# THREE ESSAYS ON MONETARY MACROECONOMICS

## AN EMPIRICAL EXAMINATION OF THE SOUNDNESS OF THE ALTERNATIVE MONETARY MODEL AND MONETARY POLICY IN CANADA

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## Abstract

*This series of essays explores the soundness of the Alternative Monetary Model (AMM) of Smithin (2013, 2018) via an examination of the monetary policy and monetary transmission mechanism in Canada. The AMM has assumptions that are more consistent with the real world than other approaches to macroeconomics and monetary theory, and the reliability of the AMM through the business cycle will be examined. The model was tested using abduction and numerical methods. The results were also tested econometrically, and the predictions of the directional change of the variables were found to have an accuracy of 91%. Historical simulations were conducted to examine the ability of the AMM to mimic the time profiles of actual economic events. The simulations indicate that if the central bank were to have implemented a real interest rate rule during these historical periods, there would have been better economic outcomes. The monetary transmission mechanism between the Bank of Canada and commercial banks is examined. Evidence suggests this relationship has changed over the period of study and that monetary policy changes have affected commercial bank activities more swiftly since the 1980's. Additional evidence supporting the endogeneity of the money supply was found. Debt dynamics were examined, and certain convergence conditions for debt-to-GDP ratios were established. In almost all cases balanced budgets are not necessary to maintain a stable debt-to-GDP ratio. In much of the existing theoretical literature, it is assumed that interest rates are greater than the growth rate to maintain the assumptions of the transversality conditions, the no-Ponzi constraint, and Ricardian equivalence. However, it was found that in half of the periods studied, Canada's real interest rates were less than the real growth rate violating these assumptions. Monetary policy was found to have a significant effect on government interest rates, whereas fiscal policy was only found to have a marginal effect. This lends credence to the idea that monetary policy should play a critical supporting role in government debt sustainability, through a real interest rate rule, as this has a strong effect on both interest rates at commercial banks and bond yields throughout the economy.*

# Dedication

*To Krista, Maureen, Ron and the rest of the family.*
*Thank you for all the love and support you have given me.*

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# Introduction: Three Essays on Monetary Macroeconomics in Canada

This series of essays examines various topics that arise in the study of monetary macroeconomics in Canada. The investigation is conducted primarily using the Alternative Monetary Model (AMM) of Smithin (2013, 2018) with Canadian data. The data sets used range from as early as the 1920s to 2015. The overarching purpose of these essays is to explore the soundness of the AMM whose assumptions are more consistent with the real world than other approaches to monetary and macroeconomic theory. The essays will examine the reliability of the AMM through the business cycle. Additionally, they will examine alternative monetary and fiscal policies to find if these would be predicted to achieve superior macroeconomic outcomes to those which were actually pursued. The essays use the framework of the AMM created by Smithin (2013, 219-288; 2018). Employing a variety of econometric techniques this work sets out first to examine the fit of the model with Canadian data since 1981. It then conducts a counterfactual exercise speculating about the impact of monetary policies on outcomes for certain economic variables, such as growth and inflation, assuming that this alternative framework targeting real interest rates had guided central bank policy decisions since 1935. Whereas, historically, the Bank of Canada has long relied on a neoclassical model of the monetary economy to inform its policy actions these essays demonstrate that preferred economic outcomes would have been expected under the AMM in both a five- and eight-equation setting.

The first essay examines trends and factors in Canadian macroeconomic data using the five-equation AMM. This analysis entails finding values for various parameters, such as the sensitivity of economic growth rates to changes in corporate profits, and for the construction of exogenous variables such as indices of confidence in both the financial markets and the real economy. This is conducted using a variety of econometric techniques ranging from first difference and 2SLS regressions to Johansen cointegration and Granger causality tests. These techniques allow for the estimation and construction of proxies for the unobserved confidence variables in order to test them against outcomes in the financial markets and the economy. In particular, changes in the constructed exogenous variables may correlate with changes in the business cycle. There will be an examination of the monetary transmission mechanism, and evidence of endogenous money will be examined. In the case of the monetary transmission mechanism, the empirical evidence suggests that this has changed over the period of study and that now monetary policy changes affect

commercial bank activities more swiftly. Also, pre-1962 and post-1980 there is evidence of cointegration in the data, supporting arguments for the endogeneity of the money supply. The evidence suggests that there has been an evolving social-economic relationship between the central bank and the commercial banks. The current relationship is found to be very robust, suggesting that a "correct" monetary policy is critical as "mistakes" will now transmit to the real economy more rapidly and thoroughly than in any other examined period.

In the second essay, an important issue encountered when using numerical methods and simulations of the five-equation AMM is the effect of fiscal and monetary policy on the real economy. Debt dynamics are examined to derive propositions about the sustainability of government debt. These propositions lead to findings of the convergence conditions for debt-to-GDP ratios. In almost all cases a balanced budget is not necessary to maintain a stable debt to GDP ratio, and it was found that interest rates as compared to the rate of economic growth are a crucial factor for stability. In much of the existing theoretical literature, it is assumed that interest rates are always greater than the growth rate. This is necessary for the models to be consistent with the assumed transversality conditions, the no-Ponzi constraint for governments, and Ricardian equivalence. However, in an examination of Canadian data, it was found that in half of the periods studied the real interest rates on government debt were less than the real growth rates. This is contrary to the assumptions made in much of the theoretical literature and raises serious questions about the conclusions of these models. Also under the heading of debt dynamics, this section of the thesis examines the effects of fiscal and monetary policy changes on government interest rates. It is found that monetary policy has a significant effect on changes in government interest rates and that fiscal policy may have a small effect in the short-run. Monetary policy was the only policy found to have long-term effects on the rate of interest paid by the government on its debt. This lends credence to the idea that monetary policy should play a critical supporting role in government debt sustainability. Okun's law is also examined. Okun's law looks at the relationship between the unemployment rate and the growth rate. It states that typically the growth rate must increase by more than one percentage point to decrease the unemployment rate by one percentage point. There is evidence to support Okun's law with a ratio of 4.03:1. This ratio was found to be consistent since 1940, indicating that even with dramatic changes in technology over the whole period, the relationship between the growth rate and the unemployment rate was roughly constant. This finding runs counter to much of the existing literature on this subject. However, the level of growth

that would be needed to maintain zero change in the unemployment rate was less stable over the period. The growth rate that would be needed to reduce the measured unemployment to zero is undoubtedly greater than estimates by mainstream economists of the so-called natural rate of growth. Nonetheless, such a growth rate is well within the bounds of the post-war historical experience.

The third essay will focus on the eight-equation AMM. The additional equations will introduce interest rate policy, exchange rates, and net foreign debt positions into the model. Historical simulations were conducted to examine the ability of the model to mimic the time profiles of actual economic events. Historical simulations were made for the 2008 financial crisis, the Great Depression, WWII and stagflation in the 1970s. In all cases, the model predicts that if the central bank were to have used a real interest rate rule that limits volatility in the commercial bank's real prime rate, there would have been better economic outcomes than actually occurred.

These three essays examine monetary macroeconomics in Canada. One of the overarching themes is the central bank's influence on the economy. Examining the findings of these essays together exposes the vital role of the central bank's policy for many aspects of the economy. The findings will show that since 1980 there is a high degree of transmission between the policy rate at the central bank, and the prime rate at commercial banks. Thus, any monetary policy changes will be transmitted through to the interest rates at commercial banks, and throughout the economy to a higher degree than pre-1980.

This leads to an examination of the relationship between the policy rate at the central banks, and interest rates on government debt. A robust relationship between interest on government debt and the policy rate at the central bank was found, with the central bank's policy rate leading this relationship. This has debt sustainability implications, where higher interest rates at the Bank of Canada leads to higher interest rates on government debt, making sustainable outcomes harder to achieve. When a policy rule is included in the model that limits volatility of real interest rates at commercial banks, it leads to better economic outcomes, when simulating the economy with the AMM. Thus, summarizing these findings, it would indicate that consumer interest rates follow the policy rate at the central bank, the government debt position is improved with lower real interest rates, and the economy experiences better economic performance when there was less volatility in the commercial bank's real interest rate. Thus, it may indicate the benefit of having a policy rule

at the central bank that targets, and limits real interest rate fluctuations at commercial banks, at a level low enough to maintain government debt sustainability, and a robust economy.

Overall these three essays examine the validity of the AMM, and obtain predictions on numerous economic outcome variables, through numerical methods, that the model makes when policy shocks are simulated. These predicted changes will be tested against Canadian economic data. Additionally, related topics are explored such as monetary transmission mechanisms, leading, and lagging relationships of constructed exogenous variables, government debt dynamics, and limits set out by Okun's law. Thus, together, these three essays offer substantial evidence in support of the superiority of the AMM over mainstream neoclassical macroeconomic models based on a comprehensive examination of Canadian economic data.

# Essay 1: An Empirical Examination of Canadian Macroeconomic Data

## *I. Introduction*

The framework the central banks use to determine monetary policy may have an outsized effect on the outcome of key economic variables. The Bank of Canada has prescribed to neoclassical models of the monetary economy when determining appropriate policy action. Much of this policy relies on nominal interest rates and base money supply changes. There has been much research done on the effectiveness of the Bank of Canada's ability to transmit their desired policy effects to key economic variables, such as interest rates or inflation in the economy, using these traditional neoclassical models.

The effectiveness of the Bank of Canada's ability to transmit its monetary policy to outcome variables, such as inflation and employment has been brought into question by various authors both inside and outside the central bank. Summarizing the effectiveness by these authors, Rowley and Spotton Visano (2004) suggest that there is no substantive evidence from bank publication to support the claim that the central bank current policy tools are useful at maintaining its core mandates surrounding inflation and. This underlines that current neoclassical policy may not be the most effective tool for the bank of Canada for modelling the monetary transmission mechanisms. However, one can find evidence supporting a transmission mechanism from the central bank's policy rate to the commercial bank's prime rates as demonstrated in studies by Hendry (1992) and by Clinton and Howard (1994) in Canada, and by Atesoglu (2004) in the United States. Both Canadian studies were conducted before 1996, a critical year for monetary transmission as the way the Bank of Canada sets overnight interest rates changed that year. As the monetary transmission mechanism between the overnight rate at the Bank of Canada and the bank rate at commercial banks has been found to be one of the most likely to influence prevailing interest rates, this relationship will be tested. The relationship between these variables will be examined since the establishment of the Bank of Canada in 1935. An examination of the transmission to longer-term interest rates will be studied in essay two.

Since the global recession of 2008, many of the traditional monetary transmission mechanisms have become less effective for central banks around the world. This is as commercial banks have moved to set their interest rates policies in a more independent fashion compared to before the financial crisis. This has been documented in numerous studies in European countries, and the United States (Mora 2014; Illes and Lombardi 2013; Karagiannis, Panagopoulos and Vlamis 2014;

Hristov, Hulsewig and Wollmershauser 2014). The effectiveness of monetary transmission needs to be explored in a Canadian context since the 2008 recession, to examine if the global recession influenced monetary transmission in Canada.

All this past evidence suggests that there may be more effective models for monetary transmission and economic forecasting than the current neoclassical models at the Bank of Canada. Desirable characteristics for an alternate monetary model should be evidence-based and encompass the transmission mechanism from the overnight to prime rate, but still allow market forces to affect inflation, as well as having a real interest rate rule present at the central bank. A model that encompasses these desirable characteristics is the Alternative Monetary Model (AMM), as presented by Smithin (2009). Up to this point, there have been many authors that worked on theoretically deriving the AMM, and evaluating individual equations of the AMM (Atesoglu 2004; Atesoglu and Smithin 2006; 2006b; 2008; Collis, Paschakis and Smithin 2016; Kam 2000; Kam 2005; Kam and Smithin 2012; Smithin 2007; 2009; 2013; 2018). While much work has been conducted on the theoretical aspects and individual components of this model, a complete data-driven evaluation of all components of the AMM still needs to be conducted. This study is needed to find conclusive evidence to show monetary policy could be improved by following a real interest rate rule with the primary transition mechanism at the Bank of Canada being the overnight interest rate.

This essay will examine Canadian economic data, evaluating the framework of the five-equation AMM, as presented by Smithin (2009; 2013, 219-261; 2018). The essay will focus on the estimation of the coefficients and construct all unobserved exogenous variables in the AMM.

The AMM was created to enhance the realism of the traditional Keynesian, neoclassical, classical and monetarism models. Some of the ideas from each of these models, to a varying degree, are incorporated in the AMM, with the preservation of five fundamental components. In the AMM money is credit created and endogenous. Additionally, there is a monetary theory of the real rate of interest, and "policy rate" at the central bank. The AMM argues for a stable monetary policy that holds constant the real policy rate at a positive, but low level and monetary policy is non-neutral in both the short and long run.

This essay will also evaluate if the AMM is consistent with all theoretical restrictions. Thus, if consistent, this would allow for further examinations of the model. Some concepts in this model

that are explored are liquidity preference[1], animal spirits[2], the average firms' profit share, labour power, and the commercial bank's markup.

To complete this analysis time series data was found on a variety of macroeconomic concepts. Quarterly data were obtained from 1981 to 2014. The data was collected from a variety of Canadian government agencies, such as the Bank of Canada, and Statistics Canada, as well as from OECD resources. Canadian data is optimal for this analysis of the AMM. Canada is a small open economy, that has little influence on world markets. Changes in monetary policy in Canada are unlikely to affect world markets, unlike in the United States. Additionally, Canada has full sovereignty over its currency. With a floating exchange rate and no monetary union, the Bank of Canada can set monetary policy to achieve an optimal outcome for the Canadian economy. This is contrary to the European Union or countries that fix their exchange rates. Techniques proposed by Granger and Engle (1987) and by Granger (1999) will be used in the econometric analysis.

This paper will be organized as followed. Section II will discuss the equations of the AMM model and examine some previous literature that relates to the AMM. Section III will derive the equations of the AMM. Section IV will discuss the data sources, the empirical implications of the model and the techniques that will be performed for the empirical estimation. Section V will report the testing results for the empirical estimation. Section VI will explore monetary transmission mechanisms between the central and commercial banks. Finally, section VII will provide some concluding remarks.

## *II. The Alternative Monetary Model*

The Alternative Monetary Model (AMM) is comprised of a system of five equations. The model is as followed, as presented by Smithin (2013):

$$(1.1) \qquad y = g - t + e_0 + e_1 k, \qquad 0 < e_1 < 1 \qquad (Economic\ Growth)$$

$$(1.2) \qquad k = a - r - w \qquad (Income\ Distribution)$$

[1] The term liquidity preference in this case will theoretically be a measure of the supply and demand for money. It therefore could be thought of as a measure of investors' confidence in the market place, and hence, conform to the term coined by Keynes as liquidity preference (Keynes 1936).

[2] The term animal spirits in this case will theoretically be a measure of net autonomous demand. It therefore could be thought as a measure of confidence by agents in the economy. Therefore, it can be generally represented by the term animal spirits coined by Keynes (1936).

(1.3) $p = p_0 + w_{-1} - a$ $(Inflation\ Determination)$

(1.4) $w = h_0 + t + h_1 y_{-1}, \quad 0 < h_1 < 1$ $(Real\ Wage\ Determination)$

(1.5) $r = m_0 + m_1 r_0 - (1 - m_1)p, 0 < m_1 < 1,\ m_0 > 0$ $(Real\ Interest\ Rate)$[3]

In this model, there are five endogenous variables (y, $k$, $p$, $w$, and $r$). The endogenous variables are the real rate of growth of GDP ($y$), the firm's markup ($k$), the inflation rate ($p$), the natural logarithm of the real wage ($w$), and the real prime interest rates charged at commercial banks ($r$). Additionally, there are four exogenous variables ($g$, $t$, $a$, and $r_0$). The exogenous variables are total government spending as a percent of GDP ($g$), total government revenue as a percent of GDP ($t$), the natural logarithm of the real productivity per worker ($a$), and the real interest rate target at the central bank ($r_0$). In this model, there are also four intercept terms ($m_0, w_0, p_0, and\ e_0$). The following will examine definitions of the intercept terms, and section III will display a derivation of this model, to allow for the theoretical definitions of these terms.

The intercept terms are exogenous variables in this model and are not defined as constants. The variable ($m_0$) represents the markup in the banking sector between the policy rate at the central bank, and the prime lending rate at the commercial banks. An larger number would indicate an increase of market power at the commercial banks, the converse would indicate a decrease in market power.

The variable ($w_0$) represents the real influence gained by labor. This variable is comprised of all past gains in real wages, that labor has successfully retained, over all past labor relations. An increase in this variable would indicate a gain in labor influence, and real wages, the reverse would indicate an erosion of these powers.

The variable ($p_0$) could be thought to encompass the idea of "liquidity preference". Liquidity preference was a term coined by Keynes. The concept was to have a variable that conveyed the sentiment of the money market (Keynes 1971/1930). In the context of the AMM, this variable will theoretically be based on the supply and demand for money, as demonstrated by its theoretical

[3] This model is designed in a linear fashion using discreet time. While there is some debate in the field of economics if models should incorporate non-linear elements or continuous time that subject is not in the purview of these essays. These essays build on and test the AMM based on the assumptions of the model that incorporate this linear discrete framework. Justification of this framework can be examined in work by Smithin (Smithin 2018).

derivation in section III. Therefore, an increase in this variable would represent a decrease in an agent's willingness to hold money, and thus, invest more money in the money markets; a "bullish" sentiment. Conversely, a decrease in this variable would indicate an increase in an agent's willingness to hold money and invested less; a "bearish" sentiment.

Finally, $(e_0)$ could be thought to encompass some of the idea of "Animal spirits". Animal spirits is thought of as the amount of spending in the economy related to instinct or emotion, not based on real variables (Keynes 1971/1930). In the context of the AMM, it could also be thought of as a measure of business confidence, as some of the business investment is based on future expectations, both rational or irrational, instead of current profits. Theoretically, this will be derived to be an indicator of net autonomous spending by the private sector. This is a measure of how enthusiastic businesses are about the future. This is a broader definition of animal spirits then a traditional Keynesian would use as it encompasses both the rational and irrational expectation changes. An increase in enthusiasm would be not based on current profit, but the expectation of future returns and an increased willing to invest in new projects. A decrease in this number would indicate that businesses are more pessimistic about the future, and less willing to invest.

Smithin (2013) stated that the AMM is preserving the following five features:

> "These are (1) that money and credit creation are an essential feature of the way the economy works, not just a superfluous addition to a barter exchange economy, (2) the money supply is endogenous, (3) there is a *monetary* theory of the *real* rate of interest, (4) the monetary "policy rate", and (5) monetary policy is non-neutral in both the short run, and over a longer time horizon."

These five features allow money to hold a real, non-neutral role in the model. Money in this model is credit created by actions taken in the market, allowing for endogenous money growth based on market participant's decisions. Additionally, this model allows money to be non-neutral thus real policy changes can have real long-run effects.

The monetary transmission mechanism of policy to prime rate has been studied in an American context, by Atesoglu (2004), and in a bilateral context by Atesoglu and Smithin (2008). The former examined the linkage between the federal fund's rate at the Federal Reserve, and the prime interest rates at commercial banks in the United States, and the latter explores the independence of Canadian monetary policy. The results indicate, since 1992 monetary policy transmission has become more complete, and the Federal Reserve led the commercial banks in the setting of interest

rates. Atesoglu argued that this lends support to the view of a horizontalist endogenous money supply. Additionally, in recent decades, Canada's monetary policy has been independent of the United States. Equation (1.5) related to this concept and was formally derived by Kam and Smithin (2012), building on the work by Atesoglu (2004). Kam and Smithin derive a profit-maximizing commercial bank was optimized, displaying the relationship between the commercial and the central bank. A full derivation can be observed in section IV.I.

The income distribution equation is constructed by the expenditure breakdown method. In such this accounts for the distribution of revenue between the various agents competing for these resources. The agents in this model are the firm, labour and rentier. The rentier refers to an agent that derives an income from economic rents. This concept is captured by equation (1.2) in the AMM building on work by Smithin (1996; 2009; 2013, 224-228). A derivation of this work can be observed in section III.II. A fundamental concept in this derivation is the Keynesian theory of aggregate demand. This theory states that production in the current period is chosen to satisfy demand in future periods. Future demand is not known; thus, current production is based on an expectation of the future demand (Palley 1996).

The wage determination equation is built on the work of Atesoglu and Smithin (2006; Smithin 2009, 117-119; 2013, 230-231). Atesoglu and Smithin (2006) observed linkage between the change in wages and economic growth in the economy for the G7 countries. Thus, suggesting higher economic growth may lead to higher increases in wages for labour. This will be explored in more detail in section III.III and relates to equation (1.4).

The inflation equation (1.3) relies on the "monetary circuit" as money is endogenous in the AMM. Money comes into existence by loans made in the banking sector and is destroyed as those loans are repaid (Graziani 2003; Smithin 2011; 2013, 228-230).

The growth equation is constructed on Keynesian principles. The central concept relies on the idea that credit creation is necessary for growth to occur. Thus, the creation of new money allows for profits to incentivize firms to produce, and this causes the growth (Smithin 2013, 224-228). The derivation can be observed in section IV.v., and this concept relates to equation (1.1).

## *III. Derivation of the Alternative Monetary Model*

This section will be a complete derivation of the five-equations of the AMM and summary of past studies on the equation of the AMM. This will expand upon the derivation present in other papers and incorporate relevant empirical work on these topics. This will allow technical definitions of the variables to be derived.

### *III.i. Interest Rate Determination Equation*[4]

The interest rate equation (1.5) is derived from the theory of a profit-maximizing bank. Commercial banks will be defined as banks that have a direct "clearing relationship" with the central bank. This derivation is based on the paper by Kam and Smithin (2012).

In order to derive the interest rate equation, an examination of a commercial bank's balance sheet must occur. The following table summarizes a stylized balance sheet of a bank. A bank makes loans ($L$), and holds deposits ($D$). Loans at banks carry a competitive interest rate ($i_L$), and depositors are paid a competitive interest rate ($i_D$). Additionally, some level of reserves in the form of noninterest-bearing liabilities of the central bank ($R$) are held. Note in this example there are no formal reserve requirements; banks choose the reserves based on profit maximization. There is no requirement that reserves are non-interest bearing; the only requirement is that the central bank sets the interest rate on reserves; in this derivation assume the rate is set at zero. Furthermore, each day the commercial banks clear their transactions with the other commercial banks. If a commercial bank finds itself in a negative settlement ($S$), it must pay a penalty of interest ($i_O$). This interest rate can be thought of as the policy rate of the central bank.

***Table 1.1: A Simple Example of a Committal Banks' Balance Sheet***

| Assets | | Liabilities | |
|---|---|---|---|
| Reserves | R | Deposits | D |
| Loans | L | Settlement Balances | S |
| | R+ L | | D+S |

As presented by Kam and Smithin (2012)

From this, an objective function is derived for the bank.

[4] The interest rate determination equation was originally derived by Kam and Smithin (2012). This section will follow the derivation presented in this article.

$$(1.6) \qquad Max: \Pi = i_L L - i_D D - i_O \int_0^{\infty} f(x)dx\,(S - R) - m_0 L$$

The value of the sum of $\int_0^{\infty} f(x)dx$ is representative of the subjective cumulative probability distribution of the likelihood the commercial bankers themselves expect to end up in a negative settlement balance. Previous empirical evidence suggests that the value for this probability is generally between 0.5 and 1 (Atesoglu 2004). This variable will be simplified to the term $m_1$.

$$(1.7) \qquad m_1 = \int_0^{\infty} f(x)dx$$

The interpretation of the $m_0$ term could be thought of as the value of covering the cost of the business and making a "normal" rate of return (Kam and Smithin 2012).

From the balance sheet, one can substitute for $D$ and the objective function becomes:

$$(1.8) \qquad Max: \Pi = i_L L - i_D(L + R - S) - i_O m_1(S - R) - m_0 L$$

The choice variables for the banks are the total value of loans created, and the reserves held. Allowing one to obtain the first order condition as follows concerning $L$ and $R$:

$$(1.9) \qquad i_L - i_D = m_0$$

$$(1.10) \qquad i_D = m_1 i_O$$

Thus, the commercial bank's markup on the interest rate charged between loans and deposits will equal $m_0$, and the deposit interest rate will be a "mark-down" from the overnight interest rate at the central bank. Substituting (1.10) into (1.9) one can achieve an explanation of the transition mechanism between the central bank and the commercial banks.

$$(1.11) \qquad i_L = m_0 - m_1 i_O$$

From equation (1.11) subtracting inflation ($p$) from both sides of this equation.

$$(1.12) \qquad i_L - p = m_0 - m_1 i_O - p$$

Using the standard definition of nominal interest rate equals expected inflation ($p^e$) plus real interest rate ($r$) leads one to find the real interest rate on both loans ($r_L$) and the policy rate ($r_O$).

$$(1.13) \qquad i_L = p^e + r_L\,, i_D = p^e + r_D \; and \; i_O = p^e + r_O$$

If the expected inflation is approximately equal to the actual inflation, as assumed by many papers including in the work by Taylor (1993) on monetary policy then:

$$(1.14) \qquad i_L = p + r_L\,, i_D = p + r_D, and\ i_O = p + r_O$$

Meaning, $r_O$ is an ex-post rate relying on current observed inflation, rather than expected inflation. This follows the line of work first suggested by the original "Taylor Rule" that relied on the targeting of an ex-post policy rate (Taylor 1993). Substituting (1.14) into (1.12):

$$(1.15) \qquad r_L = m_0 - m_1 r_O - (1 - m_1)p$$

The ex-post real bank lending rate can be thought of as a proxy for the real lending rate borrowers use to estimate there borrowing costs. Thus the equation simplifies to:

$$(1.16) \qquad r = m_0 - m_1 r_O - (1 - m_1)p$$

Thus, this corresponds with the interest rate determination equation (1.5) in the AMM. Note that the definition of ($m_1$) is the subjective cumulative probability distribution of the likelihood the commercial bankers end up in a negative settlement balance. Thus, a risk neutral bank would set this variable to 0.5 and the more risk adverse the bank is, the closer this number is to 1. The ($m_0$) term was defined as the spread the commercial bank markups up their lending rates, from their borrowing rates, to cover the cost of the business, and make a "normal" rate of return. Thus, the intercept gives an indication of the power the banks have, to maintain spreads between borrowing and lending. Both concepts will be examined in more detail in the following section.

### *III.ii. Real Income Distribution Equation*[5]

The real income distribution equation examines the portion of the revenue earned by labour, firms, and the rentier. A rentier is an agent that derives income from economic rents. In this case, the rentier is deriving the income from loaning of money to the firm. To attain the real income distribution equation, one needs an income equation.

$$(1.17) \qquad P_{+1}Y_{+1} = \Pi + (1 + i)PK + (1 + i)WN$$

[5] The real income distribution equation is one derived by Smithin (2009) breaking down revenue by source it is distributed to, being labour, firms and rentier.

