteria for the U.K.- Pre-Break Sample			
K	Ca	bb	inv
0	-860.3943*	-453.4954	-972.2555*
1	-856.0471	-456.9621	-963.3267
2	-846.6903	-453.333	-953.2297
3	-838.2813	-681.7754	-949.8515
4	-829.8312	-710.6561	-943.528
5	-820.2718	-710.7199*	-933.3472
6	-812.4358	-702.7984	-923.9904

Table A.8: Lag selection criteria for the U.K.- Post-Break Sample			
K	Ca	bb	inv
0	-594.3016*	-352.0203	-722.2616
1	-589.2385	-378.6939	-712.8864
2	-584.9498	-371.7674	-702.1417
3	-585.1427	-484.2134	-696.1284
4	-576.4648	-541.8093*	-688.0521
5	-566.9156	-533.5308	-681.7092
6	-558.624	-524.4144	-670.7965

Table A.9: Lag selection criteria for the U.S.- First Period of Discretionary Policy			
K	ca	bb	inv
0	-1124.231*	-928.0038	-1509.55*
1	-1113.695	-932.9775	-1500.351
2	-1104.002	-950.1853	-1489.194
3	-1094.832	-1047.081	-1475.168
4	-1083.385	-1059.292*	-1462.04
5	-1072.125	-1050.342	-1458.408
6	-1061.467	-1039.21	-1444.78

Table A.10: Lag selection criteria for the U.S.- Period of Policy Rule			
K	ca	bb	inv
0	-383.575*	-290.3098	-533.4679*
1	-373.2616	-280.7257	-519.8069
2	-362.7306	-273.4113	-510.3359
3	-352.2354	-315.2369*	-497.7458
4	-342.1513	-311.8426	-486.849
5	-335.437	-309.8322	-472.0137
6	-324.2536	-308.4266	-458.749

Table A.9: Lag selection criteria for the U.S.- Second Period of Discretionary Policy			
K	ca	bb	inv
0	-268.8785*	-213.2967*	-385.7451
1	-260.0213	-205.6051	-395.4731*
2	-249.1682	-198.4794	-381.3989
3	-240.6326	-206.7541	-368.4899
4	-230.0465	-201.98	-353.4512
5	-219.8297	-195.5466	-341.6555
6	-211.0679	-186.5821	-327.054

B: FURTHER UNIT ROOT TEST

Table B.1: ADF Test for Pre-Break Sample- Canada

		t-stat	t-stat	Critical Values			
Variable	k	Level	First Difference	10%	5%	1%	Order of integration
ca	0	-3.220		-2.579	-2.889	-3.503	*I*(0)
bb	0	-1.706	-14.52	-2.579	-2.889	-3.503	*I*(1)
inv.	0	-1.629	-8.721	-2.579	-2.889	-3.503	*I*(1)

Table B.2: ADF Test for Post-Break Sample- Canada

		t-stat	t-stat	Critical Values			
Variable	k	Level	First Difference	10%	5%	1%	Order of integration
ca	0	-1.739	-11.06	-2.580	-2.890	-3.510	*I*(1)
bb	1	-2.016	-14.255	-2.580	-2.890	-3.510	*I*(1)
inv.	0	-1.023	-7.43	-2.580	-2.890	-3.510	*I*(1)

Table B.3: ADF Test for Pre-Break Sample- U.K.

		t-stat	t-stat	Critical Values			
Variable	K	Level	First Difference	10%	5%	1%	Order of integration
ca	0	-3.500		-2.578	-2.888	-3.500	*I*(0)
bb	5	-1.276	-3.998	-2.578	-2.888	-3.500	*I*(1)
inv.	0	-2.503	-12.891	-2.578	-2.888	-3.500	*I*(1)

Table B.4: ADF Test for Post-Break Sample- U.K.

		t-stat	t-stat	Critical Values			
Variable	K	Level	First Difference	10%	5%	1%	Order of integration
ca	0	-2.774	12.792	-2.583	-2.896	-3.521	*I*(1)
bb	4	-2.048	-3.496	-2.585	-2.900	-3.527	*I*(1)
inv.	0	-2.464	-11.215	-2.583	-2.896	-3.521	*I*(1)