The left-hand side of equation (1.17) represents expected money receipts, expressed in money terms, of current production. It consists of the price level ($P$), and the GDP level ($Y$). The right side of the equation categorizes receipts earned by the firm. The expected profit from current production ($\Pi$), the value of "constant capital" ($PK$), which can be thought of as the value of any raw materials and physical machinery used up in the production of goods (Sweezy 1970), and the nominal wage bill ($WN$). Interest ($i$) is charged on both the constant capital and nominal wage bill. This equation divides total sales into three categories, those being firms, labor and the rentier.[6]

The production function is assumed to be linear in nature. This assumption is much like the one made by Palley (1996) where the total production is a function of productivity ($A$) and employment ($N$). The following derivations are based on research and in the same style as Smithin (1986; 1996; 2003). If one assumed the production function has a one-period production lag, one would achieve the production function in equation (1.18). Although a one-period production function is used in this derivation, the number of production lags can be altered to find the most realistic production function.

$$Y_{+1} = AN \tag{1.18}$$

Using the following two definitions,

$$\pi' = \Pi/[WN(1+i)] \tag{1.19}$$

$$k' = PK/WN \tag{1.20}$$

Equation (1.19) describes the profit a firm makes, as compared to the nominal salaries of labour. This is comparable to Marx's "rate of surplus value." Equation (1.20) is a capital-labour ratio. This is comparable to Marx's "organic composition of capital," which is the relative difference between constant capital and variable capital (Sweezy 1970). More commonly this could be thought of as the capital-labour ratio, described in equation (1.20).

Substituting (1.19) And (1.20) into (1.18):

$$P_{+1}Y_{+1} = (1+\pi'+k')(1+i)WN \tag{1.21}$$

[6] This equation does not assume perfect competition. Thus, the profits are not necessarily equal across firms or industries. Nonetheless, the interest rate is the same as money can move across industries, with relatively low barriers.

Let gross profit share be equal to profit plus, physical capital expended, and raw materials as shown in equation (1.21):

$$k = \pi' + k' \tag{1.22}$$

Subsisting (1.22) into (1.21):

$$P_{+1}Y_{+1} = (1 + k)(1 + i)WN \tag{1.23}$$

Substituting in the production function (1.18), isolating $k$, and taking the natural logarithm given that:

$$\ln(1 + k) \approx k \ and \ \ln(1 + i) \approx i \tag{1.24}$$

$$k = \ln A - [i - (\ln P_{+1} - \ln P)] - (\ln W - \ln P) \tag{1.25}$$

The term $[i - (\ln P_{+1} - \ln P)]$ is the nominal interest rate less the expected rate of inflation. Thus, this is the real interest rate ($r$). The $(\ln W - \ln P)$ is the wage rate less inflation, thus it represents the real wage rate ($w$). Finally, let the "$a$" be the natural logarithm of productivity replacing the $\ln A$ term. This derives equation (1.2) in the AMM.

$$k = a - r - w \tag{1.26}$$

Thus, the profit markup is equal to the productivity per worker, less the wage rate, and interest on the wage bill.

*III.iii. Real Wage Determination Equation*

This model examines the aggregate per capita real wage. Thus, micro factors affecting individual agents is not the focus of this work. A general macroeconomic overview of the labour market that considers all agents, government, and unions effects on the labour market will be conducted.

Work in this area was conducted by Atesoglu and Smithin (2006) examined the macroeconomic relationships that affect the real wage rate in G7 countries. The main findings in this paper are that labour productivity is positively related to GDP growth rates in all the G7 countries, and additionally, that higher GDP growth is positively related to real wages in some countries. This study examined the following econometric relationship.

$$(1.27) \qquad \Delta wage = \alpha + u\Delta wage_{-1} + v\Delta gdp + \varepsilon$$

Hence, the change in wages was dependent on the change of wages last period and the change in the economic growth this period. This study found a statistically significant relationship between wages and growth in various countries (Atesoglu and Smithin 2006) and can lend insight into the fundamentals of a wage determination equation.

Smithin continued this work using the basis of these findings, along with work from other authors, such as Adam Smith, to create a classical style wage determination equation. In this equation, after-tax wages are a result of labour's power to retain real wage gains and economic growth. Additionally, it is argued that bargaining power of labour, is not only connected to the supply and demand conditions in the market, but also affected by policy changes, be they sociological, political, or otherwise (Smithin 2013). This would lead to the proposed wage equation in the AMM as follows:

$$(1.28) \qquad w = h_0 + t + h_1 y_{-1}$$

Thus, after-tax wages are a function of social, economic labour power ($h_0$), and economic growth ($y$). An econometric analysis of this equation will occur in section V.

*III.iv. Inflation Determination Equation*[7]

The determinant of inflation, in this model, is the relative supply and demand of money, as observable in equations (1.29), and (1.30). This derivation builds on multiple papers (Smithin 2003; Smithin 2009; Smithin 2013, 219-261)

$$(1.29) \qquad M^d = \psi PY \qquad 0 < \psi < 1$$

$$(1.30) \qquad M^s = \phi W_{-1} N_{-1} \quad \phi > 1$$

Equation (1.29) represents the demand for money. This equation contains the price level ($P$), and the real GDP ($Y$). This can be thought of as the demand for money balances in any form including bank deposits, as a fraction ($\psi$), of the nominal GDP. Equation (1.30) examines the money supply. This equation contains the wage rate per worker ($W$), and the population of employed agents ($N$). The supply of money is some amount greater than the total wage bill by a

[7] The inflation equation is based on the derivation from Smithin (2013)

multiple ($\phi$). The logic behind this is that firms need to finance their wage bill, and other business cost to start production of goods. Thus, the circuit begins when money is borrowed, and ends when debt is payed off. This sequence repeats quarterly as the new production levels are chosen. Examining the findings of Moore (1988), it finds that even if individual firms do not finance their wage bill through borrowing, in aggregate on a macroeconomic level, the wage bill is borrowed, and the coefficient $\phi$ should generally be grater then one (Smithin 2013).

The production function used in this derivation is linear. Thus, it has a one-period production lag, as displayed in equation (1.31).

(1.31) $$Y = AN_{-1}$$

Setting the supply of money equal to the demand for money:

(1.32) $$\psi PY = \phi W_{-1} N_{-1}$$

Substituting (1.31) into (1.32):

(1.33) $$\psi PAN_{-1} = \phi W_{-1} N_{-1}$$

Isolating inflation:

(1.34) $$P = \frac{\left[\left({}^{\phi}/_{\psi}\right) W_{-1}\right]}{A}$$

Taking the log of the (1.34),

(1.35) $$\ln P = \ln \phi - \ln \psi + \ln W_{-1} - \ln A$$

Subtracting ln $P_{-1}$ from both sides,

(1.36) $$p = p_0 + w_{-1} - a$$

Where:

(1.37) $$p = \ln P - \ln P_{-1}, \qquad w = \ln W - \ln P, \qquad a = \ln A, \qquad p_0 = \ln \phi - \ln \psi$$

Thus, equation (1.37) contains the change in price levels ($p$), the log of the real wage rate ($w$), the log of productivity ($a$), and what a Keynesian may think of as "liquidity preference" ($p_0$). The variable $p_0$ considers the changes in the supply, and demand of money, as observed in this

derivation. As $\psi$ is defined as the fraction of GDP that is demanded as money, and $\phi$ is the multiplier of the supply of the money created to fund firms. This assertion that the $p_0$ term is a measure of confidence on the financial markets will be tested in section VII. Additionally, this derivation encompassed a "cost push" or "conflict" inflation component, as wage and productivity have opposite effects on the inflation rate. Theoretically, if wages are rising faster than productivity, that would cause inflation, and the converse would cause disinflation.

*III.v. Economic Growth Equation*[8]

To derive the growth equation, the AMM relies on a standard definition of economic activity as observable in equation (1.38).

(1.38) $$Y = C + I + G$$

Equation (1.38) is comprised of the GDP level ($Y$), real consumption ($C$), investment spending ($I$), and government spending ($G$). Consumption can be thought of in propensity terms.

(1.39) $$C = cY_{-1} - T$$

Where consumption is the propensity to consume ($c$), less the real value of the taxes ($T$). Thus, this statement infers that consumption is some proportion of last periods income, less the tax bill. The loss in consumption will be equivalent to the full burden of the taxes raised by the government, as this money is quite literally not available to the consumer.

Substituting (1.39) into (1.38):

(1.40) $$Y = cY_{-1} + I + G - T$$

Dividing by $Y_{-1,}$

(1.41) $$Y/Y_{-1} = c + 1/Y_{-1}\,(I + G - T)$$

Recognizing that $(Y/Y_{-1})$ is simply one plus the growth rate in the economy this can be denoted by lower case 1 plus $y$. If the last term is multiplied by $(Y/Y)$ the equation will simplify to the following:

(1.42) $$(1 + y) = c + (1 + y)\,1/Y\,(I + G + T)$$

[8] This derivation is based of the original derivation by Smithin (2013).

Simplifying the last brackets again one can see that $G/Y$ and $T/Y$ is government spending, and revenue as a percentage of GDP, and can be denoted by $g$ and $t$. $I/Y$ is investment spending in the private sector as a percent of GDP and this can be defined as $x$. Furthermore, propensity to save ($s$) can be introduced into the consumption function.

(1.43) $$c = 1 - s$$

Thus, substituting (1.43) into (1.42):

(1.44) $$(1 + y)(1 - x - g - t) = 1 - s$$

Taking the log of the previous equation to allow for rates to be found:

(1.45) $$\ln(1 + y) \approx y \; and \; \ln(1 + s) \approx s \; and$$

Thus, archiving:

(1.46) $$y = x + g - s - t$$

One can decouple $x$ into its autonomous, and non-autonomous components. Thus, investment may depend on both the firm's profit margins experienced ($k$), and an autonomous component ($x_0$). Confidence in the future may influence the investment decision now, thus, this will be considered in the autonomous ($x_0$) component. A Keynesian would think of "animal spirits" as being based on changes in expectations without rationality. This would be in the animal spirits variable as firms are not making the decision based on current profits, but rather on irrational expectations. The definition has been expanded past how Keynes would have used it, to also include rational changes in expectations for both firms and individuals.

(1.47) $$x = (I/Y) = x_0 + e_1 k$$

Thus, this demonstrates that firms may choose investment based on a portion of current profit margins and the expectation of future profits. Additionally, define ($e_0$) as the autonomous animal spirits component net of savings:

(1.48) $$e_0 = x_0 - s$$

Substituting (1.48) and (1.47) into (1.49):

(1.49) $$y = e_0 + e_1 k + g - t$$

Hence, this derives equation (1.5).

## *IV. Data and Estimation Techniques*

### *IV.i. Date and Variables*

Canadian macroeconomic data was obtained from various government and non-government data sources. These sources include Statistics Canada and OECD resources along with others. The sample period will be from 1981 to 2014 taken at quarterly intervals. The data range is taken beginning in 1981 as the definition for some data needed in the model changed prior to that year, thus to ensure consistency this starting year is selected. The following will define the data for the variables used in this model. The following will define each variable used in the model and its data source.

Government spending ($g$), and government revenue ($t$) are measured as a percentage of GDP. In the following analysis, the seasonally adjusted spending and revenue for all levels of government were obtained from Statistics Canada. The data aggregates spending and revenues, for all levels of government (federal, provincial, and municipal), accounting for downloading or uploading of expenses/taxes between different levels of government. Revenue as a percent of GDP ($t$) ranged from 44% to 37%, and spending as a percent of GDP ($g$) ranged from 52% to 37%.

The real GDP growth rate ($y$) is the real annualized growth rate of the Canadian economy obtained from Statistics Canada. The range of this variable is from 6.5% to -3.9%.

Labour productivity ($a$), and wage rates ($w$) are the natural logarithm of both real productivity and real wage rates, on a quarterly basis. These variables were calculated from labor, wage, and gross domestic product statistics, obtained from Statistics Canada. Productivity is defined as the average GDP produced per worker. Thus, it is measuring the average inflation adjusted production of an employed person in every given quarter. The wage is defined as the average quarterly wage per worker. Thus, it measures the average inflation adjusted real wage for any given quarter. The natural logarithm range of wage ($w$) is from 9.11 to 9.41, and the natural logarithm range of productivity ($a$) is from 9.73 to 10.09.

The real prime interest rate ($r$), real overnight target rate ($r_0$), and the inflation rate ($p$) are obtained on a quarterly basis. Both the real prime rate and the real overnight target rate are adjusted

for the given inflation rate in that period. The inflation rate used in this analysis the chain weighted inflation rate. Using the chain weighted index allows for changes in the consumption basket, unlike the CPI. Thus, as prices change it is not assumed that the quantity demanded stays constant. These variables were obtained by Statistics Canada. The range of real overnight interest rates at the central bank ($r_0$), is between 10.7% and -3.5%, the range of the real prime rate at commercial banks ($r$), is between 12.5% and -1.5%, and the range of inflation ($p$), is between 9.2% and -3.7%.

The exchange rate used in the following analysis was the Canadian-dollar Effective Exchange Rate. This is an index proposed by the Bank of Canada that determines an exchange rate, for Canada, based on Canada's trade. The weights assigned to each country is dependent on the amount of trade each country has with Canada. In this essay, an appreciation of the Canadian dollar will be associated with this index increasing, and the converse will be associated with this index decreasing. The natural logarithm of this index is used for consistency with the rest of the analysis. The natural logarithm of this index ranges from 4.38 to 4.80.

*IV.ii. Estimation Techniques*

A variety of estimation techniques will be performed to determine the unbiased estimators for the various equations. The first equation to be examined will be the interest rate equation. The real prime interest rate ($r$) will be the dependent variable and it will be regressed on the overnight target rate at the central bank ($r_0$), and the inflation rate ($p$). Inflation is essential in this equation to maintain consistency with nominal values. In this equation (1.50), an estimate is needed for two variables $m_0$ and $m_1$.

$$r = m_0 + m_1 r_0 - (1 - m_1)p \tag{1.50}$$

$m_0$ is a measure of the commercial banks power, measuring the commercial banks' ability to mark up the prime interest rate, from the overnight rate at the central bank. Thus, $m_0$ may not be a constant, as the relationship with regulators, and customers are not constant across time. Thus, the technique used must not fix $m_0$ to one value and estimate an unbiased value for $m_1$. A technique that accomplishes these goals efficiently is a first difference regression. In a first difference regression, the derivative for both $r_0$, and $p$ are regressed on the derivative of $r$. This finds an estimate for $m_1$, over time. The estimate can then be reintroduced as a known into the original equation, leaving the only unknown variable as $m_0$. Consequently, a unique value for $m_0$

can be found in every quarter, and this value would consist of all the error and long run deviations from the short-term relationship found in the first difference regression.

When examining the real wage equation, the equation examines the after-tax wages to simplify and maintain consistency with the model. Additionally, the exchange rate ($q$) may influence wages, and thus was included into the estimation equation. Finally, an autoregressive component was incorporated in this equation, as last periods change in the wage rate may influence this period's compensation. In the equation, the after-tax wages ($w$) will be regressed on the previous period's growth rate ($y_{-1}$), the exchange rate ($q$), and last periods wage rate ($w_{-1}$).

(1.51) $$w_{tax\ adjusted} = h_0 + h_1 y_{-1} + h_2 q + h_3 w_{tax\ adjusted-1}$$

Much as in the interest rate equation the variable $h_0$ may not be constant, as labour power can change over time. Thus, a technique that gives a short-term unbiased estimate of $h_1, h_2,$ and $h_3$, but allows for an unrestricted value for $h_0$, for each period, is necessary. The same first difference technique can be used to find the estimates for the independent variables, and still, allow for a series of values to be found for the labour power variable. Additionally, no assumption has been made about the amount of time needed for the exchange rate, to influence the real wage rate. Agents may not react immediately to the change in the exchange rate due to many factors, for example, contracts fix wages for a given period, agents may not want to negotiate wages constantly, and agents may think a change in exchange rates is only temporary. Thus, in the analysis, various lags of the exchange rate will be observed.

The third equation to be examined is the inflation equation. As shown in (1.52), the prime interest rate at commercial banks and an autocorrelation component has been included in this equation. As in the previous two cases, $p_0$ may change over time, thus, a fixed estimator for $p_0$ is not desirable.

(1.52) $$p = p_0 + p_1(r - r_{-1}) + p_2(w_{-1} - a) + p_3 p_{-1}$$

It can be observed that in this equation there are four major components. The $p_0$ term as shown in section III relies on the demand and supply of money. A Keynesian may think of this as liquidity preference. This term has been derived to account for any changes in either the supply of, or demand for money, encompassing aspects of the quantity theory of money. Changes in underline concepts of the quantity theory of money, for example, velocity would be captured in the liquidity

preference variable through its effect on the demand and supply of money. As previously stated this will not be restricted to one value. The interest rate ($r$) component measures the effect of changing interest rates on inflation. The third component of the equation is the cost push component ($w_{-1} - a$) of inflation. This measures the effect on inflation of the differential between the growth in wages and productivity. Finally, the autoregressive component captures the persistence of inflation across periods ($p_{-1}$). To estimate the coefficient $p_1$, $p_2$ and $p_3$, a first difference estimate will be used. This will allow for all values to be known except $p_0$. To find a unique value for $p_0$, for every period, the values of the previously found coefficients will be introduced into the original equation (1.52), found in the first difference regression. This will allow all components of the original equation to be known except $p_0$, thus algebraically, a value for this variable can be obtained.

The income distribution equation (1.02) is the rearranged production function, where production relies on the firms' markup, interest rates and wages. No econometric techniques are required as no variables, or coefficients are estimated. This equation represents the aggregate logged markup over wages ($k$). To obtain the markup the calculation requires productivity ($a$) less wages ($w$) and the rentier share ($r$). The rentier is an agent that derives income from economic rents. In this case, these rents would be derived from the loaning of money to the firm. Further discussion on this topic will occur in section V.

$$k = a - r_{-1} - w_{-1} \tag{1.53}$$

The final equation to be estimated is the growth equation. As observable in equation (1.54) there have been two additional components introduced. First, one that considers the effect of the exchange rate ($q$), on economic growth. Second, an autoregressive component that allows for last quarters growth rate to affect this period ($y_{-1}$).

$$y = e_0 + e_1(g - t) + e_2 k + e_3 q + e_4 y_{-1} \tag{1.54}$$

There are five components present in this equation. First, as previously stated the animal spirits ($e_0$) component has no assumption for a constant value, thus, a unique value for this variable in every period is possible. $(g - t)$ measures the government deficit and the profit markup ($k$) component measures the sales price over the wage bill. The coefficient on this equation is predicted to be positive as firms' investment would have a component that reacts to higher profit

margins. The exchange rate ($q$) component will examine how the change in exchange rates influences growth. There has been no presumption of how long it takes agents to react to a change in exchange rates, thus, multiple exchange rate lags will be tested to determine which lag lengths have the greatest predictive strength. The final variable is the autoregressive component ($y_{-1}$). To estimate the values of $e_1$, $e_2$, $e_3$, and $e_4$ a first difference regression will be used. This will give an unbiased estimate for the short-term effects of those desired coefficients. To find the unique quarterly values of animal spirits ($e_0$) the coefficients found in the first difference regression will be brought into the original equation, equation (1.53). All values will be known except animal spirits for every period. Thus, a unique value for animal spirits can be found comprising of all unexplained error in the regression.

## *V. Econometric Analysis*

This section will be dedicated to the estimation of the five equations of the AMM, using Canadian data. The goal of these estimations is to find the coefficients of the variables and evaluate them compared to their theoretical restrictions. Additionally, estimations of the unknown variables will occur.

### *V.i. Real Interest Rate*

#### *V.i.i. Real Interest Rate Equation*

As discussed in sections III.i and IV.ii the interest rate equation examine the pass-through of real interest rates from the central bank, to commercial banks. The equation that is examined is equation (1.54) and as previously discussed the method of examination will be a first difference analysis. Thus, taking the first difference of equation (1.54) yields equation (1.55). [9]

$$r = m_0 + m_1 r_0 - (1 - m_1)p \tag{1.54}$$

$$\Delta r = m_{00} + m_1 \Delta r_0 - (1 - m_1)\Delta p \tag{1.55}$$

The coefficient ($m_1$) represents the percent of interest rate changes of the overnight rate at the central bank, that is passed onto to the commercial banks' prime rate. If the commercial banks passed on all the rate changes from the central bank this variable would be equal to 1. $m_0$ is a representation of the amount the commercial banks mark up their interest rates, from the central

[9] ($r$) is defined as the prime interest rate charged at commercial banks, ($r_0$) is the overnight rate at the central bank, and ($p$) is the inflation rate.

bank's policy rate. This variable could be influenced by competition in the banking sector, cost, and profit motivations. Additionally, note that in this case in this first difference analysis the intercept ($m_{00}$), estimated in the first difference, is not a representation of ($m_0$).

***Table 1.2: Estimating the First Difference Regression of the Interest Rate Equation***

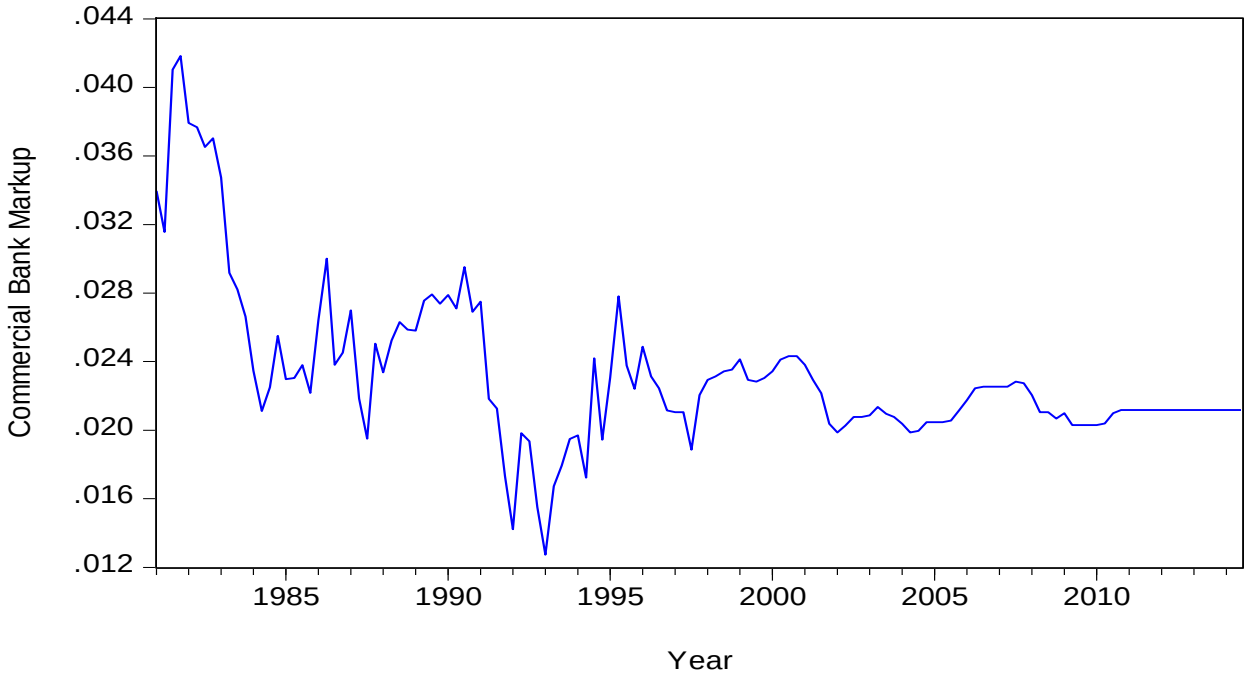
| **Independent Variables** | **Dependent Variable**<br>$\Delta r$ ($R^2$=.926, Adjusted $R^2$=.925)<br>Durbin-Watson Statistic 2.34 |
|---|---|
| $m_{00}$ | .00009<br>(.00019) |
| $\Delta r_0$ | .881**<br>(.021) |
| $\Delta p$ | .119**<br>(.021) |

*Notes: **indicates statistically significant result at a 5% level*
** indicates statistically significant result at a 10% level, Coefficients for $\Delta r_0$ and $\Delta p$ restricted to sum to 1*

As the results in Table 1.2 indicate, there is a definite relationship between the real prime interest rates offered at the commercial banks and the real policy rate at the central bank. Almost all the variation in the prime interest rates at the commercial banks are accounted for in this equation. Theoretically, this variable is restricted to a value between 0 and 1, and this result is statistically significant from both 0 and 1. Being statistically significant from 1 is a significant finding, indicating that the commercial banks do not always change their rates one for one with the central bank. Thus, there was not a complete pass through between the overnight rate at the central bank, and the prime rate at the commercial banks, hence monetary policy through this transmission mechanism may not always have a one for one impact on the prime rates at commercial banks.

$m_0$ can be estimated. The coefficient $m_1$ is known from the estimation of equation (1.55), and this value can be introduced into equation (1.54). This allows for the extrapolation of $m_0$ in every quarter. The term $m_0$ can be thought of as a representation of bank power and accounts for all error in the model and deviation from the short-term relationship found in the first difference regression. This term characterizes how the commercial banks tend to mark up their real interest rates from those of the central bank. Figure 1.1 displays the values of $m_0$ over this 34-year period.

***Figure 1.1: The Commercial Bank Markup from the Policy Rate at the Bank of Canada***




One can observe, in figure 1.1, that the markup term became less volatile in the latter part of this period post-1996, the year the Bank of Canada changed the way it set its policy rate. Pre-1996, the Bank of Canada set its policy rate off the interest rate of short-term Canadian government treasury bills. Thus, it changed the overnight rate frequently (Bank of Canada 2015). Post-1996, the Bank of Canada set the rate following a rule-based policy, where, at the discretion of the governor of the Bank of Canada, they could arbitrarily change this rate, with the idea that they would make the changes based on economic indicators. Thus, a robustness check needs to be conducted to examine if the findings hold post-1996. These findings are displayed in table 1.3 confirming that the coefficient on the central bank's markup is, although closer, still statistically significant from 1. This indicates that the transmission mechanism of the policy rate has become more critical at influencing the prime rate at commercial banks.

***Table 1.3: Robustness Check of the Internet Rate Equation Post Monetary Policy Rate Rule Changes (1996-2014)***

| **Independent Variables** | **Dependent Variable**<br>$\Delta r$ ($R^2$=.997, Adjusted $R^2$=.997)<br>Durbin-Watson Statistic 2.28 |
|---|---|
| $r_{00}$ | .00004<br>(.00007) |
| $\Delta r0$ | .962**<br>(.0175) |
| $\Delta p$ | .048**<br>(.0175) |

*Notes: **indicates statistically significant result at a 5% level*
** indicates statistically significant result at a 10% level*
*Coefficients for $\Delta r_0$ and $\Delta p$ restricted to sum to 1*

The first difference test verifies a short-term relationship. One concern of the first difference approach to annualizing the data is that it may disregard information of a long-run equilibrium relationship which would enhance the strength of the findings. Ericsson, Hendry, and Grayham (1998) proposed a solution to this potential shortcoming when working with differenced data using cointegration to determine a long-run relationship. This establishes and measures both the short run and long-run relationship between variables. To establish the link between these variables a Johansen cointegration test can be performed comparable to research performed by Atesoglu (2004). This research established a link between the Federal Funds rate at the Federal Reserve, and the prime rate at commercial banks in the United States. The relation between the central bank and commercial banks is essential as it can lend evidence towards the presence, or lack of presence, of endogenous money, and if deposits create loans. The empirical results from the Johansen cointegration test can be observed in table 1.3. The optimal lag lengths are established by the Akaike information criterion (AIC).

***Table 1.3: Cointegration between the Policy rate at the Bank of Canada and the Prime rate at Commercial Banks[10]***

| Equation and normalized Variable | Trace test ≤0 | | Cointegration Parameters | |
|---|---|---|---|---|
| | Statistic | 95% | R0 | p |
| (1) r (lag=5) | 19.1** | 15.49 | -0.895* | -- |
| Adjustment Coefficient r | -0.938** (.433) | | -072(.456) | -- |
| (2) r (lag=5) | 46.23** | 29.79 | -0.959* | -0.39* |

*Notes: **indicates statistically significant result at a 5% level * indicates statistically significant result at a 10% level,*

[10] Only a Johansen cointegration test is displayed in this section to prove a long-term and short-term relationship. Cointegration between variables implies Granger causality. This is proven by work conducted by Engle and Granger (Engle and Granger 1987). Granger causality was tested for in all cointegration analyses throughout the essays but are not reported, as the Granger causality test do not add further insight into the relationship.

Observing table 1.3 one can make three critical observations. First, the Johansen test gave an estimation of the commercial bank's pass-through coefficient close to the value found in the first difference analysis. This adds confidence to the estimation that the pass-through coefficient is equal to a value close to, but less than one. Second, there is the presence of cointegration, lending evidence to a long run relationship between the two variables and supports the concept of endogenous money (Moore 1988; Lavoie 1996). This allows one to examine the presence of uni- or bi-directional causality in this equation. Indicated by the error correction terms, the commercial bank interest rate is statistically significant, but not the central bank's overnight rate. This implies that the commercial banks adjust their interest rates to maintain the long-run stable relationship with the central bank. Furthermore, 90% of the adjustment to the prime interest rates happens within one-quarter of a change in the central bank policy rates. Since the previous test indicated that the central bank holds some power over the interest rate on loans and deposits at commercial banks, they would then have indirect power to influence the money supply through this mechanism. The direction of the causality in interest rates lends evidence to support a horizontalist endogenous approach to money supply (Atesoglu 2004; Lavoie 2014). Horizontalist suggests that money supply is influenced by the creation, and repayment of loans. Money supply increases as banks make loans, as the loan made would be coupled with a deposit in an account. Thus, loans make deposits. When that loan is repaid, the money is then destroyed as the deposits are reduced. This is all irrespective of the reserves held in the banking sector. Thus, the central bank influences interest rates at commercial banks, allowing the central bank to influence the money supply through the policy rate. This concept will be examined in more detail in the following section.

*V.i.ii.i A Historical Examination of the Pass-Through Coefficient*

This further examination of the monetary transmission mechanism that will be examined is the relationship between the overnight rate at the Bank of Canada, and the prime rate at the Canadian commercial banks, since the creation of the Bank of Canada, in 1935. The findings of this section will examine how effective this policy tool has been at effecting the interest rates, at Canadian commercial banks, over the past 80 years. Additionally, this section will lend evidence to the structure of the money supply. Finally, the effectiveness of changes to monetary policy, through changing the bank rate, throughout this sample will be examined.

This section will be a historical examination of the bank rate, at the Bank of Canada. The bank rate is currently set at 0.25% above the target rate. The bank rate is the annualized rate that the Bank of Canada charges on one-day loans to financial institutions (Bank of Canada 2015) The prime rate is the rate that commercial banks charge their most creditworthy customers. This rate also has some correlation to other loans offered at the commercial banks. The transmission mechanism between the Federal Funds rate and the prime rate of commercial banks in the United States has been examined by Atesoglu (2004). These results will be discussed in section III.i.ii.i. Additional to examining a different country, a more extended period will be examined compared to the work of Atesoglu, allowing for the observation on how the effectiveness of monetary policy in Canada has changed over time.

The period that will be examined is from March 1935 to August 2015. The start of the sample coincides with the establishment of the Bank of Canada, and the creation of the bank rate. In this period, there were five distinct sub-periods. From March 1935 to November 1956, the bank rate was set at the discretion of the Bank of Canada. In this period, the nominal rates were relatively stable. From November 1956 to June 1962, the bank rate was set at 0.25% above the 3-month treasury-bill, of the federal government, causing volatility in the rate. From June 1962 until March 1980 the rates were again set at the discretion of the central bank. In this period, the rates were more stable than in the previous period, but the central bank changed rates more than the period prior to 1956. From March 1980 to February 1996, the rate was again set 0.25% above the 3-month Treasury-bill, causing volatility. Pre-1996 the rates were set by the Bank of Canada, at the top of a 0.5% operating band (Bank of Canada 2015). This section will examine the interest rate transition mechanism in each period. It is important to note that while the Bank of Canada does not have direct control over the rate of the 3-month treasury bill, it can still have an indirect effect on the rates, by the process of buying and selling treasury bills. Thus, in periods where the bank rate was set off the treasury markets, the Bank of Canada still could indirectly affect the bank rate.

These sections will examine four critical aspects of the association between the rates. First, how the effectiveness of the transmission has changed over time. Second, there will be an examination if there is long-run cointegration between the prime and bank rates. Third, an examination of evidence to support an endogenous money supply. Forth, an examination of whether there is uni-directional, or bi-directional causality present in the sample.

This section will be structured in the following way. Section V.i.ii.ii. will focus on past research and theoretical models to put in perspective the findings of this paper. Section V.i.ii.iii. will examine the linkage between the bank rate at the central bank and the prime rate at the commercial banks. Section V.i.ii.iv will empirically examine the findings for each period, and Section V.i.ii.v will have some concluding remarks.

*V.i.ii.ii. Theory on the Transmission Mechanism*

A similar study has been conducted on data from the United States. Atesoglu (2014) examined the relationship between the federal fund's rate at the Federal Reserve and the prime rates at the commercial banks for the years 1987 to 2002. In this study, it was determined that monetary policy had become more readily able to influence the rates at commercial banks in the more recent period. Additionally, there was evidence to support an endogenous money supply. Furthermore, for the years pre-1994 Atesoglu found bi-directional causality between the federal fund's rate and the prime rate, meaning that in the long run, both interest rates changed to form a stable long-run relationship. Atesoglu (2004) argued that this would give evidence to the endogenous money supply in the structuralist sense. Post 1994 it was found that there was only the presence of uni-directional causality, where the prime rate changed to create the long run stable relationship, and thus Atesoglu argued, that this supports endogenous money in the horizontalist sense. It is not clear that these findings would ultimately lead to the evidence of the two conclusions on structuralism, or horizontalism that Atesoglu proclaimed. Instead a conclusion that the socioeconomic relationship between the central bank and the commercial banks had evolved over this time and that both structuralist and horizontalist elements are present, as the two theories are not necessarily mutually exclusive may be more appropriate.

The econometrics will follow the same methodology as the paper by Atesoglu, with the use of Canadian data, allowing for the comparison across countries. In a subsequent paper by Atesoglu and Smithin (2008), Canadian and American central banks, rates were found to be cointegrated prior to 1988. Post that period the rates moved independently. Thus different results may be present in this analysis.

Another critical article on this relationship is a paper by Kam and Smithin (2012). In this paper using a profit-maximizing bank, they derived an equation to describe the relationship between the central bank and commercial banks in both nominal and real terms. These derivations were

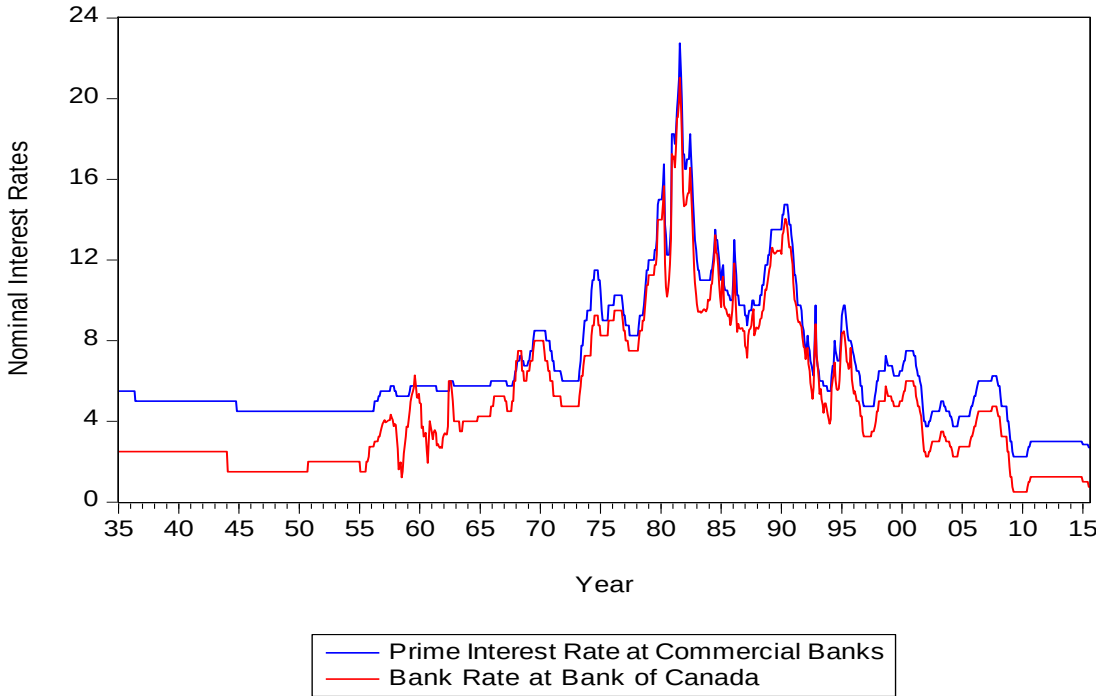
previously discussed in section III.i. The derived relationship between the central and commercial banks in nominal terms can be observed in equation (1.56).

(1.56) $$i = m_0 + m_1 i_0$$ [11]

*V.i.ii.iii. The Bank rate and Prime Rate*

Throughout this period, the bank rate and prime rates changed together to a varying degree. The rates can be observed in Figure 1.2. From this figure, it would suggest that, for at least some periods in this sample, there may be cointegration present between the bank rate and the prime rate.

***Figure 1.2: Prime Rates at the Commercial Banks and the Bank Rate at the Bank of Canada***

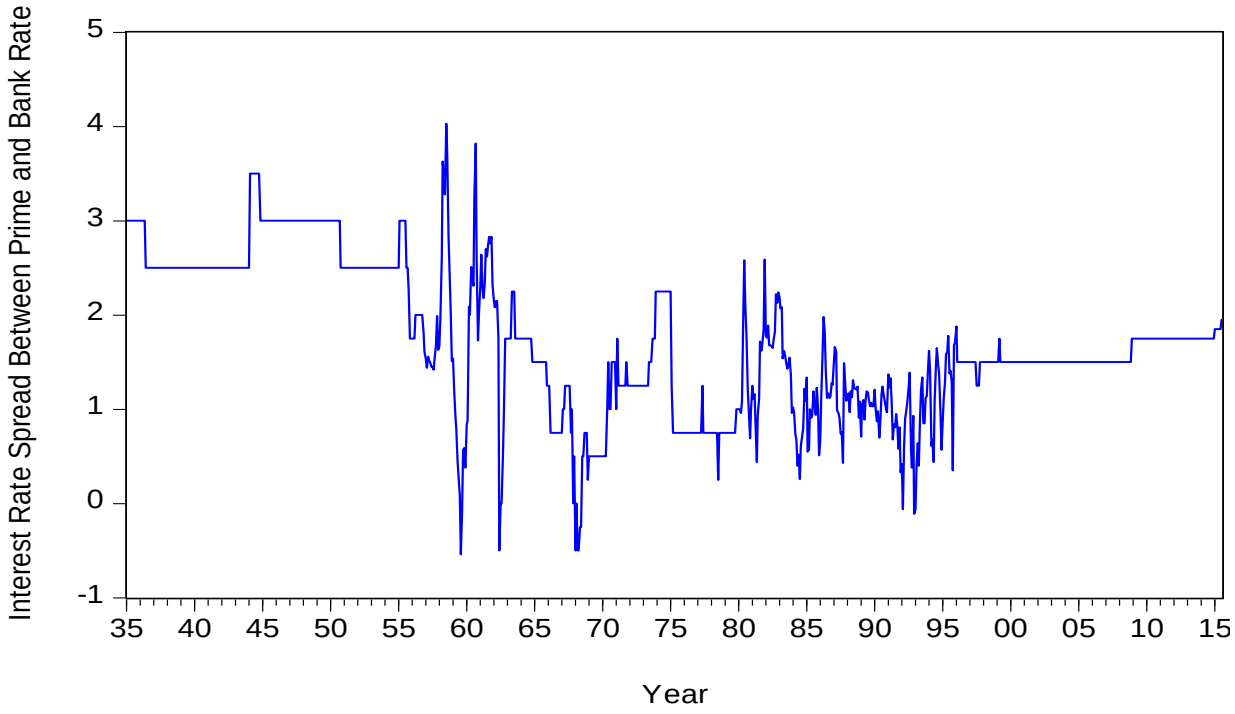



Examining figure 1.2, one can observe that there are periods of volatility in both the prime rate and the bank rate. The periods when the bank rate is set by the government treasury markets corresponds to higher volatility.

[11] This equation indicates that the prime rate at commercial banks ($i$) is composed of some fraction ($m_1$) of the central bank's policy rate ($i_0$), plus a markup over that rate ($m_0$). In the derivation of this equation the $m_1$ is affected by the probability distribution of the commercial banks ending with a negative settlement balance with the central bank, from the collective viewpoint of the commercial banks. Thus, this variable would rely on the risk adversity of the banks. The markup component in this equation would account for the cost of any regulations, market structure, legislation, and allow the banks to earn a "normal profit" (Kam and Smithin 2012).

In Figure 1.3 one can observe the spread between the prime rate and the bank rate. Generally, with a few exceptions, the prime rate was higher than the bank rate. The difference between the two rates was between 4 and -0.5 percent. Again, in the periods of the rates being set by the treasury market, the spreads were more volatile. Since the central bank began having full control over the rates, in 1996, one can observe the rate has been relatively constant, in a range between 1.75 and 2 percent. In the most recent years, the spread has been increasing, indicating that banks may be trying to increase their capital, and strengthen their balance sheets.

***Figure 1.3: Spread Between the Prime Rates at the Commercial Banks and the Bank Rate at the Bank of Canada***




*V.i.ii.iv. Empirical Findings*

The results in this section were found by both ordinary least squares, Johansen cointegration tests, and vector error correction modelling techniques. A first difference analysis will be used to achieve an unbiased result in the short run relationship between the two variables. A cointegration analysis will explore if this relationship is present in the long term. Equation (1.58) is the first difference equation that will be tested. This equation involves the first difference of the prime and bank rate to observe an unbiased estimate for $m_1$, without making any assumptions about $m_0$. $m_0$ has not been restricted to one value, as one can observe in figure 1.3, the spread between the bank

and prime rate has changed over time, thus, the bank power/markup term ($m_0$) may not be constant. The results can be observed in table 1.4.

(1.57) $$i = m_0 + m_1 i_0$$

(1.58) $$\Delta i = m_{00} + m_1 \Delta i_0$$

***Table 1.4: Estimation of a First Difference Regression for the Monetary Transmission Equation***

| Variable | Independent variable | | | |
|---|---|---|---|---|
| | Prime Rate | Prime Rate | Prime Rate | Prime Rate |
| Intercept | -0.0015(.006) | 0.003(.005) | 0.004(.005) | -0.0034(.01) |
| Pass-through 1935-2015 | 0.728 (.015)** | 0.967 (.059)** | 0.992 (.068)** | 0.969 (.059)** |
| Pass-through 1935-1956 | -----(-----) | -0.857(.131)** | -0.883(.135)** | -0.860(.131)** |
| Pass-through 1956-1962 | -----(-----) | -0.921(.07)** | -0.946(.084)** | -0.923(.077)** |
| Pass-through 1962-1980 | -----(-----) | -0.467(.069)** | -0.491(.076)** | -0.470(.069)** |
| Pass-through 1980-1996 | -----(-----) | -0.120(.61)* | -0.144(.70)** | -0.122(.062)** |
| Pass-through 2008-2015 | -----(-----) | -----(-----) | -0.105(.141) | -----(-----) |
| Direct Set | -----(-----) | -----(-----) | -----(-----) | 0.01(.012) |
| R squared | .69 | .77 | .77 | .77 |
| ADJ R squared | .69 | .77 | .77 | .77 |
| Durbin-Watson | 2.11 | 2.18 | 2.18 | 2.18 |

Notes: ** indicates a 5% confidence interval, *indicates a 10% confidence interval.

It is observable in table 1.4 the coefficient on the central banks' bank rate of interest ($m_1$ in equation (1.58)) has changed over the sample periods. Over the entire period around 73% of changes in the bank rate at the central bank, have been passed through to the commercial banks' prime rate. However, this has not been uniform over the 80-year period. Prior to 1962 very little, between 11% in the prior period, and 4.6% in the latter period, of the changes were passed on by the commercial banks. In the former part of this period the central bank had control over the bank rate, the latter part of the period the rate followed the interest rates of government bonds. From 1962 to 1980 the changes were passed on at a rate of 50% when the central bank had control over the rates. A 50% pass through would indicate a risk neutral bank in this period, as theoretically derived by Kam and Smithin (2012).

Between 1980 and 1996 the Bank of Canada set rates off the government bond market. In this period, the pass-through was 84.7%. Since 1996 the Bank of Canada had autonomy over the policy rate, and in this period the pass-through was 96.7%. If this current period was analyzed regarding pre, and post the recession of 2008, it could be observed that before the recession commercial banks changed rates one for one with the central bank, with the pass-through being statistically insignificant from 1. Post the recession, the value of the pass-through decreased to 88.7%. This

can be contrasted to the findings of Atesoglu (2004), that in the 1980's a pass-through was found in the United States of 80%. In the late 1990's, and early 2000 this went to unity. These findings of this paper, as the pass-through of rates, increased to a point where it reached unity in the early 2000's in Canada as well. Papers by various authors (Mora 2014; Illes and Lombardi 2013; Karagiannis, Panagopoulos and Vlamis 2014; Hristov, Hulsewig and Wollmershauser 2014) have found that since the recession of 2008 monetary transmission mechanisms have become much less effective around the world. The findings of this paper are that this monetary transmission mechanism has been observed to be slightly less effective, but not a decrease in effectiveness to the same scale as observed around the world in other transmission mechanisms.

Further conclusions are indicated from this analysis. First, the amount of pass-through was found to be irrespective of the way the Bank of Canada sets its policy rate. When the bank had full autonomy over the rates, the pass-through coefficient was 11%, 50%, and 96.7%. When the rate was restricted to the prevailing rates on government debt, the pass-through coefficient was 4.6% and 84.7%. Thus, there is no discernible pattern in the way the bank of Canada sets rates, affecting the effectiveness of the pass-through coefficient. Testing this concept in the final regression in table 1.4 it was found that the way the bank chose the interest rates was statistically insignificant. This was tested with several methods (only one test using dummy variables is displayed in the table), all coming to the same conclusion, that how the Bank of Canada sets interest rates, is unrelated to the pass-through of the policy rate to the commercial banks' prime rate.

Second, the pass-through of this rate has become closer to one. Pre-1962, this was not a very useful policy tool for affecting the prime rate at commercial banks. In the latest decades, however, this has become a much more powerful instrument, where almost all the changes are passed on in the interest rate, suggesting the socioeconomic relationship between the commercial and central banks has evolved. Furthermore, the increasing effectiveness of this tool and relationship between the central and commercial banks has made this monetary policy tool increasingly important. Any monetary policy changes affecting the bank rate will at a higher degree affect the real economy, through the interest rates channel at the Canadian commercial banks, compared to past decades. Kam and Smithin (2012) found theoretically that the efficiency term was a measure of risk aversion. As this term has increased over the decades that may indicate that the commercial banks

have become more risk-averse. Note that these values would represent a short run relationship. In order to examine a long run relationship and causality, cointegration needs to be established.

The Johansen technique and vector error correction modelling (VECM) used in this paper relies on the same methodology in Atesoglus (2004), thus, allowing the results to be comparable. This technique can be used to determine which variable is converging in the long run to create a stable relationship. [12]

A Johansen Cointegration test can be used to find the presence of a long run relationship. Along with the overall cointegration test, the periods were tested separately by first difference to ensure consistent results. Presence of cointegration would lend evidence to the endogeneity of the money supply. This argument relies on credit creation effecting the overall money supply. Thus, the money supply would rely on real interest rates at the commercial banks. If the interest rates at the central bank are cointegrated with the rates at the commercial banks, the central bank would have a degree of control over the interest rates at the commercial bank, and thus, the central bank would have indirect control of the endogenous money supply.

***Table 1.5: Johansen Cointegration test between the Commercial Banks Prime Rate and the Central Banks Policy Rate***

| | **1935:01-2015:08** | **1935:01-1956:10** | **1956:11-1962:06** | **1962:07-1980:03** | **1980:04-1996:02** | **1996:03-2015:08** | **1996:03-2008:08** | **2008:09-2015:08** |
|---|---|---|---|---|---|---|---|---|
| **Pass-through term ($m_1$)** | 0.728** (0.0157) | 0.111** (0.038) | 0.032* (0.0176) | 0.619** (0.0433) | 0.844** (0.0285) | 0.965** (0.0128) | 0.990** (0.016) | 0.883** (0.018) |
| **$R^2$** | .69 | .031 | .049 | .49 | .82 | .96 | .96 | .96 |
| **Durbin Watson Statistic** | 2.11 | 1.94 | 1.73 | 2.13 | 2.30 | 2.35 | 2.48 | 2.12 |
| **Johansen: Trace Statistic** | 31.77** | 28.30** | 10.47 | 9.92 | 37.75** | 16.70** | 35.77** | 23.45** |
| **VECM: $\Delta$i Prime Rate Error correction term** | -0.048** (0.017) | -0.080** (0.014) | -0.127** (0.054) | -0.0416 (0.032) | -0.218** (0.1099) | -0.092** (0.028) | -0.960** (0.456) | -0.576** (0.161) |
| **VECM: $\Delta i_0$ Bank Rate Error correction term** | 0.0039 (0.020) | -0.016 (0.025) | 0.159 (0.385) | 0.347 (0.039) | 0.0865 (.1195) | -0.331* (.1328) | -0.447 (.455) | -0.809** (0.191) |

Notes: Values in parentheses are standard errors. The Johansen cointegration test assumes no deterministic trend, lag interval: 1 to 1 (keeping in line with the Atesoglu (2004) and allowing for the possibility to analyses effects that happen in one month after the change). Note that results were found but not reported using the AIC to find the optimal lag length. The results were not materially different from the results reported above. ** indicates a 5% confidence interval (presence of cointegration for trace statistic), indicates a 10% confidence interval.

Table 1.5 displays the result that found the presence of cointegration, based on the trace statistics, in all but two periods. This indicates that in most sample years there is evidence

[12] This work relies on the finding by Engle and Granger (1987) on testing for a long run stable relationship between non-stationary variables and the work of Gonzalo (1994) proving that the Johansen methods (Johansen 1991) is the superior cointegration process.

supporting a long run relationship, especially since 1980. Thus, there is evidence to support endogenous money in every period except between 1956 and 1980. This does not mean that there was not endogenous money in this period, but one cannot use this monetary transmission mechanism as proof of its presence in those years. The analysis found that in the more recent decades the commercial banks changed their prime lending rates in more readily with the central bank, compared to earlier periods, lending evidence of an evolving socioeconomic relationship, where commercial banks are more integrated with the central bank. The paper by Atesoglu (2004) also found evidence of endogenous money supply in the United States post the 1980's. This appears to be consistent across the two countries.

Table 1.5 also has information on the error correction term found by vector error correction modelling. This variable can help determine causality between the linkage of the policy and prime rate. In all periods that have evidence of cointegration, one can observe that the prime interest error correction term is statistically significant. Thus, this suggests uni-directional causality where the prime rate is adjusting to maintain a long run stable relationship. In the period post-1996, there was the presence of bi-directional causality meaning that both the bank and prime rates were adjusting to maintain a long run relationship. Additionally, post the 2008 recession, one can observe evidence of bi-directional causality where both the prime and central banks change interest rates to maintain a long run relationship. Atesoglu (2004) would conclude by the uni-directional causality as evidence of horizontalism, and bi-directional causality as evidence of structuralism. Both horizontalists and structuralists would agree on endogenous money, but their opinion diverges on whether the interest rates at the central bank are exogenous or endogenous. The two theories do not have to be mutually exclusive, and there is evidence to support both.

*V.i.ii.v. Conclusion*

This section explored many questions about the monetary transmission mechanism between the Bank of Canada and the commercial banks. On the question of the effectiveness of this mechanism, it was found that it has become increasingly effective, regardless of the way the Bank of Canada sets rates. This suggests that monetary policy is more important than in past decades, as more of the change in policy can transmit to the real economy compared to past decades. This is consistent with the findings for the United States found by Atesoglu (2004).

Evidence was also found for the presence of endogenous money supply. From 1935-1956, and 1980-2015 conclusive evidence to support that result was observed. Furthermore, in all periods where evidence was found that supports endogenous money, there was also evidence that supported the commercial banks' prime rate adjusting to maintain this long run relationship. All the evidence suggests that there has been an evolving socioeconomic relationship between Canadian commercial banks, and the Bank of Canada. Over this 80-year period, it was observed that commercial banks have, to an increasing degree, set their prime interest rates based on the central bank's policy rates. Thus suggesting, the amount of risk financial institutions is willing to assume, and their relationships with other institutions have changed over time.