Table B.5: ADF Test U.S.- First Period of Discretionary Policy

		t-stat	t-stat	Critical Values			
Variable	K	Level	First Difference	10%	5%	1%	Order of integration
ca	0	-1.546	-10.68	-2.578	-2.888	-3.500	*I*(1)
bb	4	-2.235	-6.816	-2.578	-2.888	-3.501	*I*(1)
inv.	0	-0.865	-9.536	-2.578	-2.888	-3.500	*I*(1)

Table B.6: ADF Test U.S.- Period of Policy Rule

		t-stat	t-stat				
Variable	K	Level	First Difference	10%	5%	1%	Order of integration
ca	0	-0.765	-7.682	-2.608	-2.950	-3.628	*I*(1)
bb	3	-0.649	-18.794	-2.612	-2.958	-3.648	*I*(1)
inv.	0	-2.033	-5.051	-2.608	-2.950	-3.628	*I*(1)

Table B.5: ADF Test U.S.- Second Period of Discretionary Policy

		t-stat	t-stat	t-stat	Critical values			
Variable	k	Level	First Diff.	Second Diff.	10%	5%	1%	Order of integration
ca	0	-0.650	-5.667		-2.619	-2.975	-3.689	*I*(1)
bb	0	-3.648			-2.619	-2.975	-3.689	*I*(0)
inv.	1	-1.128	-2.697	-5.495	-2.620	-2.978	-3.696	*I*(2)

C: LAG SELECTION FOR VAR MODEL

Table C.1: VAR lag Selection for Pre-Break Sample- Canada

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	1119.87				1.0e-12	-19.0918	-19.063	-19.021
1	1438.33	636.92	9	0.000	5.2e-15	-24.3817	-24.2667	-24.0984*
2	1453.82	30.969*	9	0.000	4.6e-15*	-24.4926*	-24.2913*	-23.9968
3	1461.98	16.33	9	0.060	4.7e-15	-24.4783	-24.1908	-23.77
4	1467.8	11.637	9	0.235	5.0e-15	-24.4239	-24.0501	-23.5032

Table C.2: VAR lag Selection for Post-Break Sample- Canada

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	930.299				1.0e-12	-19.1196	-19.0874	-19.0399
1	1241.11	621.62	9	0.000	2.0e-15	-25.3425	-25.2137	-25.024
2	1264.09	45.966*	9	0.000	1.5e-15*	-25.6308*	-25.4054*	25.0734*
3	1270.57	12.947	9	0.165	1.6e-15	-25.5787	-25.2567	-24.7824
4	1272.69	4.2412	9	0.895	1.8e-15	-25.4369	-25.0183	-24.4017

Table C.3: VAR lag Selection for Pre-Break Sample- U.K.

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	942.453				8.5e-11	-14.679	-14.6518	-14.6121
1	1138.18	391.46	9	0.000	4.6e-12	-17.5966	-17.488	-17.3292
2	1144.38	12.398	9	0.192	4.8e-12	-17.5528	-17.3627	-17.0849
3	1146.67	4.575	9	0.870	5.3e-12	-17.448	-17.1764	-16.7795
4	1281.85	270.36*	9	0.000	7.4e-13*	-19.4195*	-19.0664*	-18.5505*

Table C.4: VAR lag Selection for Post-Break Sample- U.K.

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	715.22				2.2e-11	-16.005	-15.9711	-15.9211
1	825.848	221.25	9	0.000	2.3e-12	-18.2887	-18.1535	-17.9532
2	838.8	25.904	9	0.002	2.1e-12	-18.3775	-18.1408	-17.7903
3	844.359	11.118	9	0.268	2.3e-12	-18.3002	-17.9621	-17.4613
4	920.715	152.71*	9	0.000	5.0e-13*	-19.8138*	-19.3743*	-18.7233*

Table C.5: VAR Lag Selection for the U.S.- First Period of Discretionary Policy

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	1429.07				4.2e-14	-22.2824	-22.2552	-22.2156
1	1758.34	658.53	9	0.000	2.8e-16	-27.2865	-27.1779	-27.0192
2	1779.86	43.048	9	0.000	2.3e-16	-27.4822	-27.2921	-27.0143
3	1793.82	27.923	9	0.001	2.2e-16	-27.5597	27.2881	-26.8913
4	1855.3	122.95*	9	0.000	9.5e-17*	-28.3797*	-28.0266*	-27.5107*

Table C.6: VAR Lag Selection for the U.S.- Period of Policy Rule

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	461.024				2.3e-14	-22.9012	-22.8554	-22.7745
1	578.966	235.88	9	0.000	9.8e-17	-28.3483	-28.1651	-27.8416
2	594.817	31.703	9	0.000	7.0e-17	-28.6909	-28.3703	-27.8042
3	619.328	49.022	9	0.000	3.3e-17	-29.4664	-29.0084	-28.1998
4	641.093	43.529*	9	0.000	1.8e-17*	-30.1046*	-29.5093*	-28.458*

Table C.7: VAR Lag Selection for the U.S.- Second Period of Discretionary Policy

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	356.311				2.5e-14	-22.7943	-22.749	-22.6555
1	422.195	131.77	9	0.000	6.5e-16	-26.4642	-26.2832	-25.9091*
2	434.758	25.126	9	0.003	5.2e-16*	-26.694*	-26.3774*	-25.7226
3	437.255	4.9949	9	0.835	8.4e-16	-26.2745	-25.8222	-24.8868
4	450.749	26.988*	9	0.001	6.9e-16	-26.5645	-25.9764	-24.7604

D: VECTOR AUTOREGRESSION RESULTS

Table D.1: VAR Pre-Break Sample- Canada

ca	coeff	Std. Err.	z	P>|z|
ca_{t-1}	0.8817982	0.0940694	9.37	0.000
ca_{t-2}	-0.0656096	0.1239075	-0.53	0.596
ca_{t-3}	-0.0720148	0.0954029	-0.75	0.450
bb_{t-1}	0.0114238	0.0238567	0.48	0.632
bb_{t-2}	-0.0275333	0.0271312	-1.01	0.310
bb_{t-3}	0.0238771	0.0242179	0.99	0.324
inv_{t-1}	-0.091234	0.0451255	-2.02	0.043
inv_{t-2}	0.0759388	0.0648596	1.17	0.242
inv_{t-3}	-0.0035741	0.0451295	-0.08	0.937
const	0.0021363	0.002842	0.75	0.452
bb				
ca_{t-1}	-0.4086608	0.3590143	-1.14	0.255
ca_{t-2}	-0.132649	0.4728907	-0.28	0.779
ca_{t-3}	0.6453996	0.3641034	1.77	0.076
bb_{t-1}	0.5629054	0.0910487	6.18	0.000
bb_{t-2}	0.3108582	0.1035456	3.00	0.003
bb_{t-3}	0.0810688	0.092427	0.88	0.380
inv_{t-1}	0.1955329	0.1722207	1.14	0.256
inv_{t-2}	0.2285086	0.2475354	0.92	0.356
inv_{t-3}	-0.5170193	0.1722358	-3.00	0.003
const	0.0159463	0.0108463	1.47	0.142
inv				

ca_{t-1}	-0.3879067	0.2030312	-1.91	0.056
ca_{t-2}	0.1668526	0.267431	0.62	0.533
ca_{t-3}	0.2038002	0.2059092	0.99	0.322
bb_{t-1}	-0.0025709	0.0514902	-0.05	0.960
bb_{t-2}	-0.0280319	0.0585575	-0.48	0.632
bb_{t-3}	0.0401428	0.0522697	0.77	0.442
inv_{t-1}	1.097875	0.0973949	11.27	0.000
inv_{t-2}	-0.0373736	0.1399872	-0.27	0.789
inv_{t-3}	-0.1342818	0.0974035	-1.38	0.168
const	0.0137113	0.0061338	2.24	0.025