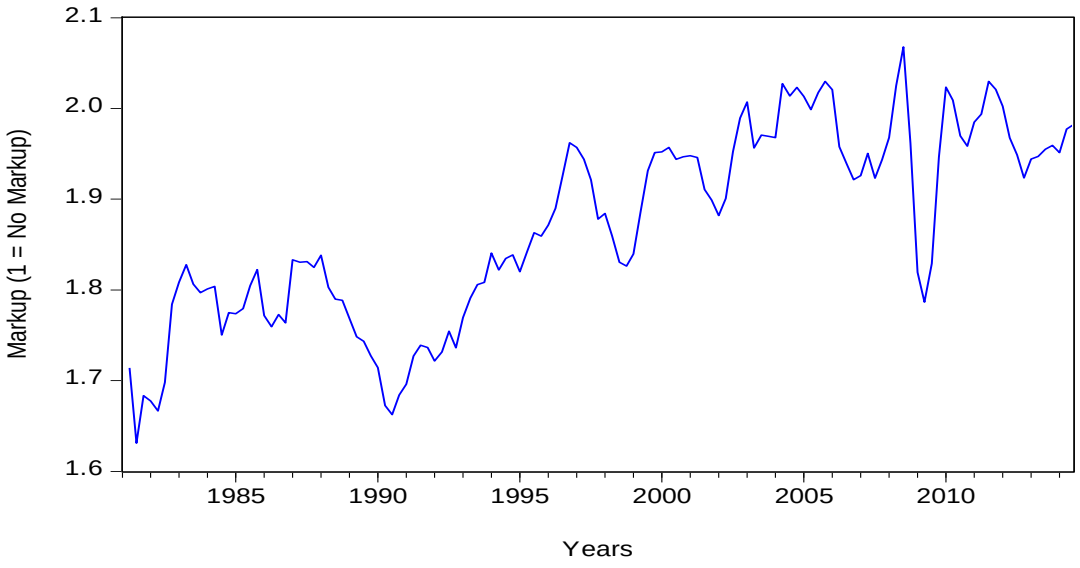
*V.ii. Income Distribution Equation*

As previously mentioned in sections III.ii, and IV.ii the Income distribution equation does not require econometrics. The purpose of this equation is to examine the shares of revenue the different agents receive. The equation derived in III.ii is stated below in equation (1.59):

$$k = a - r - w \quad (1.59)$$ [13]

In this case, the rentier extracts their rents by loaning money to the business; thus, as an approximation for the rentier share, the real interest rate will be used for the first examination. The firms' markup over wages can be observed in figure 1.4.

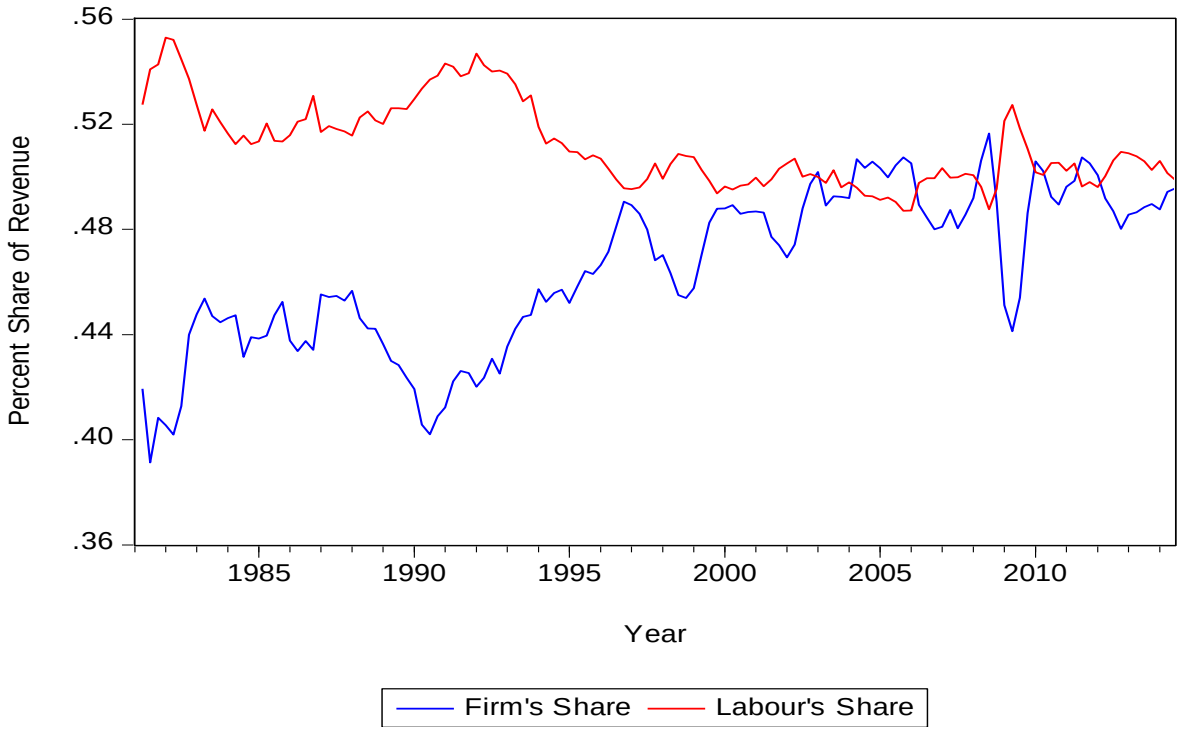
***Figure 1.4: Aggregate Firms' Markup over Labour and Financing Costs***




[13] Equation (1.56) consists of the aggregate markup the firm charges over the wage bill ($k$), the average productivity per worker ($a$), the aggregate wage received per worker ($w$), and the rents collected by the rentier ($r$).

It can be observed in figure 1.4, that there was a gradual increase in the markup over the wage bill from the beginning of the 1980's. During the recession of 1981, the markup was 65%, which increased to over 80% before the 1991 recession. Post the 1991 recession; the markup continued to grow to over 100% until the recession of 2008. In the recession, the markup quickly fell by 25%, eventually returning to a rate a little below 100%. A 100% markup means firms were doubling their labour costs when selling products. Labour is not the only cost associated with running a firm. Other necessities to running the firm, for example, capital, are built into the markup and present in the firms' share. Thus, part of this build could represent an increased cost of other inputs needed to run an organization, relative to the cost of labour. The data can be examined regarding what proportion of the income accrues to what agent. This can be examined in figure 1.5.

***Figure 1.5: Income Shares as a Percentage of Revenue by Group (Labour, Firms, and Rentier)***



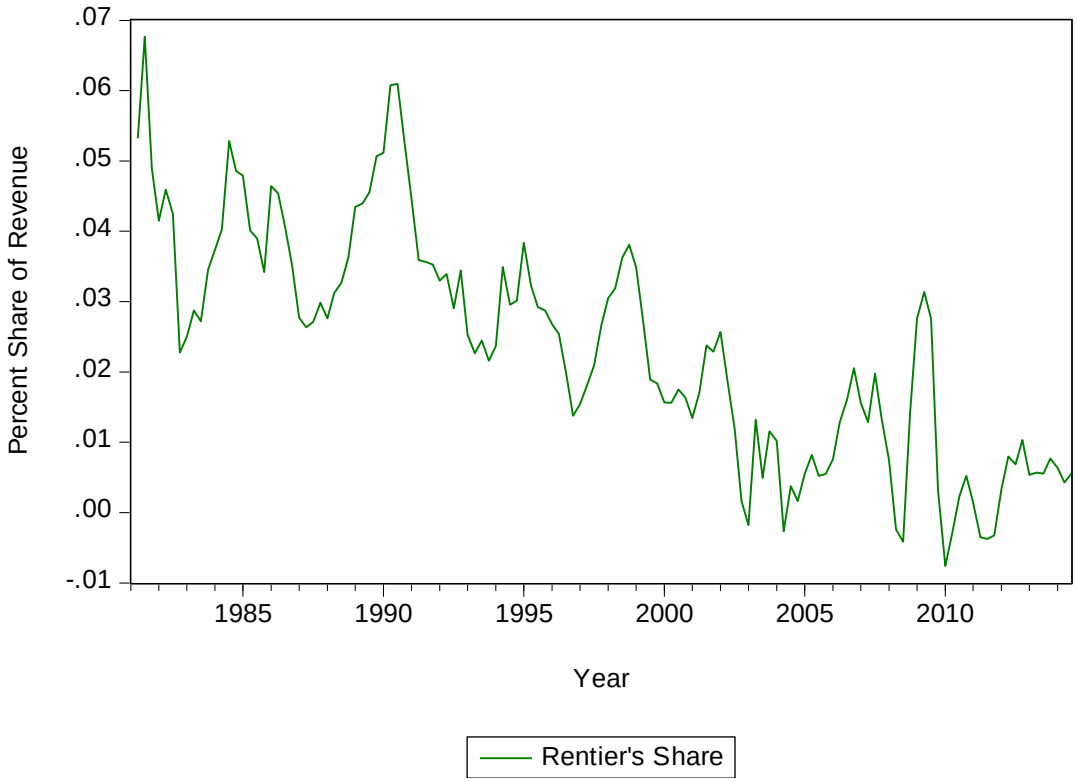



Figure 1.5 is the proportion of revenue that the firm, labour, and rentier receive. Labour has experienced a contraction in their overall income share, reducing the share from around 55% of revenue in the 1980's to about 50% of revenue in 2014. This share of income for labour has been observed to increase during recessions. When examining the recessions of 1981, 1991, and 2008, all are associated with increases in labour's share. This may indicate that labour's wages are not as sensitive to economic slowdowns, compared to firms' revenue. Additionally, labour lost most of its share in times of economic growth. This additionally could indicate that labour may not be as sensitive to the business cycle as firms are.[14]

The firm has experienced a growth of their share, increasing from 40% in the 1980's to 50% in 2014. In all three recessions, 1981, 1991 and 2008, the share of the firms was reduced. Outside of the recessions, the share of the firms was growing. This may indicate that firms are more economically sensitive than labour, increasing and decreasing their relative share throughout the business cycle. The rentier's income fell throughout this period, as the real interest rate decreased. The rentier share was reduced from 6% to just above 0%. This share went to zero as the interest

[14] Note this figure shows proportion only not wage in real terms. Real wages will be discussed in the following sub-section.

rates in the economy decreased, post the 2008 recession, indicating that the firms gained share from both labour and rentiers over this period. Using the real interest rate for the rentiers share may not be realistic as the rentier approved zero since 2003, and thus, an alternate measure will be examined.

In the AMM, the rentier share was defined as the real prime interest rate at the commercial banks. Although this may give an approximation to the rentier share, the firm's interest rates may vary from the prime interest rate, as firms or entrepreneurs may not be able to borrow from commercial banks at this rate. Instead, firms may issue bonds and pay bondholders an interest rate higher, or lower than the prime rate, or issue equity and pay equity holders a dividend. In this case, total household income from these sources can be found from Statistics Canada. Once the numbers are transformed into a percent of GDP it shows that using the prime interest rate as a proxy may have been a good approximation in some, but not all periods. The effects on profit markup from the different definitions of rentier share can be observed in figure 1.7. In figure 1.6, one can see the profit markup when using this new interest rate. As one can observe, this markup follows the same patterns as the markup displayed in figure 1.4.

***Figure 1.6: The Firm's Markup with new Definition of Rentier Share***

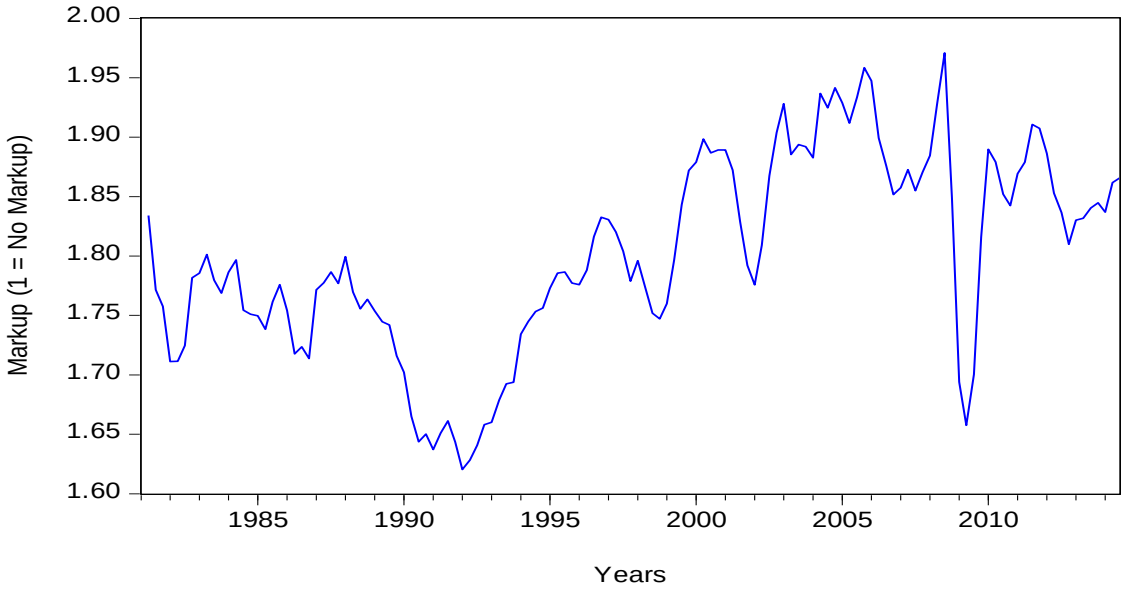
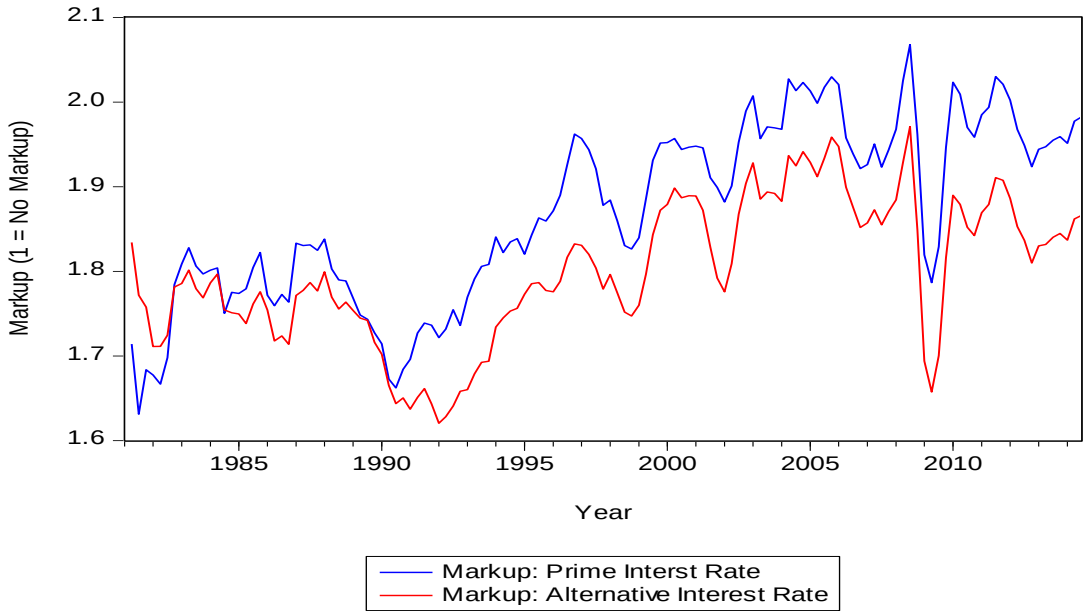
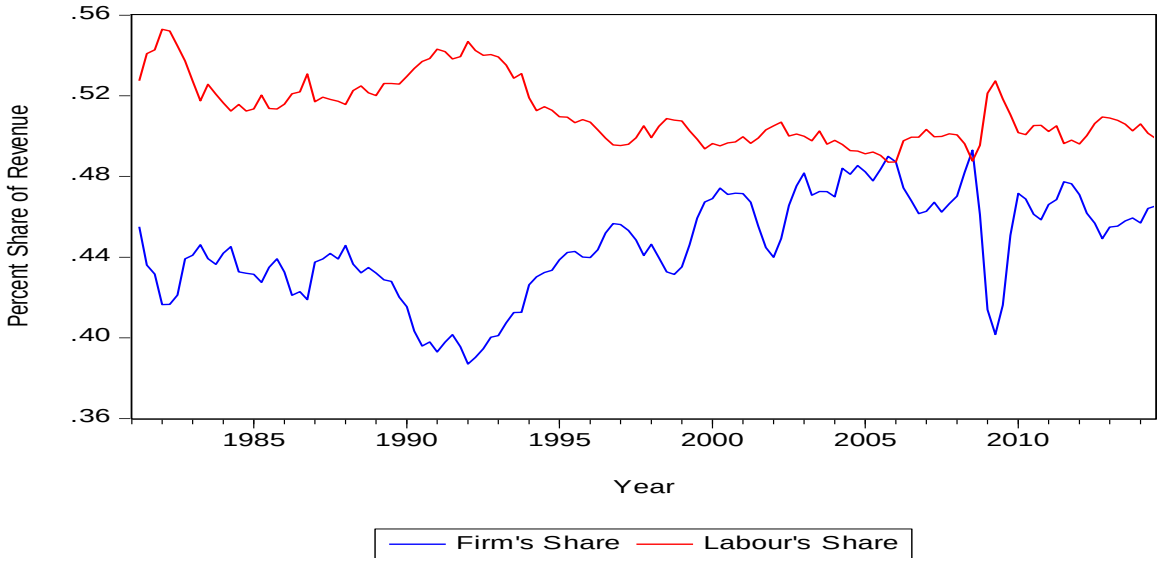


***Figure 1.7: Comparing the Firm's Markups with the Two Definitions of Rentier Share***




The difference from this new definition of rentier share observed in figure 1.6 shows a different trend. One can observe a downward trend in the firm's markup until the early 1990's. This reversed and increases until the 2008 recession following the same pattern as for the prime interest rate. This indicates that the prime interest rate is a satisfactory approximation, but it can overemphasize the firm's profit share at the expense of the rentier. Figure 1.6 examines the shares for each group with the new definition of the rentier.

**Figure 1.8: *Income Shares as a Percentage of Revenue by Group* with new definition of Rentier**




One can observe from figure 1.8, the pattern for labour share was unaffected over this time. There was, however, a change in the distribution between the firm and rentier. Under the new definition, the firm's profit share was on a downward trend from 1981 until 1993. At the same time, the rentier could increase its extraction from the firm. Post-1993 there was an increase in the firm's share, at the expense of both labour and the rentier. The rentier did lose share post-1993, but unlike the previous definition, their share did not decrease to zero.

When examining the 2008 recession, it is observable that the three groups were affected differently. First, labour increased its share. This analysis examines the average worker. In this case, as observed in figure 1.9, the average productivity and wage were increasing during the recession. This may be due to firms reducing their least productive workers, with lower than average wages first as reducing low productivity low wage employees will increase the average wages and productivity. As figure 1.9 indicates, average wages were growing faster than average productivity meaning that this would increase the share of income labour receives, compared to total productivity. Second, one can observe, in figure 1.6, the rentier receiving an increase in their income in 2008. This can be attributed to a decreasing inflation rate, at the beginning of the recession. This decrease means less of the rents earned by the rentier were devalued by the loss

of investment, due to inflation. Finally, in 2008, as observed in figure 1.8, the firms had a sharp decline in their share, while both labour and the rentier increase their share.

***Figure 1.9: The 2008 Recession: Changes in Averages Wage and Average Productivity***


*V.iii. Real Wage Equation*

The wage equation was derived and explained in sections III.iii. and IV.ii. The equation examines the effect of macro factors on the aggregate wage. The equation that will be tested can be observed in equation (1.59).

$$w_{tax\ adjusted} = h_0 + h_1 y + h_2 q + h_3 w_{tax\ adjusted(-1)} \tag{1.59}$$

In this analysis, the real after-tax wages will be used to simplify this process. In this equation, there are three known variables.[15] As mentioned in the previous section no restrictions were placed on what lag would be the most predictive for the exchange rate, as it may take time for the exchange rate to influence wages. The most substantial lag length will be reported in table 1.6. The variable $h_0$ accounts for the other factors that may affect wages not included in this model. Examples of these factors could be the social-political power of labour or policy decisions of the government. The coefficient for these three variables ($h_1$, $h_2$, and $h_3$) will be estimated in a first difference regression. A first difference regression will be used to deal with non-stationary concerns, and an examination of only the short-run effects will occur. In order to perform this econometric

[15] The growth rate ($y$), the exchange rate ($q$) and the wage rate ($w$)

technique, the first difference of the known variables must be found as displayed in equation (1.60). The results of this test are presented in table 1.4.

(1.60) $$\Delta w_{tax\ adjusted} = h_{00} + h_1 \Delta y + h_2 \Delta q + h_3 \Delta w_{tax\ adjusted(-1)}$$

***Table 1.6: Estimation of the First Difference Regression of the Wage Equation***

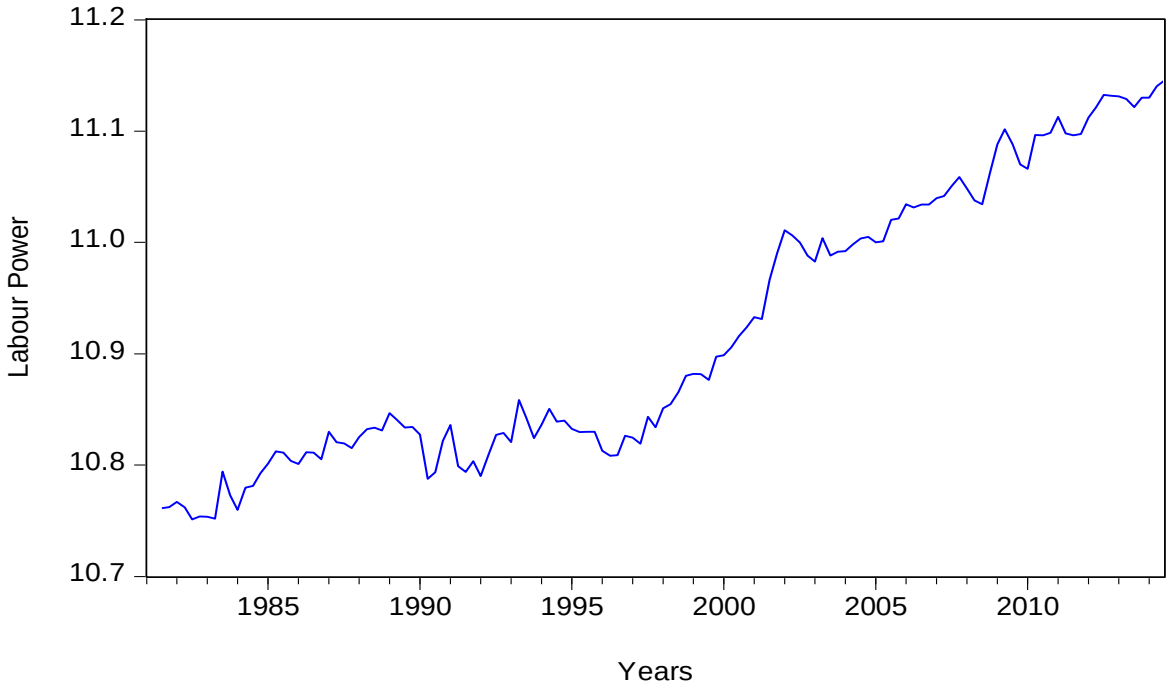
| Independent Variables | Dependent Variable<br>$\Delta \boldsymbol{w_{tax\ adjusted}}$ ($R^2$=.12, Adjusted $R^2$=.10)<br>Durbin-Watson Statistic 2.12 |
|---|---|
| $h_{00}$ | 0.003 |
| | (0.001) |
| Δy | 0.216** |
| | (0.104) |
| Δq(-1) | -.115** |
| | (0.042) |
| Δw(-1) | -.247** |
| | (.083) |

*Notes: **indicates statistically significant result at a 5% level*
** indicates statistically significant result at a 10% level*

Table 1.6 examined short-run changes in the aggregate wage. These results indicate there is a definite association between the real wage and gross domestic product. An increase in the GDP of 1% is associated with a 0.22% increase in the real after-tax wage. Theoretically, the coefficient on the growth variable is restricted between 0 and one as presented by Smithin (2013). The findings in this model were consistent with this theoretical result. The most significant lag of the exchange rate is a one period lag. This indicates that a 10% appreciation in the exchange rate would be associated with a 1.2% decrease in the overall aggregate wage. Finally, the presence of autocorrelation is found in the wage equation. If these short-run estimators can be introduced into equation (1.59), all values are known except for the $h_0$ variable, as $h_{00}$ is not equivalent. As the $h_0$ term is the only unknown in every period a unique value for this variable can be determined, and this variable would account for all the long-term effects of all variables on aggregate wages. The value of this variable can be observed in figure 1.10.

Figure 1.10 displays real wage gains maintained by labour. Pre-1995, this variable was somewhat horizontal indicating labour power was constant. Post-1995 this variable has been on an upward trend. This could indicate that there have been more labour-friendly policies leading to labour receiving real wage gains.

***Figure 1.10: Time Path for $h_0$ The Social Political Power of Labour***




The significant "spikes" in this graph correlate with economic events. An examination of the four economic slowdowns and recessions in this period will be conducted. These slowdowns occurred in 1981, 1991, 2001 and 2008. In 1981 there was a recession, post this recession there was an increase in the value of this variable followed by years of volatility. Before the 1991 recession, one can observe a decrease in this variable followed by a substantial rebound as the recession occurred. After the recession, this variable was in a range until 1996. In 2001, this variable increased as the recession occurred, then was followed by this variable decreasing and the 2008 recession held the same pattern as 1991.

There may be a couple of explanations for these patterns. First, this could be partially due to employment. This could indicate that during the recession the first group of labour to become unemployed are the lower wage workers, increasing the average wages over the period. A second explanation could be that labour and unions do not like accepting wage reductions. Thus, at the beginning of the recession, as inflation is falling, sometimes to deflation, the nominal wages were not falling at the same pace or rising at the contracted rates. This would increase real wages in the economy, as wages would be growing faster than inflation. A third explanation could be that unionized labour has higher real wages and is more difficult to layoff then their non-unionized counterparts. In the recession, if firms laid off the easiest to reduce labour first, the non-unionized

labour, this could increase the average wages, since in Canada the non-unionized labour on average earns less than the unionized labour force[16].

Contrasting the real wage gains to the findings in the previous section that labour share has been falling over this 30-year period, this indicates that although labour is receiving less of the total share of revenue, the average labour agent has made real wage gains. Thus, firms have captured a more significant portion of the productivity gains compared to labour over this period.