Table D.2: VAR Post-Break Sample- Canada

ca	coeff	Std. Err.	z	P>|z|
ca_{t-1}	0.8933048	0.1119381	7.98	0.000
ca_{t-2}	-0.0077621	0.1606464	-0.05	0.961
ca_{t-3}	-0.0541843	0.1197248	-0.45	0.651
bb_{t-1}	-0.0716278	0.0316412	-2.26	0.024
bb_{t-2}	0.1040447	0.0352271	2.95	0.003
bb_{t-3}	0.0031563	0.032349	0.10	0.922
inv_{t-1}	-0.0244063	0.0707805	-0.34	0.730
inv_{t-2}	0.0521221	0.1166444	0.45	0.655
inv_{t-3}	-0.0769315	0.0746512	-1.03	0.303
const	0.0086564	0.0034943	2.48	0.013

bb	coeff	Std. Err.	z	P>|z|
ca_{t-1}	0.4812416	0.3636113	1.32	0.186
ca_{t-2}	0.5414739	0.5218315	1.04	0.299
ca_{t-3}	-1.039275	0.388905	-2.67	0.008
bb_{t-1}	0.4635139	0.1027807	4.51	0.000
bb_{t-2}	0.2930305	0.1144292	2.56	0.010
bb_{t-3}	0.1829572	0.1050799	1.74	0.082
inv_{t-1}	0.6194554	0.229918	2.69	0.007
inv_{t-2}	-0.2969814	0.3788989	-0.78	0.433
inv_{t-3}	-0.3370862	0.2424914	-1.39	0.164
const	0.0024495	0.0113507	0.22	0.829

inv	coeff	Std. Err.	z	P>|z|
ca_{t-1}	0.6675475	0.1663168	4.01	0.000
ca_{t-2}	-0.5152067	0.2386872	-2.16	0.031
ca_{t-3}	-0.0725855	0.1778862	-0.41	0.683
bb_{t-1}	-0.0156039	0.0470122	-0.33	0.740
bb_{t-2}	0.0245263	0.0523402	0.47	0.639
bb_{t-3}	-0.0193424	0.0480638	-0.40	0.687
inv_{t-1}	1.315988	0.1051652	12.51	0.000
inv_{t-2}	-0.1783424	0.1733094	-1.03	0.303
inv_{t-3}	-0.1459654	0.1109163	-1.32	0.188

const	0.0016806	00051918	0.32	0.746

Table D.3: VAR Pre-Break Sample- U.K.

ca	coeff	Std. Err.	z	P>|z|
ca_{t-1}	0.5719492	0.0925499	6.18	0.000
ca_{t-2}	0.1439235	0.1056857	1.36	0.173
ca_{t-3}	0.071375	0.1057477	0.67	0.500
ca_{t-4}	-0.0737299	0.1047119	-0.70	0.481
ca_{t-5}	0.0244229	0.0883828	0.28	0.782
bb_{t-1}	0.0893481	0.050046	1.79	0.074
bb_{t-2}	0.0036029	0.0190843	0.19	0.850
bb_{t-3}	0.0017835	0.0190005	0.09	0.925
bb_{t-4}	0.0449099	0.0189998	2.36	0.018
bb_{t-5}	-0.0735809	0.0482475	-1.53	0.127
inv_{t-1}	-0.1175211	0.136849	-0.86	0.390
inv_{t-2}	-0.1802899	0.1726377	-1.04	0.296
inv_{t-3}	-0.2245473	0 .171952	-1.31	0.192
inv_{t-4}	0 .2586251	0.1715936	1.51	0.132
inv_{t-5}	0.1449234	0.13809	1.05	0.294
const	0.0218429	0.0133025	1.64	0.101
bb				
ca_{t-1}	-0.0974968	0.1509938	-0.65	0.518
ca_{t-2}	-0.0544981	0.1724247	-0.32	0.752
ca_{t-3}	0.1276672	0.1725258	0.74	0.459
ca_{t-4}	0 .0113629	0.1708359	0.07	0.947
ca_{t-5}	-0.1535366	0.1441952	-1.06	0.287
bb_{t-1}	0.4412597	0.0816493	5.40	0.000
bb_{t-2}	0.0262241	0.0311357	0.84	0.400
bb_{t-3}	0.0076435	0.0309991	0.25	0.805
bb_{t-4}	0.8903689	0.030998	28.72	0.000
bb_{t-5}	-0.3805693	0.0787151	-4.83	0.000
inv_{t-1}	0.3875548	0.2232671	1.74	0.083
inv_{t-2}	-0.2509086	0.2816559	-0.89	0.373
inv_{t-3}	-0.0133202	0.2805373	-0.05	0.962
inv_{t-4}	-0.2517189	0.2799525	-0.90	0.369
inv_{t-5}	-0.105828	0.2252919	-0.47	0.639
const	0.045963	0.0217029	2.12	0.034
inv				
ca_{t-1}	0.0103755	0.0620666	0.17	0.867
ca_{t-2}	-0.0648657	0.0708759	0.92	0.360
ca_{t-3}	0.0310351	0.0709174	0.44	0.662
ca_{t-4}	-0.016664	0.0702228	-0.24	0.812