Additional to the wage equation, Atesoglu and Smithin (2006) examined the connection between economic growth and productivity. There could be a theoretical linkage as gains in economic growth can be attributed to two causes. An increase in productivity, or of employment. An extension of this equation will examine how these same factors can affect productivity. Thus, the equation that will be estimated is as follows, in equation (1.61).

(1.61) $$a = c_0 + c_1 y + c_2 q + c_3 a_{-1}$$

As per the previous equation, the same factors will be examined in the first difference space to account for non-stationary concerns and find the short run effects. Thus, the estimated equation can be observed in equation (1.62). The results of this equation can be observed in table 1.7.

This equation explained 65% of the variation in the productivity variable. In the productivity equation, the only statistically significant factor in the equation is the growth rate. In this case for every 1% increase in the growth rate, it is correlated with a .46% increase in the productivity. Combining this with the previous analyses, where a 1% increase in the growth rate correlated with a .22% increase in the wage rate. Thus, this suggests that when the GDP increases by 1% this is correlated with the productivity per worker increasing by 0.46%, and the wage increase by 0.22%. Therefore, this indicates that firms and rentier on average capture 52.2% of the productivity gains, and labour retained 47.8% of the gains.

(1.62) $$\Delta a = c_{00} + c_1 \Delta y + c_2 \Delta q + c_3 \Delta a_{-1}$$

[16] Statistics Canada labour force survey found that in 2008 the median unionized labour earned $24.46 an hour and the average non-unionized labour earned $19.83. Statistics Canada Table 282-0073 February 1th 2018..

***Table 1.7: Estimation of the First Difference Regression of the Productivity Equation***

| Independent Variables | Dependent Variable<br>$\Delta \boldsymbol{w_{tax\ adjusted}}$ ($R^2$=.56, Adjusted $R^2$=.55)<br>Durbin-Watson Statistic 1.60 |
|---|---|
| $c_{00}$ | 0.002<br>(0.0004) |
| $\Delta y$ | 0.459**<br>(0.043) |
| $\Delta q$ | -.009<br>(0.015) |
| $\Delta a(-1)$ | 0.077<br>(.067) |

*Notes:* ***indicates statistically significant result at a 5% level*
** indicates statistically significant result at a 10% level*

*V.iv. Liquidity Preference*

*V.iv.i. Inflation Equation*

The inflation equation, as discussed in section III.iv, and IV.ii attempts to describe the relationship between inflation, interest rates, productivity, and wages. These components can be observed in equation (1.63).

$$p = p_0 + p_1 r - r_{-1} + p_2(w_{-1} - a) + p_3 p_{-1} \tag{1.63}$$

In equation (1.63) inflation ($p$) is a product of several factors.[17] One driver of inflation in the AMM is a cost push component, measuring if wages are growing faster than productivity. The theory behind this concept is that if wages are growing faster than productivity that will cause inflation, if the converse is true then there would be disinflation. The coefficient on the cost push term is assumed to be equal to one in the AMM thus, in this initial analysis it will be restricted to that value. To determine the short run effects in this variable, a first difference estimator will be used. This will also deal with the non-stationarity of wages and productivity. as observable in equation (1.64). The final term is $p_0$, the term that was earlier derived to be a measure of supply, and demand for money. This is theoretically a measure of "liquidity preference" which could be thought of as an indicator of "bullishness" or "bearishness" in the money market. Since the demand for and supply of money has not stayed constant over this period. This term will represent all long-term factors in the model.

$$\Delta p = p_{00} + p_1 \Delta r + p_2(\Delta w_{-1} - \Delta a) + p_3 \Delta p_{-1} \tag{1.64}$$

[17] These variables being the real interest rates ($r$), previous inflation ($p_{-1}$), and a cost push term ($w_{-1} - a$).

Estimating this equation will allow for unbiased estimators of the coefficients to be found. The results of this test are presented in table 1.6.

***Table 1.8: Estimation of the First Difference Regression of the Inflation Equation***

| Independent Variables | Dependent Variable<br>$\Delta p$ ($R^2$=.55, Adjusted $R^2$=.55)<br>Durbin-Watson Statistic 1.68 |
|---|---|
| $p_{00}$ | -0.0003<br>(.0095) |
| $\Delta r$ | -0.77**<br>(0.077) |
| $\Delta w_{-1} - \Delta a$ | 1<br>(--) |
| $\Delta p_{-1}$ | 0.582**<br>(.090) |

*Notes:* ***indicates statistically significant result at a 5% level*
** indicates statistically significant result at a 10% level*
*($p_2$ restricted $p_2$ =1)*

The macroeconomic factors explored in this equation accounted for 55% of the overall short-run changes in the inflation rate. Thus, 45% of the change can be attributed to other factors, for example, the demand and supply of money, and speculation in the financial markets. These factors will be examined in the following paragraph. The results in table 1.6 showed a negative relationship between the inflation rates and real prime interest rates. An increase in the interest rates of 1% was associated with a 0.77% decrease in the inflation rate. Additionally, there was a strong presence of autocorrelation. Note that the autocorrelation is less than one. This suggests that inflation may persist from one period to another, it does not by itself accelerate exponentially causing ever increasing inflation rates going to infinity. Thus, other factors would be responsible for hyperinflation.

One concern when using first difference approach to annualizing the data is that it may disregard information of a long-run equilibrium relationship which would enhance the strength of the findings. Ericsson, Hendry, and Grayham (1998) proposed a solution to this potential shortcoming when working with differenced data using cointegration to determine a long-run relationship. This establishes and measures both the short run and long-run relationship between variables. The optimal lag length was determined by the AIC.

***Table 1.9: Cointegration between the Inflation, Prime rate at Commercial Banks, and the Differential Between Wage and Productivity Growth***

| Equation and normalized Variable | Trace test ≤0 | | Cointegration Parameters | |
|---|---|---|---|---|
| | Statistic | 95% | **r** | (w-a) |
| (1) p (lag=6) | 32.02** | 29.79 | -0.639** | 0.48* |

*Notes:* ***indicates statistically significant result at a 5% level*
** indicates statistically significant result at a 10% level*

Table 1.9 found the presence of autocorrelation in the inflation equation, validating the short-term findings with long-term evidence supporting the relationship. The cointegration parameter for the interest rate parameter is in the same range as found by first difference supporting the negative relationship between interest rates and inflation. The wage and productivity differential term was found to be positive in the long run supporting the idea of cost-push inflation in the long term.

These unbiased estimators can be introduced into equation (1.63). Thus, meaning all values for all variables are known in every period, except for the $p_0$, variable as $p_{00}$ is not equivalent. As $p_0$ is the only unknown in every period a unique value for this variable can be determined in every period, that accounts for all unexplained variation in the model. The value of this variable can be observed in figure 1.11.

***Figure 1.11: $p_0$ Liquidity Preference (inverse) Variable Tacking Other Factors Not Accounted for in the Estimation of the Inflation Equation (1.60)***

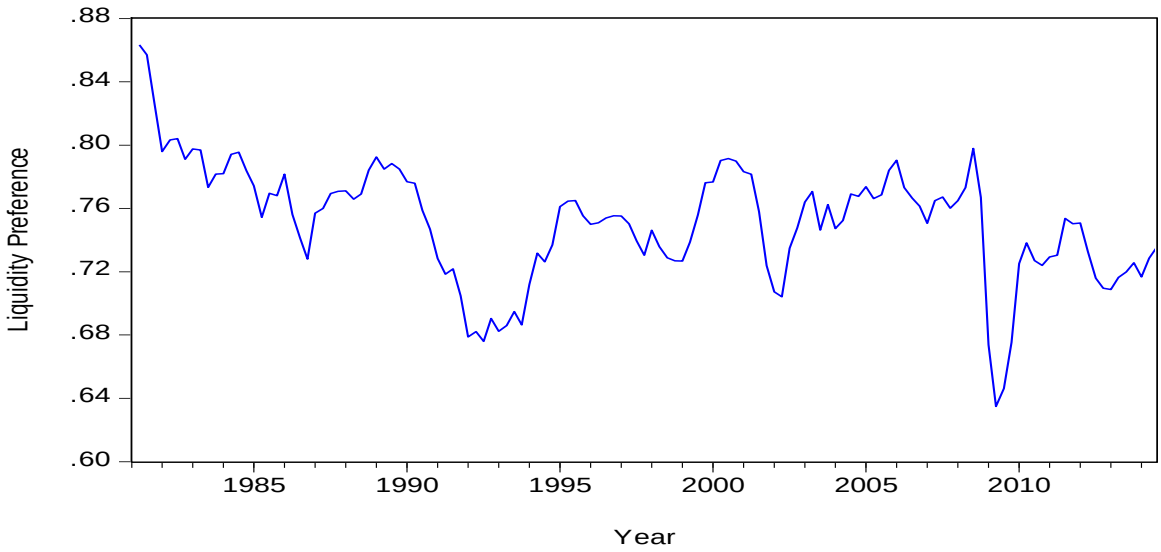


Figure 1.11 accounts for other factors affecting inflation. As section IV.iv derived, this variable may be thought of as liquidity preference, relying on the demand for, and supply of money. Figure 1.11 is the inverse of this concept. A decreasing number indicates liquidity preference has increased. This means that agents would want to hold more real money, and less in the financial markets, thus, one could think of this as a "bearish" sentiment in the markets. The converse scenario would indicate a decrease in liquidity preference. Agents would like to hold less real money balances and hold more in the financial markets, thus a bullishness in the market.

A full analysis of this variable will follow this section, with the following being an overview of the non-statistical evidence. In this figure, one can see that the value of $p_0$ was higher in the early 1980's, then in a range since that time. This could be because of the high inflation rates the early 1980's. With the inflation rate being high agents would not have an incentive to hold money balances, as these would be devaluing. This would indicate a low level of liquidity preference as the graph supports. Further one can examine the economic slowdown. In 1991 the decrease in this variable happened over several years and did not start significantly increasing until the year 1995. This would indicate a bearish sentiment in the early 1990's, correlating with this period the S&P/TSX Composite started 1990 at 3969 ending 1994 at 421. Over this five-year period, the markets fell three out of the five years. The total return on the S&P/TSX Composite was 6.1% or 1.2% annually. Inflation during that period had a compounded average rate of 2.5%. Thus, the real average return on the S&P/TSX Composite, excluding dividends, was negative 1.3%. This indicates that there was a "bearish" sentiment on the market as the average inflation-adjusted return on the S&P/TSX Composite was negative, and 4.4% lower than the average inflation-adjusted return, excluding dividends, since 1980, which was 3.1% per year[18]. The 2001 and 2008 slowdowns have two similarities to them. The variable decreased quickly, starting the first quarter of the slowdown, but also recovered quickly. In the 2008 case, this saw a very dramatic slow down to levels not seen anywhere else in this 34-year period, indicating that there may have been very pessimistic views about the outlook of the money markets, followed by recovery the following year. On the TSX the stock market lost 35% of its value over the course of 2008. The following

[18] Yahoo Finance aggrege returns S&P/TSX Composite and Bank of Canada historical inflation data December 14th 2015

year the TSX recovered 57% of what it had lost the previous year. Thus, the markets may have moved with this variable which will be explored in greater detail in the following section.

*V.vi.ii.i. Cross Country Examination of Liquidity Preference*

A key aspect of the model is the liquidity preference term. Evidence supporting that this term is what it has been theoretically defined as is needed to give the overall conclusions relevance. Liquidity preference is theoretically defined as a measure of the supply and demand of money. Hence, it is a representation of bullishness or bearishness in financial markets. This section will test this assertion to determine if this variable is in fact what it is theoretically derived to be. Thus, it will be testing against other measures of confidence in the financial markets.

This section will be examining both Canada and the United States quarterly de-seasoned data from 1982-2015 and 1973-2015 respectively. Data from the United States is added in this section as its financial markets/survey data may be more consistent with larger sample sizes. The discrepancy in the starting dates is due to the data in the United States being more readily consistent compared to data in Canada. The data from the United States will be tested with both beginning dates of 1973 and 1982 for robustness. Conducting a cross-country analysis will examine if there are any cross-country effects between these countries, as Canada's top trading partner is the United States. 75.6% of exports go to, and 66.4% of imports come from, the United States, whereas the United States exports only 19% of its total exports to, and receives 14.6% of its imports from, Canada[19]. This allows for the examination of the cross-border relationship of liquidity preference.

*V.iv.ii.ii. Empirical Tests*

This section will test the previously proposed equation. The tests will be conducted through first difference regressions, as outlined in section V.iv.i. The approach of this section will be to calculate and examine liquidity preference and coefficients for both Canada and the United States. This will give insight into the consistency of the model across countries and examine if any theoretical restrictions are violated. Additionally, where applicable, the results will be compared to external data sets that would be thought of as proxies for the constructed exogenous variables.

[19] Statistics Canada Table 228-0069 March 21st 2017 and U.S. Census Burrow U.S. International Trade in Goods and Services Report March 21st 2017.

This equation relies on a cost-push concept of inflation, real interest rates, inflation persistence, and the liquidity preference concept, that depends on the supply and demand of money. In order to find the values for the unknown parameters in equation (1.63), a first difference regression will be conducted to find unbiased values for $p_1$, and $p_3$. $p_2$, in this section, will be assumed to be equal to one as it is based on the theoretical concept of cost push inflation (Robinson 1979). The first difference regression is observed in equation (1.65).

(1.65) $$\Delta p = p_{00} + p_1 \Delta r + p_2(\Delta w_{-1} - \Delta a) + p_3 \Delta p_{-1}$$

***Table 1.10: Estimation of the First Difference Regression of Inflation for Canada and the United States***

| Variable | Independent variable | |
|---|---|---|
| | Canada | The United States |
| $p_{00}$ | -0.0043 (.0009) | 0.0004 (.001) |
| $\Delta r$ | -0.795 (.075)** | -0.881 (.036)** |
| $\Delta w_{-1} - \Delta a$ | 1 (--) | 1 (--) |
| $\Delta p_{-1}$ | 0.617 (.088)** | -0.133 (.038)** |
| R squared | .57 | .81 |
| ADJ R squared | .57 | .81 |
| Durbin-Watson | 1.73 | 1.98 |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level

Observing table 1.10, it contains the first difference inflation regression for both Canada and the United States. There is a strong negative correlation between interest rates and inflation in both countries. This indicates that as real interest rates rise at commercial banks, it is associated with a reduction in the inflation rate in the short-run. This effect was constant across countries. Additionally, there is some inflation persistence in the Canadian data. This effect is, however, less than one. Thus, inflation would not continue to grow to hyperinflation, based on a rise in inflation in one period. In the United States, there was a negative inter-period reaction to inflation where higher inflation one period had a negative effect on inflation in the next. Note that the value for $p_{00}$ is not the value for the $p_0$ (liquidity preference) variable. In a first difference regression, no assumption is made about the "intercept" coefficient in the regression, and thus, a value is not determined. Therefore, if these estimators are introduced into the original inflation equation (1.63), all values are known except for the $p_0$ term in every period. Thus, with algebraic principals, unique values for this variable, in all periods can be found. This assumes that the liquidity preference term variable would account for all long run error in the model. This term can be observed in figure 1.12.

***Figure 1.12: $p_0$ Inverse Liquidity Preference for Canada and the United States***

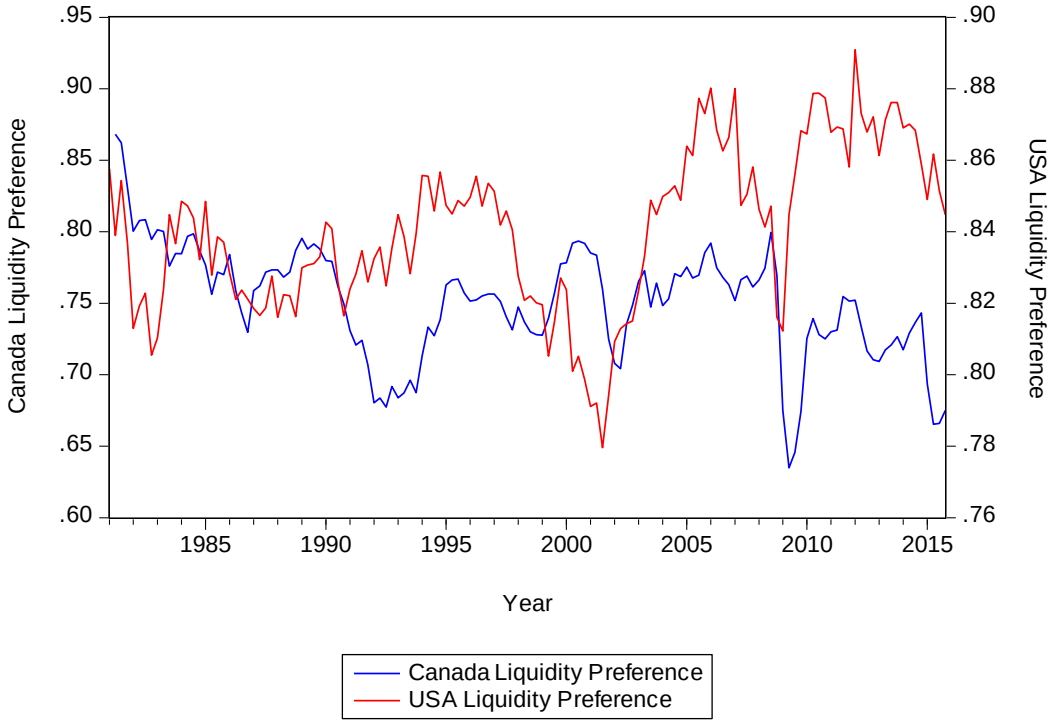



Figure 1.12 depicts the generated values for the inverse of liquidity preference, in both Canada and the United States. Increased values of this term, theoretically, would indicate people are having less of a preference to have liquidity. Thus, intern, this would be thought of as a "bullish" trend in the financial markets. The reverse would indicate a "bearishness" in the financial markets. When examining the figure, several observations are notable for both Canada and the United States. In the case of Canadian liquidity preference, it can be observed that this variable fell in the three recessions and the slowdown. When examining the recession of 2008, it can be observed that the recession started in the same quarter that the values for liquidity preference began to decrease. This is true also in the case of the 2001 slowdown, a steep decrease followed by a quick recovery. In the 1990's, however, this variable suffered a prolonged period of being below average. This quick recovery in the liquidity preference term coincides with a relatively quick recovery in the Toronto Stock Exchange (TSX) after 2001, and 2008 recessions. When examining the prolonged low level of liquidity preference in the early 1990's, this coincided with below average real returns on the TSX over the same period.

The United States suffered a recession in 1982, 1990, 2001, and 2008. Examining the latest two recessions one can observe that for some time before the recession the values for liquidity

preference reached a peak, before the recessions. In the case of the 2008 recession, the liquidity preference variable reached a peak in the first quarter of 2007. In the 2001 recession, this variable reached a local peak in the last quarter of 1999, of a more general peak of 1997. Thus, suggesting that at some point the liquidity preference variable may have been leading the markets. The recession in 1982 and 1991 was associated with a smaller drop in this variable.

To test if this variable is indeed a measure of investors' confidence one needs to compare the variable to financial returns. A Johansen cointegration test and vector error correction modelling (VECM) was conducted to examine both the existence of cointegration and leading/lagging relationships in the long run between the two factors.

***Table 1.11: Johansen Cointegration Test for Liquidity Preference in Comparison to the DJIA,***

| | The United States |
|---|---|
| Trace Statistic | 57.09** |
| Max-Eigen Value | 52.52** |
| $\Delta p_0$ (Liquidity Preference) Error correction | -0.004 (0.016) |
| $\Delta DJIA$ (DJIA) Error correction | -1.07 (0.13)** |
| $\Delta TSX$ (TSX S&P 500) Error correction | N/A |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level, lag length 1 is used for Canada and Unites States

Table 1.11 indicates the relationship between the liquidity preference for the United States and the Dow Jones Indusial Average (DJIA). The Canadian data did not meet all the criteria for this test to be meaningful thus the analysis will continue with the data from the United States. US data is measured with a lag length determined by the max of the AIC.[20] The test indicates that by both Trace and Max Eigen test the variables are cointegrated at a 5% confidence level. With this confirmed, one can explore a long-run relationship between two variables, conducted through vector error correction modelling. The significant negative coefficient found on the VECM term DJIA indicates that the variable is changing to maintain its long-run relationship with the liquidity preference term. Further, the VECM error correction term indicates that all the disequilibrium is corrected within one period.

[20] Note there were some technical factors mitigating the results of the Canadian, thus not allowing a further examination, but did not affect the results of the United States. Thus, this analysis will continue with the examination of the results from United States.

Since the finding of cointegration of the liquidity preference and the DJIA, this suggests a long run relationship between these two terms. To explore this relationship, an examine the concurrent and future periods returns of the DJIA when there is a "large movement" in the liquidity preference term. A one standard deviation change in the liquidity preference in a three-month period will be the baseline for a "large movement."

***Table 1.12: DJIA Returns Associated with a One Standard Deviation Increase in Liquidity Preference Term Thoracically Indicating "Bearishness" in the Financial Markets***

| Date | Change in LP | Return Next Period | Return This Period | Real Retunes Next, This |
|---|---|---|---|---|
| 2012Q2 | -.017 | (1.5%) | 4.5% | (2.1%), 4.1% |
| 2008Q4 | -.031 | (18.0%) | (11.2) | (18.1), (11.9) |
| 2007Q2 | -.032 | 1.1% | 3.4% | 0.8%, 2.9% |
| 2001Q3 | -.012 | (13.8) | (1.9%) | (14.1%), (2.3%) |
| 2000Q2 | -.022 | (2.0%) | (1.9%) | (2.6%), (2.4) |
| 1999Q2 | -.014 | (1.2%) | 15.2% | (1.6%), 14.9% |
| 1998Q1 | -.013 | 14.6% | 6.2% | 14.4%, 6.1% |
| 1990Q3 | -.015 | (15.9%) | 9.4% | (16.6%), 8.4% |

Before examining the results in table 1.12, facts about the DJIA data need to be expressed for the results to be meaningful. The DJIA had 40 quarterly decreases during the 122 quarters recorded, which gives a 32.7% chance of encountering a negative period. Additionally, out of the 40 losses, only seven were recorded with a loss of over 10%, representing 5.73% of the entire sample. As Table 6 displays, four of these seven periods are identified. Additionally, the model has predicted a total of 8 periods of losses, of which 75% of those predictions are correct for the following periods. If one were predicting losses at this success rate or better, by random chance, it would only occur 1.77% of the time. Lastly, if one looks closely at those dates, they are all corresponding to a significant adverse event in US economic history. This evidence further indicates that the liquidity preference term may be a measure of investors' confidence. Additionally, one can examine the bullish case where liquidity preference decreased by one standard deviation as displayed in table 1.13.

***Table 1.13: DJIA Returns Associated with a One Standard Deviation Decrease in Liquidity Preference Term Thoracically Indicating "Bullishness" in the Financial Markets***

| Date | Change in LP | Return Next Period | Return This Period | Real Retunes Next, This |
|---|---|---|---|---|
| 2015Q3 | +.039 | (0.8%) | 3.9% | (1.1%), 3.4% |
| 2012Q1 | +.032 | 4.5% | 5.6% | 4.1%, 5.1% |
| 2009Q4 | +.012 | 3.7% | 5.8% | 3.2%, 5.2% |
| 2009Q2 | +.032 | 12.3% | 2.1% | 12.3%, 2.3% |
| 2007Q1 | +.013 | 4.4% | 3.4% | 3.4%, 2.9% |
| 2005Q3 | +.043 | (1.8%) | 4.4% | (2.6%), 3.4% |
| 2005Q1 | +046 | (2.8%) | 4.6% | (3.5%), 3.6% |
| 2003Q3 | +.015 | 6.1% | 8.9% | 5.7%, 8.3% |
| 2002Q1 | +.015 | 0.2% | 9.3% | (0.1), 9.0% |
| 2001Q4 | +.014 | 9.3% | (13.7%) | 9.0%, (14.1%) |
| 1999Q4 | +.012 | 1.9% | 0.7% | 1.2%, 0.2% |
| 1994Q3 | +.016 | (7.5%) | 8.1% | (8.0%), 7.6% |
| 1989Q1 | +.014 | 3.2% | 9.0% | 2.2%, 7.9% |

In the bullish case, the effects seem to be found in the concurrent period. The model predicted 13 periods of gains based on the increase in liquidity preference term (inverse of liquidity preference) in the concurrent period and was accurate 92% of the time. If choosing periods for gains by random chance this accuracy rate, or better, would occur 4.25% of the time. The one period that was mispredicted is a period that overlaps with the previous table. This period was predicted to be a loss from a sharp drop in liquidity preference in the previous period. This was followed by a sharp gain which is a bullish sign. The following period then has a significant return on the DJIA as predicted by the model. This gives more evidence liquidity preference may be a numeric representation of investors' confidence as it changes with the financial markets, as it is theoretically defined.

Because of the stationary nature of the Canadian data, it could not be tested by the Johansen cointegration test. In this circumstance, a VAR Granger causality with the Wald test would be more appropriate to establish evidence of short-run causality between the TSX and the liquidity

preference term. This will help establish evidence that these two series are in fact related, and liquidity preference may be a measure of investors' confidence. Table 1.14 will display the results of this test.

***Table 1.14: Granger Causality Test for Liquidity Preference in Comparison to the TSX,***

| Test | Granger Causality |
|---|---|
| | Canada (1) |
| Lags | 1 |
| Liquidity Preference granger cause the TSX chi-sq/(probability) | 2.70 (.1002) |
| TSX granger cause liquidity preference chi-sq/probability | 5.44** (.0197) |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level

The results in table 1.14 indicate that there is strong evidence that the TSX causes changes in the liquidity preference term, and the test did not find that the liquidity preference term caused the TSX, with a probability just over the 10% threshold. Thus, this indicates that there is some short-term relationship between liquidity preference and the TSX. Additionally, the liquidity preference term is found to be a measure of investors' confidence in Canada. However, there may be limited forecasting, from the liquidity preference term to returns on the TSX, as this may not be a leading indicator of market performance in Canada.

### *V.v. Animal Spirits*

#### *V.v.i. Growth Rate Equation*

The final equation to be estimated in this essay is the growth equation. As derived and examined previously in section III.v. and IV.ii., this equation consists of five components, as displayed in equation (1.66).

$$y = e_0 + e_1 k + e_2 q + e_3 (g - t) + e_4 y_{-1} \quad (1.66)$$ [21]

[21] To determining the growth rate ($y$) it involves the profit markup ($k$) as determined in section VI.ii., the exchange rate ($q$), the total government spending and revenue ($g - t$). This equation has been modified to account for the previous quarters growth rate ($y_{-1}$).

In order to maintain consistency with the previous analysis, no assumptions are made about the length of time it takes for changes in the exchange rate to have a real impact on the economy. Thus, multiple lags will be tested, and the most statistically significant one will be displayed in table 1.15. Additionally, the assumption in the model is that the coefficient on the deficit is equal to one, thus, $e_3$ will be restricted for this analysis. The question will examine the short run effects in the model through a first difference regression to deal with any non-stationary concerns. The intercept term $e_0$ encompasses all other effects in the model and will account for any long run variation. As derived in section III.v. this could be thought of as an animal spirits variable that measures confidence in the economy, effecting business investment. This would imply that the variable may not be restricted to a signal value. The first difference equation is presented in equation (1.67). The first difference will be found for all the known variables ($y,\ k,\ q,\ g\ and\ t$) as this will allow the finding of the unknown coefficients ($e_1,\ e_2, and\ e_4$).

(1.67) $$\Delta y = e_{00} + e_1\Delta k + e_2\Delta q + e_3\Delta(g - t) + \varepsilon_4\Delta y_{-1}$$

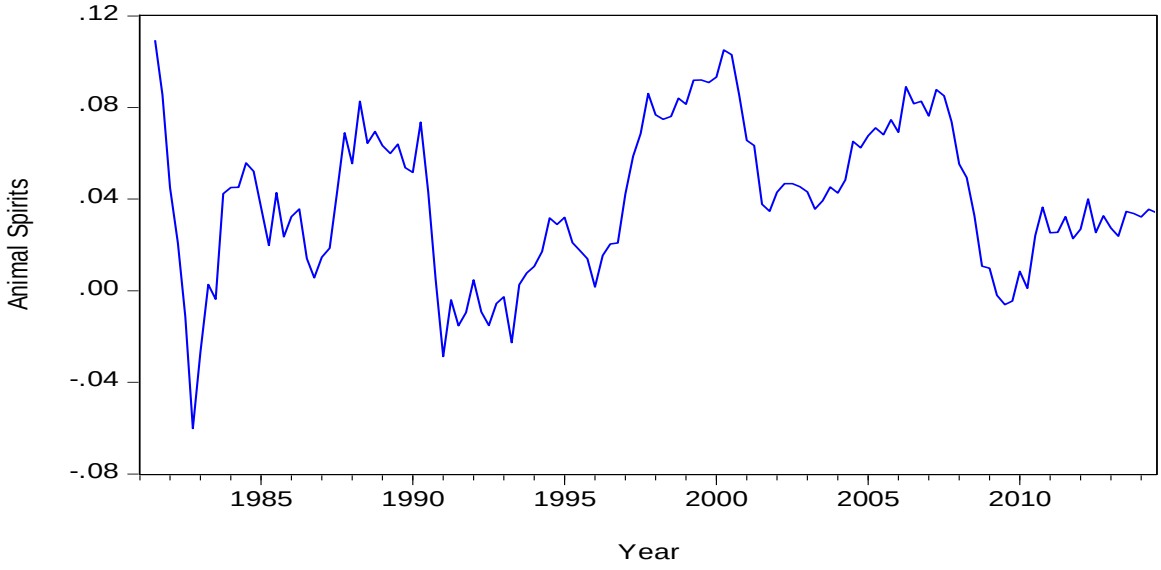
***Table 1.15: Estimation of the First Difference Regression of the Growth Equation***

| **Independent Variables** | **Dependent Variable**<br>$\Delta$y ($R^2$=.35, Adjusted $R^2$=.33)<br>Durbin Watson Statistic: 2.25 |
|---|---|
| $e_{00}$ | 0.0004 (0.0011) |
| $\Delta$k | 0.403** (0.067) |
| $\Delta q_{-8}$ | -0.064 (.044) |
| $\Delta y_{-1}$ | 0.464** (.113) |

*Notes:* ***indicates statistically significant result at a 5% level*
** indicates statistically significant result at a 10% level*
*($e_3$ restricted to $e_3$ =1)*

The results in table 1.15 showed a positive effect on the growth rate and the firm's markup. Smithin theorized that this variable should be restricted to a value between 0 and 1 which was consistent with the findings (Smithin 2013). There was the presence of positive autocorrelation found in the model. These unbiased estimators can be introduced into equation (1.66). Thus, all values are known, except for the $e_0$ variable, as $e_{00}$ is not equivalent. $e_0$ is the only unknown in every period, thus unique value for this variable can be determined, accounting for all the long run variation in the equation. The value of this variable can be observed in figure 1.13.

***Figure 1.13: $e_0$ Animal Spirts Variable Tacking Other Factors Not Accounted for in the Estimation of the Growth Equation (1.62)***




This variable ($e_0$) displayed in figure 1.13, has several patterns to be explored. There are four periods of growth in this variable, followed by periods of sharp declines. The declines occur in 1981, 1991, 2001 and 2008 coinciding with the recessions. Between these dates this variable steadily increased in value. As derived in section III.v. this variable theoretically should be a representation of confidence in the economy. As such it has been labeled "animal spirits. An interesting observation can be made in the timing of the decreases in this variable. Examining this variable in 2008 one can observe that the variable reaches a peak at the third quarter of 2007. Through this period until the third quarter of 2008 this variable decreased in value. This is significant as the recession in Canada only began in 2008, thus, this variable reached its peak the year before the recession. In the case of liquidity preference, examined in the previous section, it reached a peak in the third quarter of 2008. Hence, the animal spirits variable reached its peak before the liquidity preference variable. The reason this variable was falling in those periods is that firm's profits, the exchange rate, government budget, and the previous growth rate, would have indicated a growth rate higher than observed in the quarters leading up to the third quarter of 2008. This indicates that some other factor was affecting growth negatively the year before the recession began. Examining the 2001 slow down the same conclusion can be observed. This variable reached

a peak in 2000 and the "technology bubble" bursting, did not occur until midway through 2001[22]. Again, liquidity preference reached its peak at the beginning of the slowdown. There is not enough data to examine 1981 in depth, and the 1991 recession did not face the same lead up as the two that followed. In 1991 this variable and liquidity preference reached a peak at the beginning of the recession. Further evidence can be observed that this variable does have a relationship to confidence in the economy. A more in-depth analysis on the linkage between the animal spirits and confidence in the economy will occur in section V.v.ii.

*V.v.ii.i Cross-Country Examination of Animal Spirits*

Animal spirits is a key term in the model. Proof that this term is what they were defined to be theoretically is needed to give the overall conclusions more significance. The animal spirits term is theoretically the autonomous spending less savings in the economy. Hence, this represents the amount of spending/investing in the economy not directly related to current profits. Thus, this would indicate that it considers expectations or confidence in the markets.

This section will be examining both Canada and the United States quarterly de-seasoned data from 1982-2015 and 1973-2015 respectively. The inclusion of the United States will allow for stronger evidence supporting animal spirits being a measure of confidence in the economy.

*VI.v.ii.ii. Empirical Test*

The growth equation explains changes in the growth rates, based on the business profit markup, the exchange rate, deficit and the previous period's growth rate. When estimating the unknown parameters in equation (1.66), a first difference regression will be conducted. This will estimate the short-run effect of this equation. The first difference regression that will be tested is observed in equation (1.68).

$$(1.68) \qquad \Delta y = e_{00} + e_1 \Delta k + e_2 \Delta q + e_3(\Delta g - \Delta t) + e_4 \Delta y_{-1}, \qquad 0 < e_1 < 1$$

[22] The technology bubble led to a recession in the United States, a major trading pattern of Canada, but not in Canada. An economic slowdown, not 6 months of negative growth, was experienced in Canada.

***Table 1.16: Estimation of the First Difference Regression of the Economic Growth Equation***

| Variable | Independent variable | |
|---|---|---|
| | Canada | The United States |
| $e_{00}$ | 0.0003(.001) | 0.00007 (.001) |
| $\Delta k$ | 0.377(.064)** | 0.368(.092)** |
| $\Delta q$ | -0.056(.0425) | 0.047(.0286)* |
| $\Delta g - \Delta t$ | 1(--) | 1(--) |
| $\Delta y_{-1}$ | 0.468(.112)** | 0.413(.0754)** |
| R squared | .33 | .22 |
| ADJ R squared | .32 | .21 |
| Durbin-Watson | 2.23 | 2.01 |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level

Table 1.16 is the first difference regression for the growth equations in both Canada and the United States. In this analysis, it can be observed that in both countries the profit share of firms is significantly correlated to the growth rate in the economy. In both countries, a one percent increase in the firms' markup over labour share is related to an increase in the growth rate of 0.37%. This change was consistent across countries. The analysis found that the most statistically significant lag of the exchange rate was eight quarters or the change in the exchange rate two years ago. This may indicate that it takes time for firms and agents to adapt to a new exchange rate. In the United States, there was a definite correlation between the exchange rate eight quarters ago and the growth rate. Thus, suggesting that the stronger dollar may have a marginal benefit to the economy of the United States, where a 10% appreciation in the value of the US dollar would be associated with a 0.47% increase in the growth rate. In both Canada and the United States autocorrelation was found to persist. In both cases around 45% of a change in the growth rate in the previous period, will persist over the next period. This value is under one which indicates that this persistence will not cause the growth rate to increase to infinity. Note that the value for $e_{00}$ is not the value for the $e_0$ (animal spirits) variable. In a first difference regression, no assumption is made about the intercept, and a value is not determined by regression. The short-run estimates from equation (1.68) can be introduced into the original growth rate equation (1.66). All values are known except for the $e_0$ term and using algebraic principals one can simulate a unique value for this variable in all periods, that will account for all long-run variation in the equation. This gives a range of values for this term that can be observed in figure 1.14. Theoretically, the error in the model is the animal spirits term, based on autonomous demand less the saving rate indicating expectations in the economy.

***Figure 1.14: Generated $e_0$ Animal Spirits term for Canada and the United States***

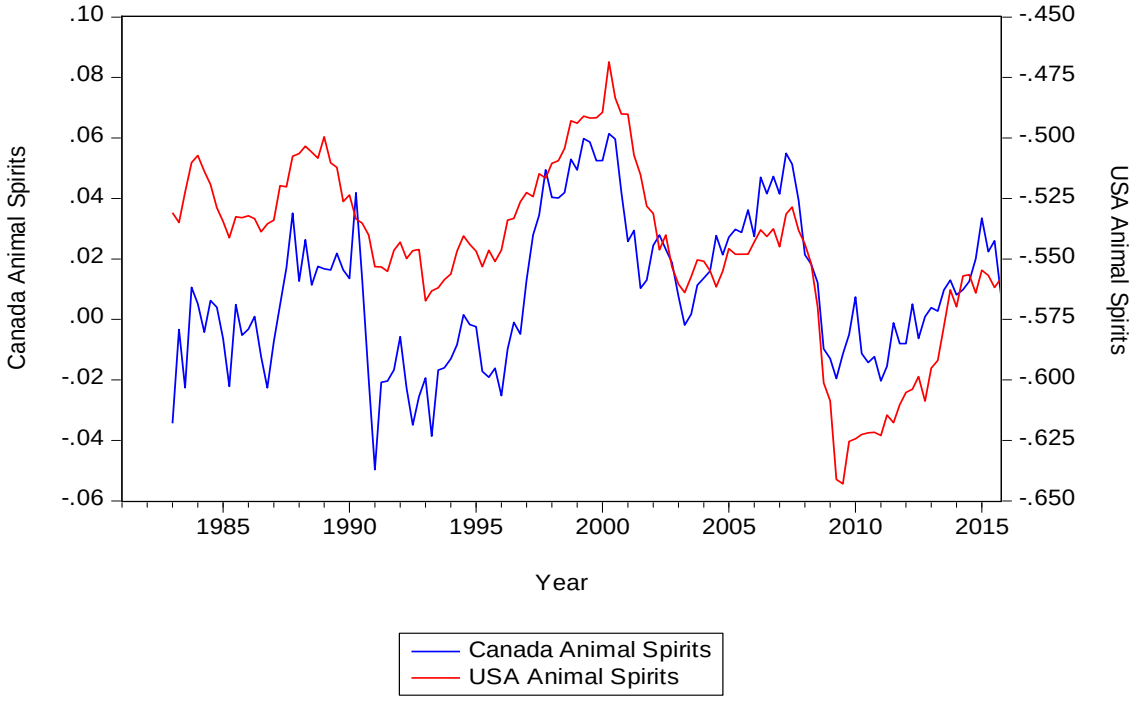



Figure 1.14 contains the generated animal spirits variable. When examining the Canadian data, it can be observed that there was a decrease in this variable when recessions occurred. The values also achieve peaks before the recessions in both 2001, and 2008. This reached a peak in the second quarter of 2007, before the 2008 recession, and in the second quarter of 2000 in the 2001 economic slowdown. This may indicate that this variable is a leading indicator of economic growth.

In the case of the United States, before the 2008 recession, the animal spirits variable reached a peak in the third quarter of 2007, and in the second quarter of 2000 before the 2001 recession. Before the mild recession in the second quarter of 1990, this variable began to decrease in the second quarter of 1989. These assertions will be tested for both countries.

In order to test if any causality is present in the relationship between the economic growth rate and animal spirits term, a VAR Granger causality test will be used. A Johansen cointegration test is ineffective in this case because of stationary variables. This will assess if there is any relationship between the two variables in the short term and determine which variable(s) Granger causes the relationship.

***Table 1.17: Granger Causality Test for Animal Spirits and Economic Growth***

| Test | Granger Causality | |
|---|---|---|
| | Canada (1) | United States (2) |
| Lags | 6 | 6 |
| Animal spirits Granger cause economic growth chi-sq/(probability) | 21.09** (.002) | 14.59** (.0237 |
| Economic growth Granger cause animal spirits chi-sq/probability | 30.96** (.000) | 26.28** (.0002) |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level

Table 1.17 indicates the relationship between the growth rate variable and animal spirits variable with lags lengths found by AIC. This test indicated in both Canada and the United States that there is a bi-directional relationship. Thus, this suggests that both the growth rate and animal spirit term are changing to maintain a short-run relationship.

When examining animal spirits across countries, as in figure 1.14, one can observe a high degree of correlation between the two as they tend to move together. The calculated correlation between these two variables, Canada and the United States, is 0.55. This indicates that shocks that affect confidence very often affected both countries in the same way, yet there no presence of cointegration, which would indicate that one variable does not directly influence the other.

## *VI. Conclusion*

This essay explored the background of the Alternative Monetary Model (AMM) and derived the equations that will be the basis of the three essays. Testing of the AMM with Canadian data was collected, covering many aspects of the economy for the years between 1981 and 2014. This paper found values for those variables and tested these against any technical restrictions.

In the interest rate determination equation, it was found that the commercial banks did not move interest rates one for one with the central banks. Further, an examination of monetary transmission mechanism over the entire history of the Bank of Canada was conducted. It found that since the 1980's, there has been a substantial reliance on this mechanism, by the commercial banks, meaning that commercial banks follow the Bank of Canada's lead when setting their prime rates. Furthermore, there was much evidence to support the idea of endogenous money.

Supplementary to the coefficients, there was the creation of the constructed exogenous variables. The estimation techniques allowed for these variables to be found on a range of topics.

The interest rate equation allowed for the finding of the markup at the commercial banks examining how the banking sectors power has changed over time. The income distribution equation examined the shares of income distributed between the firm, labour and rentier over this 34-year period. Labour share has slowly contracted, the rentier share has been volatile in a range, and the firms have been increasing. The wage equation allowed one to observe the real wage gains earned by labour through a constructed exogenous variable named "the social-political power of labour." This variable encompassed the real wage gains labour has experienced since 1981. and showed an increase in the real wage gains by labour since 1995. Thus, contrasting this to the shared labour receives, one can observe there has been on average real wage gains, even as labour is receiving a smaller share of the total firm's revenue. The inflation equation allowed for the finding of the constructed exogenous variable named "liquidity preference" representing the demand and supply of money, and agents' attitudes in the financial markets. This was a volatile variable that, at times, changed with the economy. Additionally, when examining the recessions in 1991, and 2008 there may be a correlation with the financial markets. In the earlier recession, this variable stayed relatively low for a five-year period. In the same period, financial markets experienced negative real returns. Contrasting that finding to the 2008 recession liquidity preference fell very rapidly then rebounded in the following year, although to a lower level. This was consistent with the experience of a substantial decrease, followed by a partial recovery on the financial markets. This relationship between "liquidity preference" and the financial markets was examined further. It was found that large changes in the liquidity preference variable, was associated with changes in the financial markets. Finally, estimating the growth rate equation allowed one to observe the created exogenous variable named "animal spirits." This variable theoretically relied on confidence in the economy. This variable turned negative before the two most recent economic slowdowns, suggesting this variable may be a leading indicator. This finding was confirmed with the Johansson cointegration test that found that GDP growth rates changed to maintain a long run stable relationship with the animal spirits term.

The values of these variables will be used in the simulation of the economy that will be conducted in the next essays. Having coefficients and the values for the variables in this 34-year period will allow for the simulating of economic events and allow for the AMM to predict outcomes of different events. The simulations will be able to give an insight of the theoretical effects the AMM would predict to occur given various government policies, and economic events.

# Essay 2: The Predicted Effects of Changing Macroeconomic Policy in Canada Using Numerical Methods

## *I. Introduction*

Various authors have studied component of the AMM using both theory and econometric analysis (Atesoglu 2004; Atesoglu and Smithin 2006; 2006b; 2008; Collis, Paschakis and Smithin 2016; Kam 2000; 2005; Kam and Smithin 2012; Smithin 2007; 2009; 2013; 2018). Numerical methods are the critical next step in this analysis. This will allow for an application of the theory and an examination of the adjustment mechanisms of the model with the use of actual data. Using the Canadian data allows for an unbiased analysis of the mechanisms of the model as all coefficients have been calibrated from actual data. This essay examines the theoretical implications of the Alternative Monetary Model (AMM), based on the empirical results in the previous essay. Section II will apply numerical methods to examine the implications of the model, and Section III will apply numerical methods to the model, with the inclusion of autocorrelation. These numerical method simulations will examine the theoretical effects of various fiscal and monetary policy changes, as well as economic events.

A recurring theme in section II and III is the effect of the government sector on the real economy. The government will be found to influence the real economy mainly through the channel of fiscal policy. Thus, limits to this concept must be explored. Section IV will examine the sustainability of deficits, and the consequences monetary policy would have on this sustainability.[1] There has been research conducted on this subject by numerous authors with much of the research assuming that interest rates must be higher than economic growth. This is in order not to violate the transversality and no-Ponzi game conditions, assumptions that are necessary for Ricardian equivalence (Azizi et al. 2012). Although this assumption is widely used there is evidence that is commonly violated in the real world as shown in a study by Bohn ( 2005). This section examines this concept with the use of debt dynamics. Much work has been conducted on fiscal effects on government interest rates. Saleh and Harvie (2005) surveyed the area and found that a majority of the empirical work found a positive correlation between government interest rates and the budget

[1] Sustainability in this context will be defined as what level of debt to GDP will be achieved if a country ran a constant fiscal, and monetary policy, as well as experiencing constant economic growth and interest rates. This is not to say that this will determine the country's ability to borrow, or that a country will achieve the stated debt to GDP levels. Instead only making a statement on if policies and economic conditions were contestant into time going to infinity these policies would imply the debt to GDP ratio would approach.

deficit, in the sense that a more substantial deficit correlates with higher interest rates. Counter to these conclusions is the work by Hartman (2007). Hartman research concluded that when exploring data from the United States, the linkage between interest rates and the deficits was inconclusive, but there was evidence that may support the crowding out effect. Additionally, studies that examined other smaller countries found varying results. For example, Hsing (2009) used the open-economy loanable funds model in the context of government interest rates in Slovenia and failed to find evidence that a deficit had any effect on government interest rates. Much of this research only focuses on the effect of fiscal policy, without incorporating the effect of monetary policy through the prime interest rate. The examination conducted in this essay will incorporate monetary policy, with the hypothesis that monetary transmission from the central bank's prime rate to government bond yields is the more operative channel, compared to fiscal policy. This section will examine what effect fiscal, and monetary policy, through monetary transmission, have on the yields of government bonds, as it will be revealed that the interest rates on government bonds have a significant role on the effect of government debt sustainability.

Section V will examine Okun's law. Okun's law examines the tradeoff between employment, and the growth rates, theoretically stating that growth must increase more than one for one with decreases in unemployment (Okun 1962). The relationship between unemployment and growth has been tested by other authors, and the stability of this relationship has been tested for other countries. Work conducted by both Huang and Lin (2006), and Yilmazuday and Yazgan (2009) demonstrated that the Okun coefficient, that determines employment's sensitivity to economic growth might vary over time when examining quarterly data. Both studies based their findings on data from the United States. Knotek (2007) found that there has been a general relationship between unemployment and growth. However, it was unstable at a time when examining the short-term effects of Okun's law. This relationship has been found to be not stable in other countries as well. In a study of Japan, it was found the Okun coefficient had moved in a range between 6.43:1 to 1.03:1[2] when examining short-run effects (Kurosaka 2012).

Not all data supports Okun's law, for example, a study by Durech, Minea, Mustea, and Slusua (2014) of the Czech Republic and Slovakia was conducted and failed to find this Okun's law

[2] This figure indicate how much economic growth is associated with the reduce unemployment. Thus, a ratio of 6.43:1 would indicate that economic growth would need to increase by 6.43% to be associated with a 1% reduction in unemployment.

relationship at the regional level. The global structural differences between the countries in the previous literature and Canada may lead to different results. Additionally, some of the previous studies only examined limited ranges of data covering periods as short as a couple years. This study that will be conducted in this paper will examine the longer-term effects of Okun's law. Monetary policy was also not introduced in these models. This section will examine if there is evidence in Canada supporting Okun's law. Theoretically, there may be a limit to the real rate of growth in the economy when the entire workforce is employed. This will allow for a calculated potential upper limit to the real growth rate in Canada. Likewise, this may indicate a limit to the effectiveness of government stimulus.

## *II. Numerical Methods of the Alternative Monetary Model*

The policy implications for the AMM using numerical methods will be examined in this section. The model was proposed by Smithin (2013, 219-261; 2018). [3]

$$(2.1) \qquad y = g - t + e_0 + e_1 k, \qquad (Economic\ Growth)$$

$$(2.2) \qquad k = a - r - w \qquad (Income\ Distribution)$$

$$(2.3) \qquad p = p_0 + p_1 r + w_{-1} - a \qquad (Inflation\ Determination)$$

$$(2.4) \qquad w = h_0 + t + h_1 y_{-1}, \qquad 0 < h_1 < 1 \qquad (Real\ Wage\ Determination)$$

$$(2.5) \qquad r = m_0 + m_1 r_0 - (1 - m_1)p, \;\; 0 < m_1 < 1, \;\; m_0 > 0 \qquad (Real\ Interest\ Rate)$$

Equation (2.1) through (2.5) comprise the AMM with one modification. The modification was the inclusion of the interest rates in equation (2.3), to include the effect of interest rates on inflation through the monetary transmission from the central bank policy rate. The effects of the exchange

[3] The variables will be defined as the following. The endogenous variable is the real rate of growth of GDP (y), the firm's markup (k), (p) the inflation rate, the natural logarithm of the real wage (w), and the real prime interest rates charged at commercial banks (r). The exogenous variables are total government spending as a percent of GDP (g), total government revenue as a percent of GDP (t), the natural logarithm of the real productivity per worker (a), and the real interest rate target for the overnight rate at the central bank ($r_0$). In this model, there are also four intercept terms. The intercept terms will be defined as the bank power to mark up over the central banks interest rates interest rates $m_0$ , the social political power of labour capturing all the real wage gains retained by labour $w_0$, The liquidity preference variable capturing the "bullishness" or "bearishness" in the financial markets $p_0$, and the animal spirits variables measuring confidence in the economy $e_0$

rates will be returned to the model in essay 3, where the dynamics of the exchange rates are modelled.

The values of the variables and coefficients in this model were econometrically determined in the first essay. When using the year 2012 as the base year, values can be obtained for all the coefficients and constructed exogenous variables. The base values for the coefficients and variables that will be used are observable in table 2.1.

***Table 2.1: Value of Coefficients Found in Essay 1 that will be Required into the Numerical Methods in this essay***

| | | | |
|---|---|---|---|
| $e_1 = 0.403$ | $p_1 = -0.77$ | $e_0 = 0.339$ | $h_0 = 10.103$ |
| $m_1 = 0.881$ | $h_1 = 0.216$ | $m_0 = 0.021$ | $a = 10.09$ |
| $g = 0.398$ | $r_0 = -0.00467$ | $p_0 = 0.705$ | $t = 0.38$ |
| $q = 4.69$ | | | |

Given these inputs, the model would predict values for all endogenous variables. This has been theoretically derived by Smithin (2013). Thus, this paper will focus on numerical methods, by simulating the model. The advantage of numerical methods is that it allows for the observation of intermediate adjustment mechanisms between the variables, as different policy's and economic events are applied to the model.

The first simulation finds a baseline rate of the economy. This value would be the predicted economic growth, inflation, real interest rates, wages, and profit markup if the economy were unchanging. Thus, this could be thought of as a steady state in the economy. The findings will be a reference point for the simulations that apply economic events to the model.

The baseline can be observed below in figure 2.1. This indicates the levels for the outcome variables, which the various proposed economic changes will be compared against in the following sub-sections.

***Figure 2.1: Simulation of the Baseline of the Canadian Economy, Based on the level of Economic Variables from 2012***

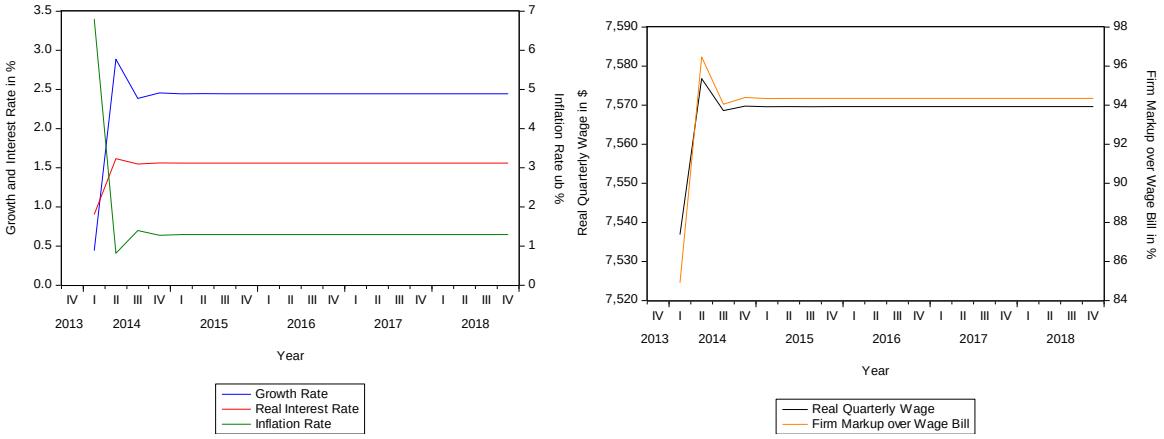



***Table 2.2: Values for Determined Variables in Baseline Simulation***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

These will be the values used for comparison in the following sub-sections, to determine the extent of the changes to the outcome variables, when various policy changes occur, as predicted by the AMM. Note there is predicted to be economic growth at the static level of this model. Thus, the country does not go to a "natural" level of GDP. The next sub-sections will be examining numerous fiscal, monetary, policy, and economic events.