ca_{t-5}	0.0748899	0.059272	1.26	0.206
bb_{t-1}	0.0377999	0.0335623	1.13	0.260
bb_{t-2}	0.006755	0.0127984	0.53	0.598
bb_{t-3}	0.0007143	0.0127423	0.06	0.955
bb_{t-4}	-0.0062689	0.0127418	-0.49	0.623
bb_{t-5}	-0.0222892	0.0323562	-0.69	0.491
inv_{t-1}	0.7682544	0.0917748	8.37	0.000
inv_{t-2}	0.1561084	0.1157758	1.35	0.178
inv_{t-3}	0.2148252	0.115316	1.86	0.062
inv_{t-4}	-0.0955369	0.1150756	-0.83	0.406
inv_{t-5}	-0.1073844	0.0926071	-1.16	0.246
const	0.0130627	0.0089211	1.46	0.143

Table D.4: VAR Post-Break Sample- U.K.

ca	coeff	Std. Err.	z	P>|z|
ca_{t-1}	0.4625691	0.102318	4.52	0.000
ca_{t-2}	0.003692	0.1150746	0.03	0.974
ca_{t-3}	0.1123422	0.1152529	0.97	0.330
ca_{t-4}	0.3035391	0.1154532	2.63	0.009
ca_{t-5}	0.0695843	0.1102508	0.63	0.528
bb_{t-1}	-0.0988531	0.0655628	-1.51	0.132
bb_{t-2}	-0.0474161	0.0312392	-1.52	0.129
bb_{t-3}	-0.0102381	0.0315957	-0.32	0.746
bb_{t-4}	-0.008783	0.0313589	-0.28	0.779
bb_{t-5}	0.0940577	0.0655535	1.43	0.151
inv_{t-1}	-0.0171325	0.2019562	-0.08	0.932
inv_{t-2}	-0.1246797	0.2291241	-0.54	0.586
inv_{t-3}	0.2892099	0.2318357	1.25	0.212
inv_{t-4}	-0.3364245	0.2339936	-1.44	0.151
inv_{t-5}	0.4165221	0.1918468	2.17	0.030
const	-0.0434316	0.0274927	-1.58	0.114
bb				
ca_{t-1}	0.1568553	0.1252788	1.25	0.211
ca_{t-2}	0.1190385	0.1408981	0.84	0.398
ca_{t-3}	0.0858753	0.1411164	0.61	0.543
ca_{t-4}	-0.2469767	0.1413616	-1.75	0.081
ca_{t-5}	-0.0142499	0.1349918	-0.11	0.916
bb_{t-1}	0.7259965	0.0802756	9.04	0.000
bb_{t-2}	-0.0341398	0.0382495	-0.89	0.372
bb_{t-3}	-0.0648191	0.038686	-1.68	0.094
bb_{t-4}	0.9764896	0.038396	25.43	0.000
bb_{t-5}	-0.7139327	0.0802641	-8.89	0.000
inv_{t-1}	0.4286692	0.2472765	1.73	0.083
inv_{t-2}	-0.5784056	0.280541	-2.06	0.039
inv_{t-3}	0.3761955	0.2838611	1.33	0.185