*II.i. Fiscal and Monetary Policy*

This sub-section will be examining changes to fiscal and monetary policies. These will include an examination of the effect of austerity, a reduction in the tax rates, a balanced budget reduction in the government's budget, and an increase in the bank rate at the central bank.

Government austerity is always a controversial topic in politics. The idea behind austerity is that it decreases the size of the deficit, by reducing government spending. Figure 2.2 displays the predicted effects of austerity policy. The austerity policy that will be tested is a 5% reduction in government spending, reducing government spending from 39.8% of GDP, to 37.81%. Table 2.3 displays the changes. This policy would move the government from having a budget deficit of 1.8% of GDP to a surplus of 0.2% of GDP.

***Figure 2.2: Simulation of an Austerity Policy from Reference Values***

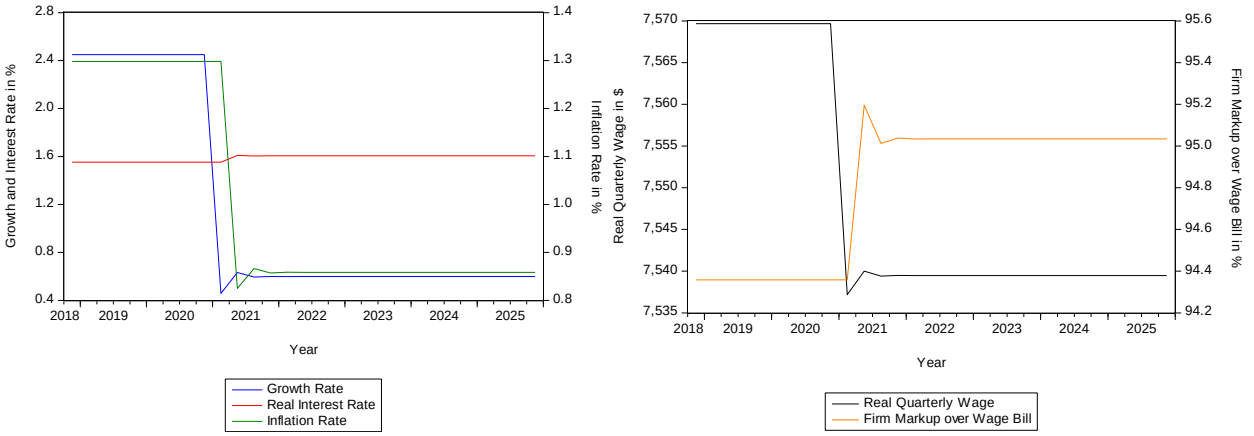



***Table 2.3: Numerical Comparison of an Austerity Policy to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Austerity | 0.60% | 0.86% | 1.61% | $7,539 | 95.0% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

In this simulation using the AMM, it can be observed that austerity is predicted to reduce the growth rate, inflation rate, and wages making the economy grow at a slower pace, and labour worse off. It also predicted an increase in interest rates at commercial banks and the firm's profit share. The interests of the different agents in the economy are not aligned. Labour is predicted to be worse off, and the firms, and rentiers (people who receive income from wealth) may be better off. This misalignment of incentives may explain why austerity policies are controversial.

The next simulation will examine an equivalent reduction in the tax rate. In this instance, a tax cut would be classified as the government reducing the size of revenue collected in comparison to the overall economy. Therefore, the government revenue compared to GDP will decrease. The tax reduction will reduce the revenue collected from 38% of GDP, to 36.01%. This would have the effect of increasing the government's budget deficit from 1.8% of GDP to 3.8%. Figure 2.3 displays the results of this change, with table 2.4 numerically displaying the changes. These changes are in comparison to the original reference point; thus, this does not consider the previous simulation of changes to the government's spending policy. Hence, the tax reduction policy is examined independently.

***Figure 2.3: Simulation of a Tax Reduction from Reference Values***

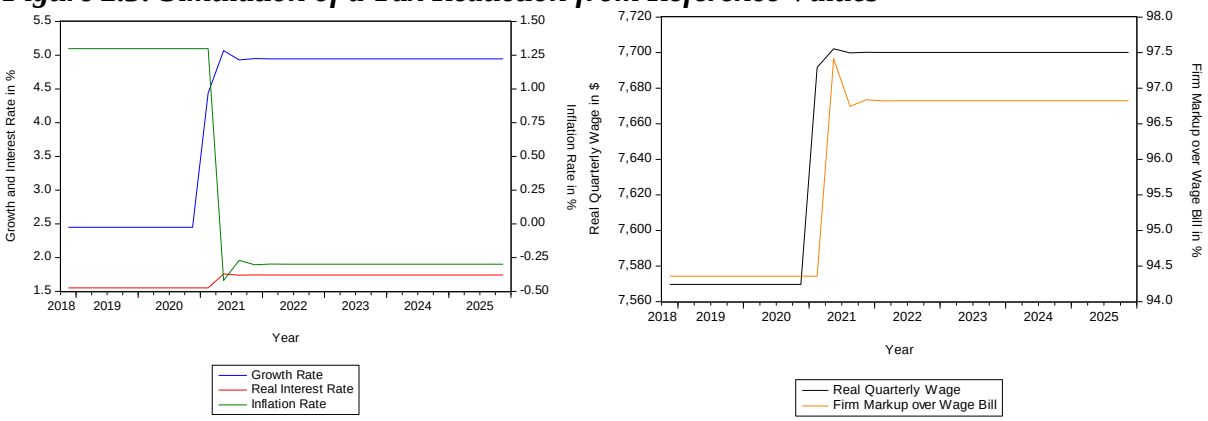



***Table 2.4: Numerical Comparison of Tax Reduction to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Tax Reduction | 4.94% | -0.30% | 1.74% | $7,700 | 96.8% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

In this simulation, it is observable that all agents benefited from the tax reduction. The AMM implies that labour, firms, and rentiers positions are increased, with tax reductions. This alignment of incentives may show why tax reductions are broadly perceived as politically popular policies. Additionally, the growth rate increased, and the inflation rate decreased. In this case, the change did increase the deficit to 3.8% of GDP. Section IV will examine the sustainability of deficits and will examine limits that may have to be considered.

There are many disagreements about the balanced budget multiplier. In figure 2.4, and table 2.5 one can observe a negative balanced budget multiplier, as predicted by the AMM. This figure examines if both of the previous changes, a reduction in government spending by 5%, accompanied by an equivalent decrease in taxes, happened simultaneously. This would hold the deficit constant at 1.8% of GDP.

***Figure 2.4: Simulation of the Combined Effects of a Reduction in Both Taxes and Government Spending from Reference Values***

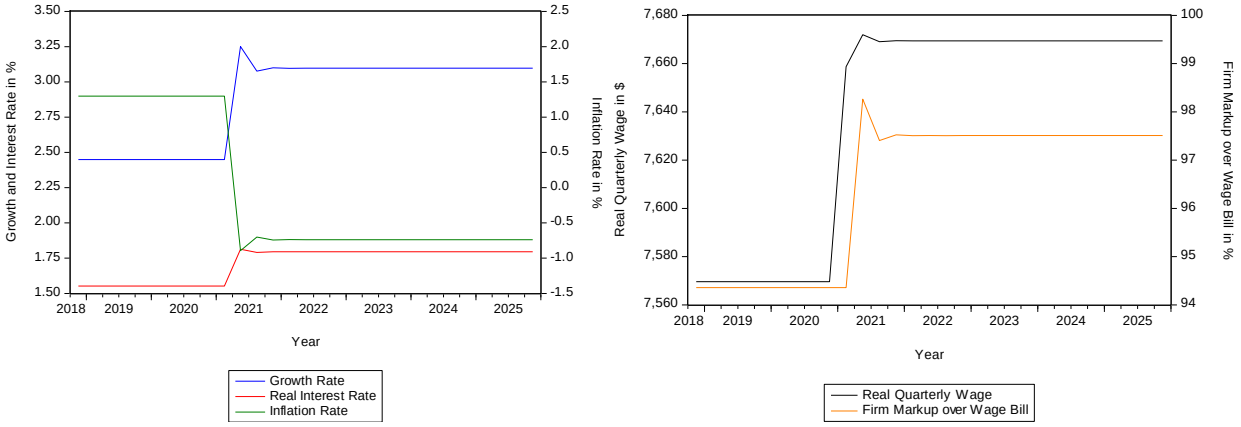



***Table 2.5: Numerical Comparison of a Reduction in Both Taxes and Government Spending to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Combined | 3.10% | -0.73% | 1.79% | $7,669 | 97.5% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

This simulation displays the predicted benefit in the AMM of governments being efficient with their resources. Both labour and firms benefit from a decrease in the size of government when it comes to wages, and the firm's markup. Note this may not call for no government, as it does not consider the benefits that both labour, and firms may receive from public goods, or a regulatory system enforcing laws. It does suggest that it may be better to run a government that does not spend frivolously, as that money may improve the economy, and agent's standings if it is returned in the form of lower taxes. Additionally, this simulation displayed that the AMM predicts that there is a negative balance budget multiplier, increases in the size of government would be predicted to reduce the growth rate.

Monetary policy has often been used as protection against recessions. Monetary authorities have been observed to cut interest rates at the central bank when recessions occur and raise those rates after exiting from the recession. This simulation will examine the predicted effects of an increase of the interest rate by 2%. This is a substantial increase in a single quarter, but central banks have in the past changed their policy rates by more than this, over several quarters. The simulation can be observed in figure 2.5 and table 2.6.

**Figure 2.5:** ***Simulation of an Increase of the Policy Rate at the Central Bank from Reference Values***

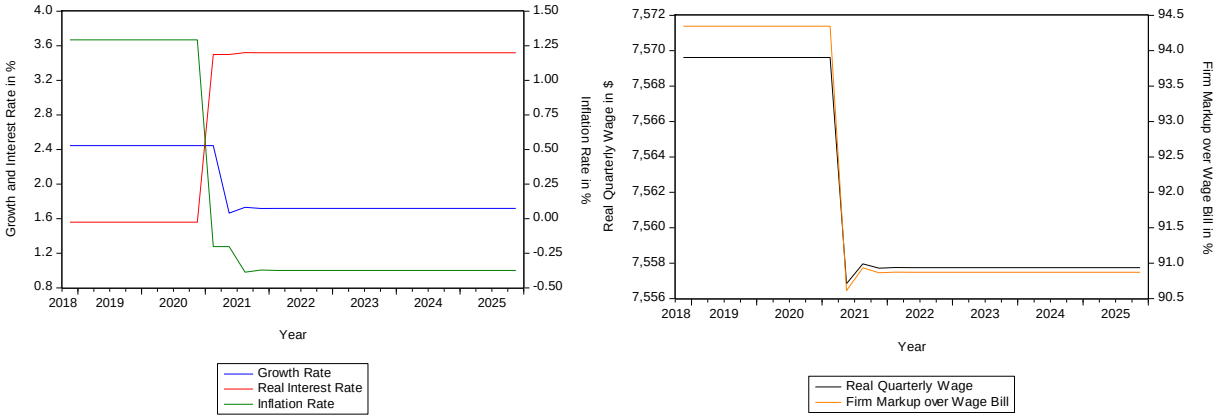



***Table 2.6: Numerical Comparison of an Increase of the Policy Rate at the Central Bank to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Policy Rate Reduction | 1.71% | -0.37% | 3.52% | $7,557 | 90.9% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

The act of the central bank is increasing the interest rates, often to reduce inflation, may have unintended consequences. This policy action did decrease the inflation rate, but it was found that the AMM predicts this policy would also reduce the growth rate, wage level, and firm's markup making both labours, and firms worse off. Additionally, interest rates at the commercial banks will increase making rentiers better off. This finding displayed that lower interest rates at the central bank may be beneficial to the economy, firms, and labour. Essay 3 will examine predicted effects of having a real policy rule, compared to the current policy rules used at the central bank.

*II.ii Labour, Productivity, and Commercial Banks*

This sub-section will examine the power and productivity of different agents in the economy. First to be examined is labour power. This can be impacted by labour legislation such as laws surrounding unions, or the average labours ability to retain real wage gains. The simulation explored in this section is an increase of the labour power by 5%. This would be some action that gave more power to labour, with no effect on productivity. Essentially labour can make real wage gains without any productivity improvements in the economy. Figure 2.6 and table 2.7 will display this simulation.

***Figure 2.6: Simulation of an Increase in Labour Power from Reference Values***

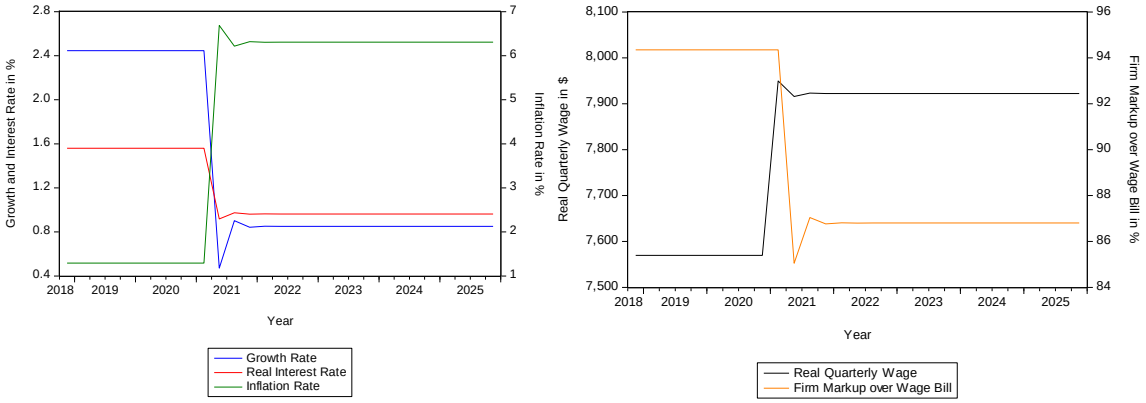



***Table 2.7: Numerical Comparison of an Increase in Labour Power to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Labour Power | 0.85% | 6.30% | 0.96% | $7,922 | 86.8% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

The increase in labour power, without an increase in productivity, was predicted to benefit labour, at the expense of the other agents. The AMM predicted that this would reduce the growth rate, interest rates and firm's markup while increasing the inflation rate. Thus, as the average labour agent was better off, the overall economy was worse off, as firm's profit and investment were reduced. This caused a slowdown in the overall economic growth rate and may indicate why labour relation legislation is controversial, as labour and firms have competing interests. However, this does not take into consideration any productivity improvements which will be incorporated in the next simulation.

Productivity has been defined as the value of goods that were produced in the last quarter, per working employee. The next simulation will examine a considerable increase in the productivity of 5%, with no change to labour power. This indicates that this is a simulation where labour was not able to retain a significant portion of the gain. A 5% change in productivity is historically a substantial change in a short period. Changes more considerable in magnitude than this, however, have been observed when new technologies have been adopted over several years. The simulation of this can be observed in figure 2.7 and table 2.8.

***Figure 2.7*: *Simulation of an Increase in Productivity from Reference Values***

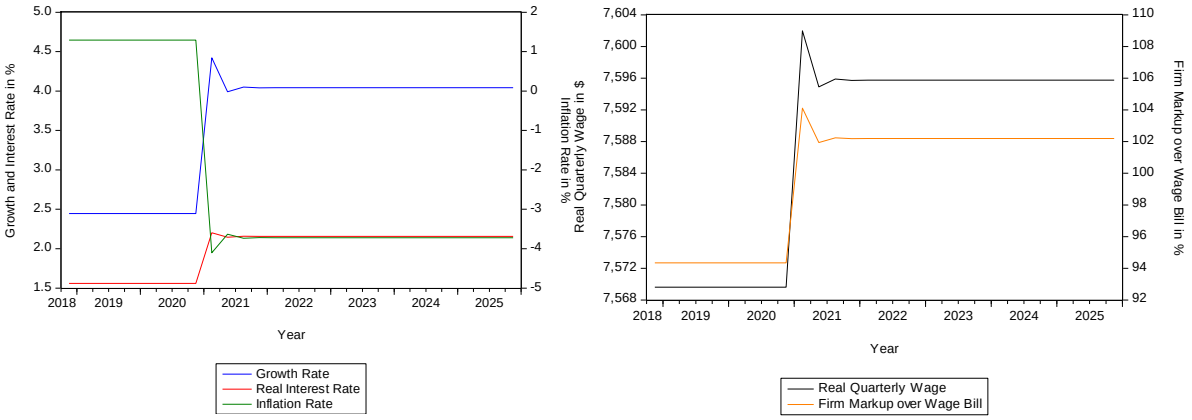



***Table 2.8*: *Numerical Comparison of an Increase in Productivity to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Productivity | 4.04% | -3.72% | 2.16% | $7,595 | 102.2% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

The increase in productivity can be observed to benefit all agents, although a more significant proportion of this benefit accrues to the firm. Additionally, this increased the economic growth rate and reduced the inflation rate. Thus, contrasting the previous finding, where all non-labour groups standings were reduced, this shows that productivity gains are predicted to accrue mostly to the firms. Labour would have to increase their power to achieve sustainable wage gains. This can demonstrate that if an increase of labour power were coupled with the increase in productivity, this would offset losses by other agents, and keep most of the benefit from accruing to only one group. Additionally, this could make the gains from productivity accrue more evenly to both labour and the firm.

The final simulation in this sub-section will be conducted on the commercial bank markup. The bank markup is a measure of the commercial bank's ability to increase the spread between interest rates on loans compared to deposits. This spread can change based on competition in the banking sector, or from the cost of regulations being passed on to agents that take on loans. This simulation will increase the markup by 1% representing an increase in the bank's power, or overall regulations on the banking sector. This will be displayed in figure 2.8 and table 2.9.

***Figure 2.8: Simulation of an Increase in the Banks Power from Reference Values***

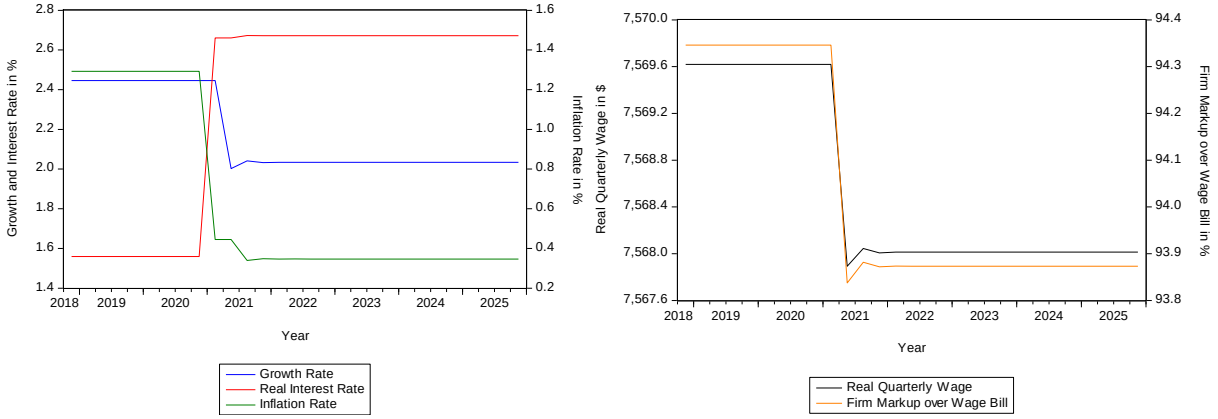



***Table 2.9: Numerical Comparison of an Increase in the Banks Power or Regulations on the Banking Sector to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Bank Markup | 2.03% | 0.34% | 2.67% | $7,562 | 92.4% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

One can observe that the increase in the bank markup slowed economic growth rates, and reduced the positions of both labour and firms. This suggests that more competition in the banking sector could also improve the overall economy if this competition reduced the differential between loans and deposits interest rates. The increase in competition would improve the position of firms, labour and the overall growth rates in the economy. Additionally, this could be an argument against burdensome, unneeded regulations on the financial industry. The AMM would predict that the economy would benefit overall if there were only regulations on the financial sector that were a necessity for stability in the overall economy.

*II.iii Changes in Confidence*

The third sub-section will examine the variables relying on confidence in both the financial markets and the overall economy.

One of these variables is "liquidity preference." Liquidity preference has been defined as a term that relies on the demand and supply of money and may be thought of as an indicator of the bullishness, or bearishness in the financial markets. For the following simulation, the effect of bearish sentiment on the financial markets was determined. This would indicate that there was a higher demand for money by agents. This simulation can be observed in figure 2.9 and chart 2.10.

***Figure 2.9: Simulation of an Increase in Liquidity Presence (a Bearishness in the Financial Markets) from Reference Values***

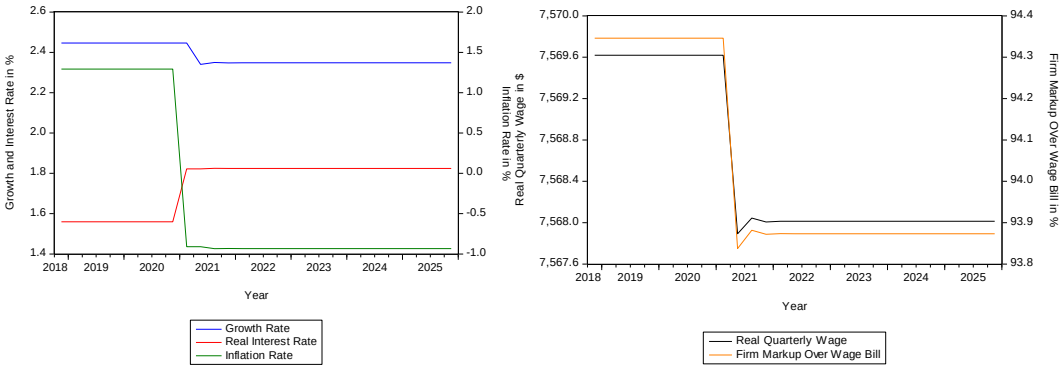



***Table 2.10: Numerical Comparison of an Increase in Liquidity Presence (a Bearishness in the Financial Markets) to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Liquidity Preference | 2.34% | -0.93% | 1.82% | $7,568 | 93.9% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

The liquidity preference variable is predicted to have a much higher impact on the interest, and inflation rates, then on the real economy. Wage, profit levels an economic growth were only marginally affected by this change in liquidity preference. This can explain why when markets become bullish or bearish it does not always correlate with an expansion or recession in the real economy.

The second confidence variable is “animal spirits.” Animal spirits is theoretically a measure of net autonomous spending that may change with the overall confidence levels in the economy. In this simulation, a small reduction of the animal spirits variable was conducted, meaning that there was a decrease in confidence in the economy. This can be observed in figure 2.10 and table 2.11.

***Figure 2.10: Simulation of a decrease in Animal Spirits (Confidence in the Economy) from Reference Values***

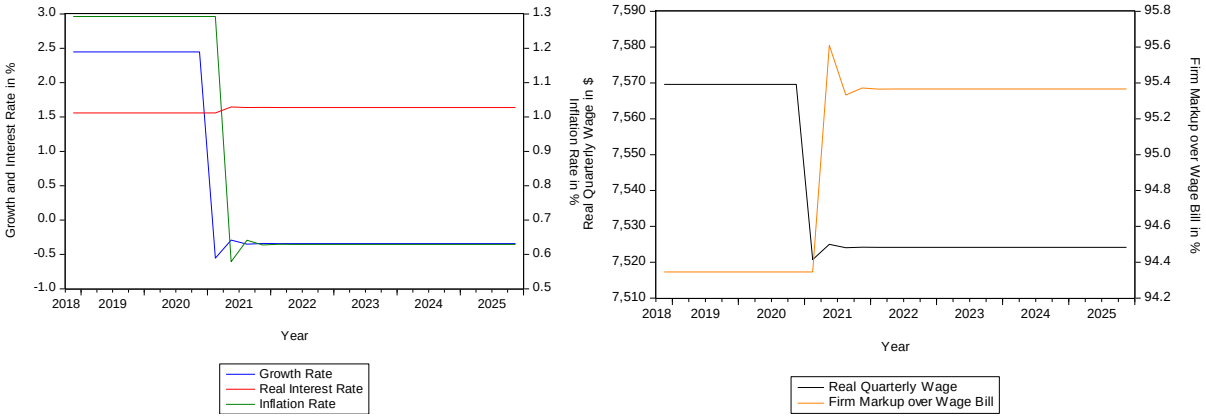



***Table 2.11: Numerical Comparison of a decrease in Animal Spirits (Confidence in the Economy) to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Animal Spirits | -0.34% | 0.62% | 1.64% | $7,524 | 95.4% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

The AMM predicted that this modest reduction in the animal spirits reduced growth and to the point where the economy went into recession. It was predicted to have a negative impact on wages, and a slight positive effect on the firm's profit share. Thus, this moves income from labour to firms when business confidence was reduced, and firms invested less. This simulation of the AMM predicted that confidence in the economy explained changes in growth, at a higher rate than changes in confidence in the financial markets.

*II.iv. The Predicted Effects of Government Intervention During a Recession*

This final sub-section will examine simulations of the effects of government intervention to counter a recession, as predicted by the AMM. In these final three simulations, the same shock to animal spirits was simulated, as occurred in the previous sub-section. The simulation will use three different forms of government intervention to restore two percent economic growth. The first simulation will have government intervene with a reduction in taxes, second will be a fiscal stimulus package, and third will be a mix of both policies.

In the first simulation, the government will respond with a policy that will reduce taxes. In figure 2.11 and table 2.12 a 1.87% decrease in the revenue to GDP ratio will be required to restore

the 2% economic growth rate. This would be an across the board reduction in the overall tax rates of about 5%.