inv_{t-4}	-0.0682302	0.2865033	-0.24	0.812
inv_{t-5}	-0.0955091	0.2348985	-0.41	0.684
const	-0.0103715	0.0336623	-0.31	0.758

inv	coeff	Std. Err.	z	P>|z|
ca_{t-1}	0.046883	0.0524744	0.89	0.372
ca_{t-2}	-0.0186438	0.0590167	-0.32	0.752
ca_{t-3}	0.0214421	0.0591082	0.36	0.717
ca_{t-4}	0.0739641	0.0592109	1.25	0.212
ca_{t-5}	-0.0865524	0.0565428	-1.53	0.126
bb_{t-1}	0.1024981	0.0336243	3.05	0.002
bb_{t-2}	0.0272568	0.0160212	1.70	0.089
bb_{t-3}	0.0146874	0.0162041	0.91	0.365
bb_{t-4}	-0.0112821	0.0160826	-0.70	0.483
bb_{t-5}	-0.0889044	0.0336195	-2.64	0.008
inv_{t-1}	0.5741628	0.1035745	5.54	0.000
inv_{t-2}	0.076889	0.1175077	0.65	0.513
inv_{t-3}	-0.121615	0.1188984	-1.02	0.306
inv_{t-4}	0.0357379	0.1200051	0.30	0.766
inv_{t-5}	0.2221573	0.0983899	2.26	0.024
const	0.0381456	0.0140998	2.71	0.007

Table D.5: VAR U.S.- First Period of Discretionary Policy

ca	coeff	Std. Err.	z	P>|z|
ca_{t-1}	0.8949784	0.0903418	9.91	0.000
ca_{t-2}	-0.1703163	0.1209385	-1.41	0.159
ca_{t-3}	0.2294056	0.1194071	1.92	0.055
ca_{t-4}	-0.0992543	0.1200981	0.83	0.409
ca_{t-5}	0.0010114	0.0861674	0.01	0.991
bb_{t-1}	0.0416727	0.0751989	0.55	0.579
bb_{t-2}	0.0560744	0.0497803	1.13	0.260
bb_{t-3}	0.1655862	0.0506261	3.27	0.001
bb_{t-4}	0.0832205	0.0509062	1.63	0.102
bb_{t-5}	0.0605378	0.0793003	0.76	0.445
inv_{t-1}	-0.4232925	0.3870233	-1.09	0.274
inv_{t-2}	0.187323	0.5608588	0.33	0.738
inv_{t-3}	0.2233906	0.5568158	0.40	0.688
inv_{t-4}	0.3268716	0.561601	0.58	0.561
inv_{t-5}	-0.4949861	0.3949029	-1.25	0.210
const	0.0117178	0.0074868	1.57	0.118

bb				
ca_{t-1}	0.0060173	0.10362580	0.06	0.954
ca_{t-2}	0.0093329	0.1387216	0.07	0.946
ca_{t-3}	0.1200755	0.136965	0.88	0.381
ca_{t-4}	-0.1439808	0.1377576	-1.05	0.296

ca_{t-5}	0.0217313	0.0988376	0.22	0.826
bb_{t-1}	0.3861227	0.0862563	4.48	0.000
bb_{t-2}	-0.1026313	0.0571002	-1.80	0.072
bb_{t-3}	0.0047021	0.0580703	0.08	0.935
bb_{t-4}	0.8233358	0.0583916	14.10	0.000
bb_{t-5}	-0.3231535	0.0909608	-3.55	0.000
inv_{t-1}	0.8633106	0.4439322	1.94	0.052
inv_{t-2}	-0.1838226	0.6433288	-0.29	0.775
inv_{t-3}	-0.0430211	0.6386914	-0.07	0.946
inv_{t-4}	-0.3850097	0.6441802	-0.60	0.550
inv_{t-5}	-0.2027592	0.4529704	-0.45	0.654
const	-0.0040112	0.0085877	-0.47	0.640
inv				
ca_{t-1}	0.0015317	0.02102	0.07	0.942
ca_{t-2}	0.0092323	0.0281391	0.33	0.743
ca_{t-3}	-0.0153626	0.0277827	-0.55	0.580
ca_{t-4}	0.0005059	0.0279435	0.02	0.986
ca_{t-5}	0.0232262	0.0200488	1.16	0.247
bb_{t-1}	0.0195859	0.0174967	1.12	0.263
bb_{t-2}	-0.015577	0.0115825	-1.34	0.179
bb_{t-3}	-0.0185842	0.0117793	-1.58	0.115
bb_{t-4}	-0.023032	0.0118445	-1.94	0.052
bb_{t-4}	-0.0208488	0.018451	-1.13	0.258
inv_{t-1}	1.066191	0.0900497	11.84	0.000
inv_{t-2}	0.0292494	0.1304964	0.22	0.823
inv_{t-3}	-0.1887524	0.1295557	-1.46	0.145
inv_{t-4}	0.1182143	0.1306691	0.90	0.366
inv_{t-5}	-0.0413807	0.091883	-0.45	0.652
const	0.0006144	0.001742	0.35	0.724

Table D.6: VAR U.S.- Period of Policy Rule

ca	coeff	Std. Err.	z	P>|z|
ca_{t-1}	0.7628598	0.1730957	4.41	0.000
ca_{t-2}	0.2787617	0.2049791	1.36	0.174
ca_{t-3}	0.1347949	0.2102466	0.64	0.521
ca_{t-4}	-0.2839589	0.2326683	-1.22	0.222
ca_{t-5}	-0.1866909	0.1995455	-0.94	0.349
bb_{t-1}	-0.1423023	0.159546	-0.89	0.372
bb_{t-2}	0.1959217	0.1290647	1.52	0.129
bb_{t-3}	0.0848351	0.1318903	0.64	0.520
bb_{t-4}	0.2128051	0.1283856	1.66	0.097
bb_{t-5}	0.2272846	0.1670886	1.36	0.174
inv_{t-1}	-0.3313117	0.9730449	-0.34	0.733
inv_{t-2}	1.488171	1.437997	1.03	0.301
inv_{t-3}	0.4329091	1.401466	0.31	0.757

inv_{t-4}	-1.59758	1.369355	-1.17	0.243
inv_{t-5}	-1.998823	1.196707	-1.67	0.095
const	0.1010356	0.0640756	1.58	0.115
bb				
ca_{t-1}	-0.0545782	0.1725762	-0.32	0.752
ca_{t-2}	-0.1852334	0.2043639	-0.91	0.365
ca_{t-3}	0.7330468	0.2096156	3.50	0.000
ca_{t-4}	-0.535456	0.2319701	-2.31	0.021
ca_{t-5}	0.3448205	0.1989467	1.73	0.083
bb_{t-1}	-0.1119008	0.1590672	-0.70	0.482
bb_{t-2}	-0.2602886	0.1286774	-2.02	0.043
bb_{t-3}	-0.2837039	0.1314945	-2.16	0.031
bb_{t-4}	0.6954625	0.1280003	5.43	0.000
bb_{t-5}	-0.1766638	0.1665871	-1.06	0.289
inv_{t-1}	3.141406	0.9701248	3.24	0.001
inv_{t-2}	-2.365901	1.433681	-1.65	0.099
inv_{t-3}	3.341517	1.39726	2.39	0.017
inv_{t-4}	-0.5497476	1.365245	-0.40	0.687
inv_{t-5}	-0.7257444	1.193115	-0.61	0.543
const	-0.1485077	0.0638833	-2.32	0.020
inv				
ca_{t-1}	-0.0524179	0.0256909	-2.04	0.041
ca_{t-2}	0.0095963	0.030423	0.32	0.752
ca_{t-3}	0.0588109	0.0312048	1.88	0.059
ca_{t-4}	-0.0057394	0.0345327	-0.17	0.868
ca_{t-5}	-0.0115888	0.0296166	-0.39	0.696
bb_{t-1}	0.0451515	0.0236798	1.91	0.057
bb_{t-2}	-0.0468126	0.0191558	-2.44	0.015
bb_{t-3}	-0.0154005	0.0195752	-0.79	0.431
bb_{t-4}	-0.0241747	0.019055	-1.27	0.205
bb_{t-5}	-0.0626304	0.0247993	-2.53	0.012
inv_{t-1}	1.017188	0.1444195	7.04	0.000
inv_{t-2}	0.005658	0.2134276	0.03	0.979
inv_{t-3}	0.3513377	0.2080058	1.69	0.091
inv_{t-4}	-0.2147001	0.2032398	-1.06	0.291
inv_{t-5}	-0.043941	0.1776153	-0.25	0.805
const	-0.0063945	0.0095101	-0.67	0.501

Table D.7: VAR U.S.- Second Period of Discretionary Policy

ca	coeff	Std. Err.	z	P>|z|
ca_{t-1}	0.3109758	0.2064733	1.51	0.132
ca_{t-2}	-0.2062885	0.2027194	-1.02	0.309
ca_{t-3}	-0.0309162	0.2027728	-0.15	0.879
ca_{t-4}	-0.1519524	0.1912834	-0.79	0.427

bb_{t-1}	-0.0253195	0.0842646	-0.30	0.764
bb_{t-2}	0.069237	0.0904446	0.77	0.444
bb_{t-3}	-0.0361625	0.0937908	-0.39	0.700
bb_{t-4}	-0.0091909	0.0915505	-0.10	0.920
inv_{t-1}	-4.663617	1.325497	-3.52	0.000
inv_{t-2}	1.996983	2.180465	0.92	0.360
inv_{t-3}	1.081874	2.155483	0.50	0.616
inv_{t-4}	-0.9105854	1.181837	-0.77	0.441
const	0.082048	0.0362742	2.26	0.024
bb	coeff	Std. Err.	z	P>|z|
ca_{t-1}	0.1609577	0.3452501	0.47	0.641
ca_{t-2}	0.1569253	0.338973	0.46	0.643
ca_{t-3}	0.2738122	0.3390623	0.81	0.419
ca_{t-4}	-0.463281	0.3198506	-1.45	0.147
bb_{t-1}	-0.1088316	0.1409013	-0.77	0.440
bb_{t-2}	-0.3332898	0.1512351	-2.20	0.028
bb_{t-3}	-0.1210024	0.1568304	-0.77	0.440
bb_{t-4}	0.7442695	0.1530843	4.86	0.000
inv_{t-1}	5.096381	2.216403	2.30	0.021
inv_{t-2}	2.632882	3.646019	0.72	0.470
inv_{t-3}	-9.462329	3.604246	-2.63	0.009
inv_{t-4}	3.285594	1.976184	1.66	0.096
const	-0.0841339	0.0606552	-1.39	0.165
inv	coeff	Std. Err.	z	P>|z|
ca_{t-1}	-0.0159472	0.030665	-0.52	0.603
ca_{t-2}	0.0417544	0.0301074	1.39	0.165
ca_{t-3}	0.0034596	0.0301154	0.11	0.909
ca_{t-4}	0.0048225	0.028409	0.17	0.865
bb_{t-1}	0.0136548	0.0125148	1.09	0.275
bb_{t-2}	-0.0161786	0.0134326	-1.20	0.228
bb_{t-3}	-0.0077763	0.0139296	-0.56	0.577
bb_{t-4}	0.0040645	0.0135969	0.30	0.765
inv_{t-1}	1.389826	0.1968599	7.06	0.000
inv_{t-2}	-0.2246612	0.3238378	-0.69	0.488
inv_{t-3}	0.1343929	0.3201275	0.42	0.675
inv_{t-4}	-0.246902	0.1755238	-1.41	0.160
const	-0.0013985	0.0053874	-0.26	0.795