***Figure 2.11: Simulation of a Recession Caused by a decrease in Animal Spirits, Government Response of Reducing the Tax Rate from Reference Values***

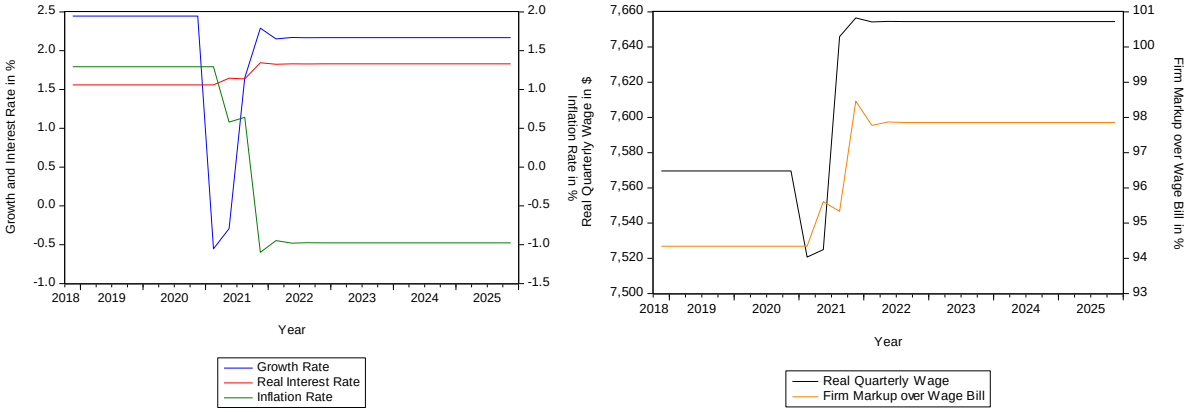



***Table 2.12: Numerical Comparison of a Recession Caused by a decrease in Animal Spirits, Government Response of Reducing the Tax Rate to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Tax Reduction | 2.16% | -0.97% | 1.82% | $7,654 | 97.9% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

In this simulation, the deficit grew from 1.8% of GDP to 3.66% of GDP. Inflation was put into a deflationary position, but firms and labour became better off as government borrowed to restore the growth rate. The policy of reducing taxes to restore the growth rate accomplished the goal of this simulation. This policy, however, did distort firms' markup, and labour's wages. If the shock to confidence is only temporary, reversing this intervention may be difficult, as the reversal would bring the firm's markup and labour's wages back to pre-recession levels. Hence ending the reduction in taxes would be unpopular by both labour, and firms.

When exploring the effect of a government spending package, government spending would need to be increased by 2.53% of GDP. This could be thought of as a government stimulus package that builds infrastructure. The simulation can be observed in figure 2.12 and chart 2.13. This would be a 6.4% increase in the overall government expenditure.

***Figure 2.12: Simulation of a Recession Caused by a decrease in Animal Spirits, Government Response of Increasing Spending from Reference Values***

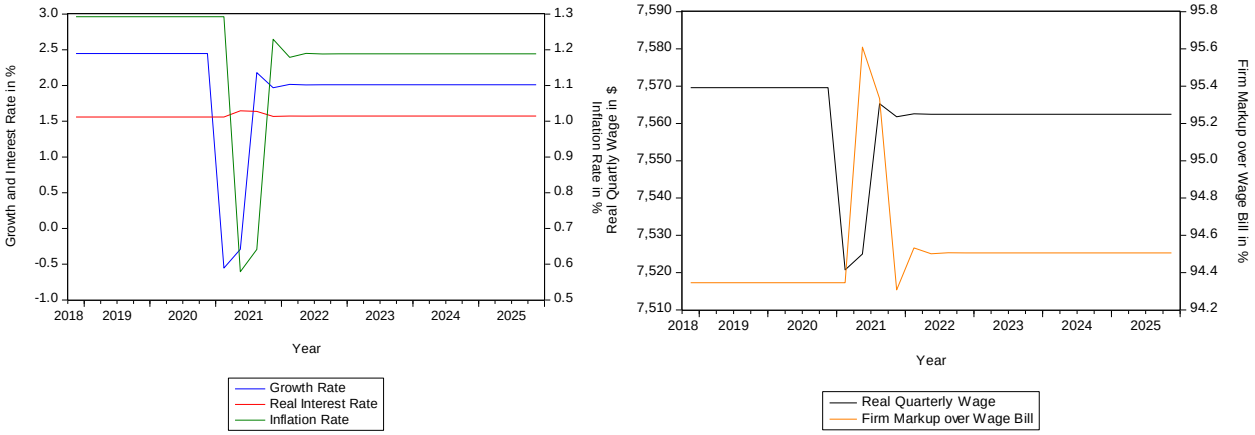



***Table 2.13: Numerical Comparison of a Recession Caused by a decrease in Animal Spirits, Government Response of Increasing Spending to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Stimulus | 2.01% | 1.18% | 1.57% | $7,562 | 94.5% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

In this simulation, the policy caused the deficit to increase from 1.8% to 4.33% of GDP but had a less distortionary effect on other variables. This policy did a better job restoring variables to the pre-confidence shock levels as compared to a tax reduction.[4] This would indicate that it may be easier to reverse the stimulus policy if the shock to confidence is only temporary, as labour, and firms would not observe a significant change in their overall standings.

The final simulation will encompass both policies, a tax cut and stimulus package, at half their size compared to the previous two analyses. This policy would reduce government revenue by 0.935% of GDP and increase spending by 1.265% of GDP. This can be observed in figure 2.13 and table 2.14. This would be equivalent to reducing the tax rate by 2.5% and increasing government spending by 3.2%.

[4] Note that this would not include any future benefits received from the stimulus investment.

***Figure 2.13: Simulation of a Recession Caused by a decrease in Animal Spirits, Government Response to Both Tax Reduction and Increasing Spending from Reference Values***

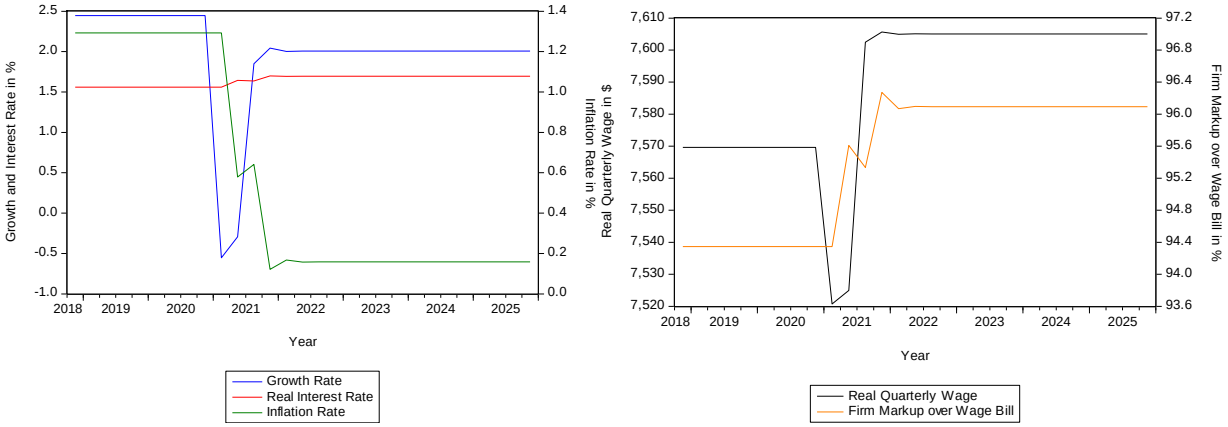



***Table 2.14: Numerical Comparison of a Recession Caused by a decrease in Animal Spirits, Government Response Both Tax Reduction and Increasing Spending to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Both policies | 2.01% | 0.15% | 1.69% | $7,605 | 96.0% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

In this simulation, the deficit would grow from 1.8% to 4% of GDP. It can be observed that the variables ended between the two extreme cases of only government spending or only tax reductions. In this case, both labour and firms are marginally better off. There is no clear preference to which system of government intervention is better in these simulations. The tax reductions were less expensive to implement and benefited both labour and firms more. Assuming this shock to confidence was temporary when confidence goes back to pre-recession levels, and the tax measures are reversed this would hurt the standing of labour and firms by making them revert to their original positions, thus being a politically unpopular option in the future. The government spending option, however, is less distortionary to labour and firms; thus when removed once confidence was restored, there would be less of an effect on wages and profits. The AMM predicted this plan would, however, be more expensive to implement. Secondly, there may be some benefits if the stimulus was used to increase efficiencies in the economy making it more productive. An increase in productivity is not modelled in this simulation.

## *III. Numerical Methods of the Alternative Monetary Model with Inclusion of Autocorrelation*

This section will include the autocorrelation components found econometrically in essay 1 in the simulations of the AMM. The model will be simulated through numerical methods. The same changes will be examined as in section II, to compare the predicted outcomes across models. The modifications can be observed in equation (2.6) through (2.10).

(2.6) $y = g - t + e_0 + e_1 k + e_2 y_{-1}$ $(Economic\ Growth)$

(2.7) $k = a - r - w$ $(Income\ Distribution)$

(2.8) $p = p_0 + p_1 r + w_{-1} - a + p_2 p_{-1}$ $(Inflation\ Determination)$

(2.9) $w = h_0 + t + h_1 y_{-1} + h_3 w_{-1}, \quad 0 < h_1 < 1$ $(Real\ Wage\ Determination)$

(2.10) $r = m_0 + m_1 r_0 - (1 - m_1)p, \ \ 0 < m_1 < 1, \ \ m_0 > 0$ $(Real\ Interest\ Rate)$

These alterations account for the autocorrelation found econometrically. Thus, the starting value for the constructed exogenous variables must be adjusted, to stay consistent with section II. The new values, used to keep the model consistent with the previous section, are observable in table 2.15.[5] This will allow for the comparison of the overall effects of changes across models, and it will examine which effects are more and less sensitive to change.

***Table 2.15: Variable that Changed compared to the Variables in the Model Presented in Section II***

| | | |
|---|---|---|
| $e_3 = 0.764$ | $p_2 = 1.1214$ | $h_3 = -0.247$ |

This consistency will allow the same simulations, as conducted in section II, to be repeated and with the same baseline results.

Again, a reference point is needed to determine the effect of the changes in the economic variables. Figure 2.14 and table 2.16 contains the baseline information. These values are the same values found for the previous model, as they are both based on the same year's data.

[5] Note all other values are consistent in keeping the findings comparable to the previous section.

***Figure 2.14: Simulated Reference Value in the Baseline Case for the Modified AMM***

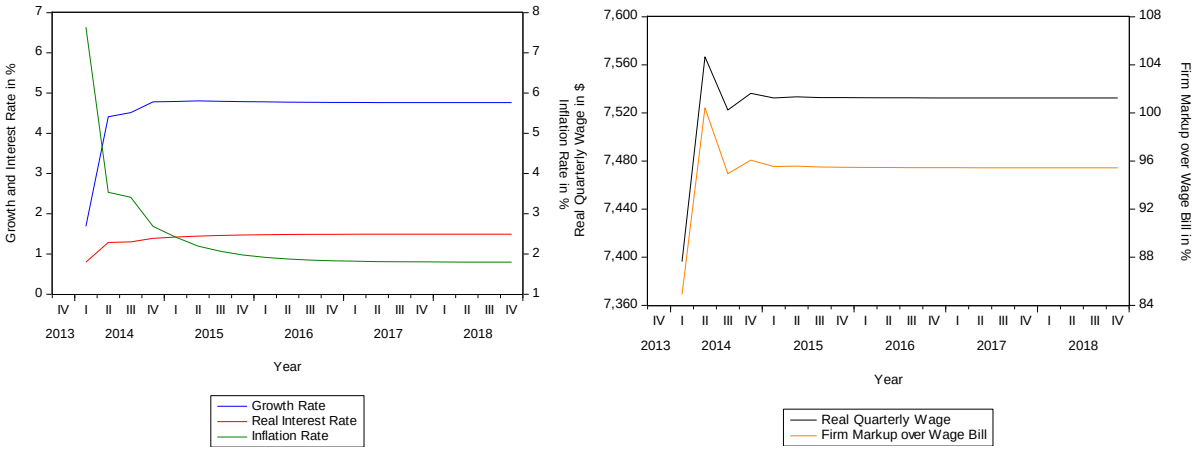



***Table 2.16: Numerical Findings of the Reference Values for the Baseline***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

From the reference point simulation, one can observe that with the autocorrelation the adjustment prosses required more time for values to achieve their steady state. This means that when autocorrelation is integrated into the AMM changes to policy may exhibit more prolonged periods of adjustment. Additionally, these policies may experience overshooting, or delays in achieving the targeted effects.

*III.i Fiscal and Monetary Policy*

This sub-section will examine changes in the fiscal and monetary policy. An examination of government austerity that represented by a 5% reduction in government spending will be conducted first in this sub-section. This policy would reduce the deficit of the government from 1.8% of GDP to a surplus of 0.2% of GDP. This can be observed in table 2.17 and figure 2.15.

***Figure 2.15: Simulation of an Austerity Policy from Reference Values***

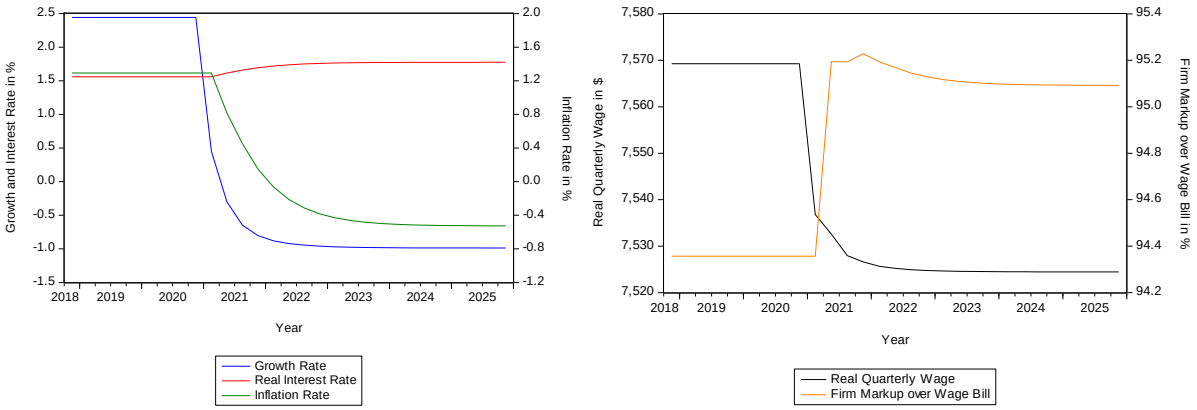



***Table 2.17: Numerical Comparison of an Austerity Policy to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Austerity | -0.99% | -0.52% | 1.77% | $7,524 | 95.1% |
| Previous Finding | 0.60% | 0.86% | 1.61% | $7,539 | 95.0% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill, the previous finding refers to the equivalent finding in section II the unmodified model

When comparing table 2.17 to table 2.3, in the previous section, it can be noted that the changes all move in the same direction, but the overall effect of the changes have been increased. Furthermore, when examining figure 2.15 and comparing it to figure 2.2 one can observe that these modifications increase the length of time for the model to move into the steady state. Firms and rentiers are found to be better off at the expense of labour. The modified and unmodified models predict the same directions but at different magnitudes.

The second simulation that will be examined is a reduction in government revenue, associated with a tax reduction. Table 2.18 examines the effect of a reduction in the tax rate, as a percentage of GDP, equivalent to what is observed in table 2.4. This reduction is the same, regarding percent of GDP as the austerity policy examined in section II. This policy, however, is not offset by a reduction in spending. Thus the deficit increases from 1.8% of GDP to 3.8% of GDP. This could be thought of as a fiscal stimulus package.

***Figure 2.16: Simulation of a Tax Reduction from Reference Values***

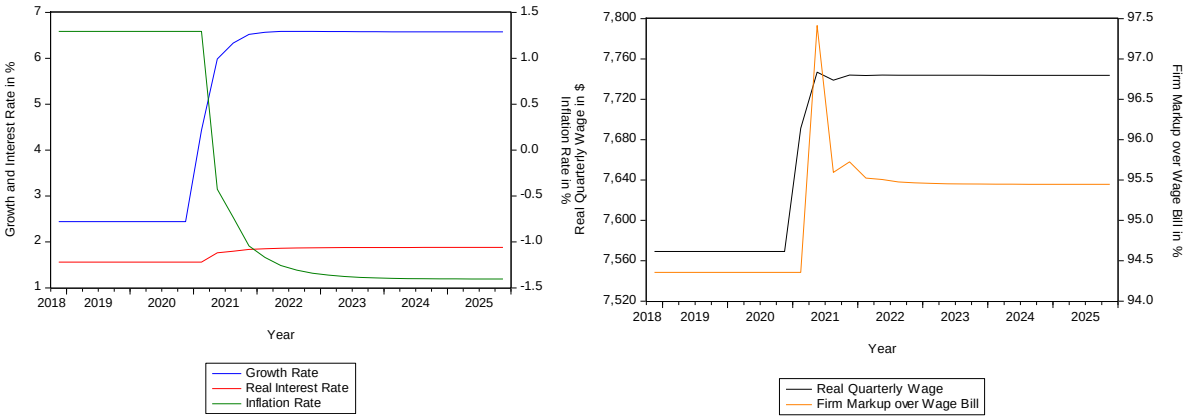



***Table 2.18: Numerical Comparison of Tax Reduction to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Tax Reduction | 6.66% | -1.40% | 1.88% | $7,743 | 95.4% |
| Previous Finding | 4.94% | -0.30% | 1.74% | $7,700 | 96.8% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill, the previous finding refers to the equivalent finding in section II the unmodified model

It can be observed that the effects are magnified when accounting for autocorrelation in the AMM. The exception being of the firm's markup which observed a smaller change. All groups, labour, firms, and rentiers, benefited from the reduction in taxes, indicating that in both models agents have reasons to lobby for tax reductions. This test did, however, increase the deficit forever, limits on this will be examined in section IV.

The next simulation will explore a combination of both a tax reduction, with an austerity policy. This can be observed in table 2.19, and it is comparable to the findings in table 2.5. In this case, there will be a reduction in government spending by 5%, with the proceeds going to reduce the tax rate, keeping the deficit constant. This explores what outcome the AMM would expect to find for the balanced budget multiplier.

***Figure 2.17: Simulation of the Combined Effects of a Reduction in Both Taxes and Government Spending from Reference Values***

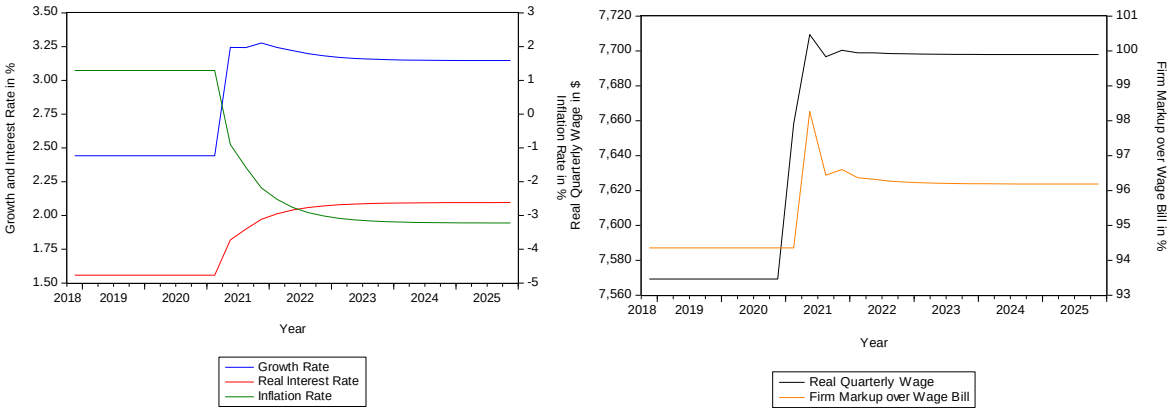



***Table 2.19: Numerical Comparison of a Reduction in Both Taxes and Government Spending to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Combined | 3.08% | -3.22% | 2.10% | $7,697 | 96.2% |
| Previous Finding | 3.10% | -0.73% | 1.79% | $7,669 | 97.5% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill, the previous finding refers to the equivalent finding in section II the unmodified model

It can be observed that both the interest and inflation rates changed more than in the unmodified model of the previous section. This would indicate that when accounting for the autoregressive variables, there was a more considerable benefit observed for the financial sector. The growth rate, wage and markup, however, respond less to changes, when the model is accounting for autocorrelation. Although all groups benefit, the benefit was slightly overestimated previously, compared to these findings.

The final simulation in this sub-section will explore the central bank policy. This will be represented by an increase in the overnight lending rates by 2%. This is thought as a tightening by the bank of Canada, often considered to reduce the inflation rate. This will be consistent with the changed observed in table 2.6. The simulations of the modified AMM are observable in figure 2.18.

***Figure 2.18: Simulation of an Increase of the Policy Rate at the Central Bank from Reference Values***

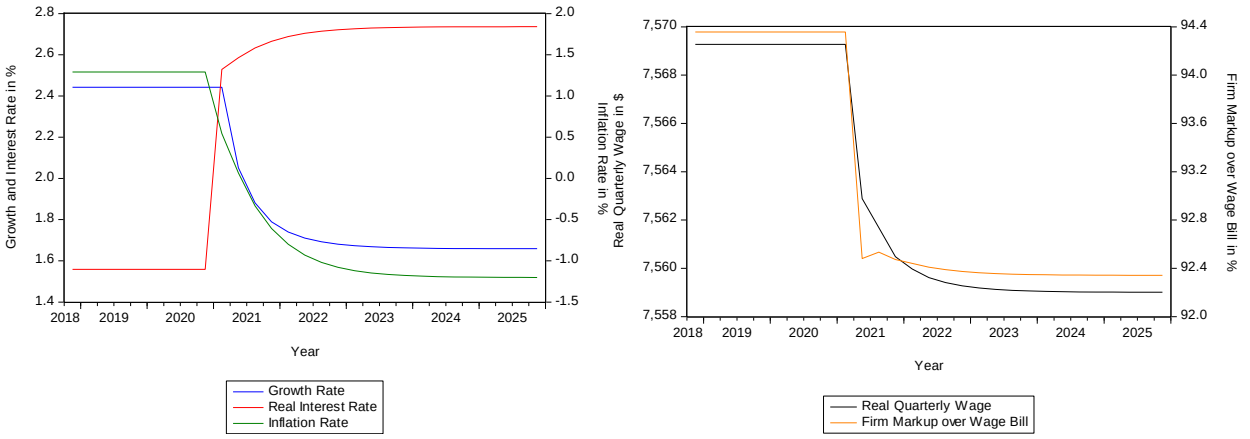



***Table 2.20: Numerical Comparison of an Increase of the Policy Rate at the Central Bank to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Policy Rate Reduction | 1.66% | -1.21% | 2.76% | $7,559 | 92.2% |
| Previous Finding | 1.71% | -0.37% | 3.52% | $7,557 | 90.9% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill, the previous finding refers to the equivalent finding in section II the unmodified model

It was found that there was slightly more effect on both growth and inflation rates, but less effect on interest, wage, and the firm's markup when compared to the previous model. This indicates that banks benefit from rising real interest rates, but in this version of the AMM, the effect was smaller than previously found in section II. The effects on both labour and firms were in the same direction as in section II. In each instance for fiscal and monetary policy only the magnitudes of the changes were affected by the inclusion of the autoregressive components, the overall directional predictions were unaffected. In all cases, the fiscal, and monetary policy had the same directional effects as in both the modified and unmodified versions of the AMM.

*III.ii. Labour, Productivity, and Commercial Banks*

This sub-section will examine the power and productivity of different groups in the economy. The changes in the power and productivity will be compared to section II.ii, as the same changes were examined in that section. First to be examined is an increase in labour power. This increase in labour power will occur with no increase in the productivity of labour. This would be a situation

where labour was increasing its share of income, compared to their productivity. The same change will occur as in table 2.7. This simulation can be observed in figure 2.19.

***Figure 2.19: Simulation of an Increase in Labour Power from Reference Values***

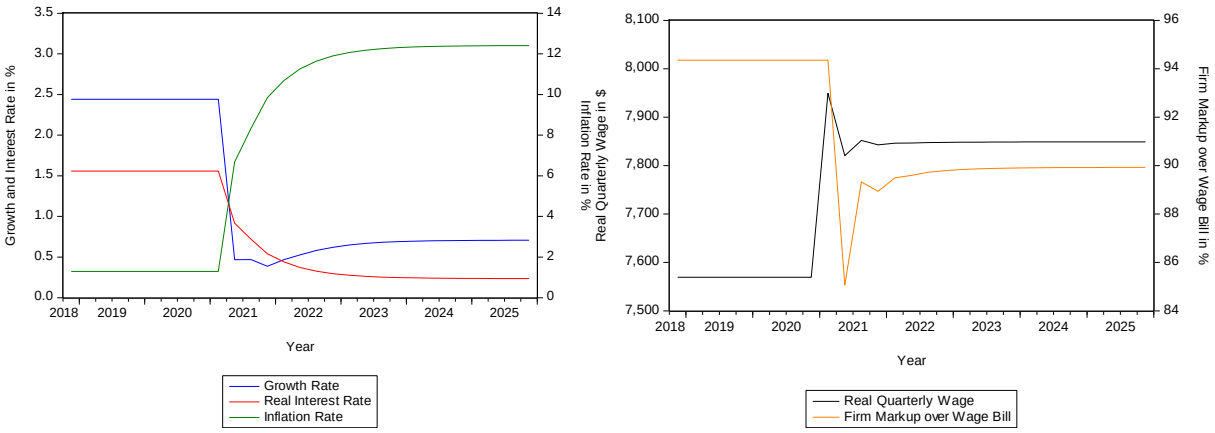



***Table 2.21: Numerical Comparison of an Increase in Labour Power to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Labour Power | 1.34% | 8.31% | 0.73% | $7,744 | 91.5% |
| Previous Finding | 0.85% | 6.30% | 0.96% | $7,922 | 86.8% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill, the previous finding refers to the equivalent finding in section II the unmodified model

It can be observed that when accounting for autocorrelation the AMM found less effect on the growth rate, wages and the firm's markup, with a more significant effect occurring in the inflation rate and interest rates, as compared to the previous section. This was a substantial change in labour power, and this change had a significant effect on inflation in the previous model. This is an extreme example of cost-push inflation. Note however because of this change in inflation there was less predicted effect on the real increase of wages, and thus the less adverse effect on firm's profits and economic growth. While accounting for autocorrelation made inflation more volatile, it predicted the other variables became less volatile, when labour power changed.

Figure 2.20 contains the simulation for a substantial increase in productivity. In this simulation, there is no increase in labour power, as was examined in table 2.8. This would mean that labour has become more productive, without being able to bargain to capture a significant amount of that gain. This examines the opposite effect of cost-push inflation, in contrast to the previous simulation of a significant increase in labour power.

***Figure 2.20: Simulation of an Increase in Productivity from Reference Values***

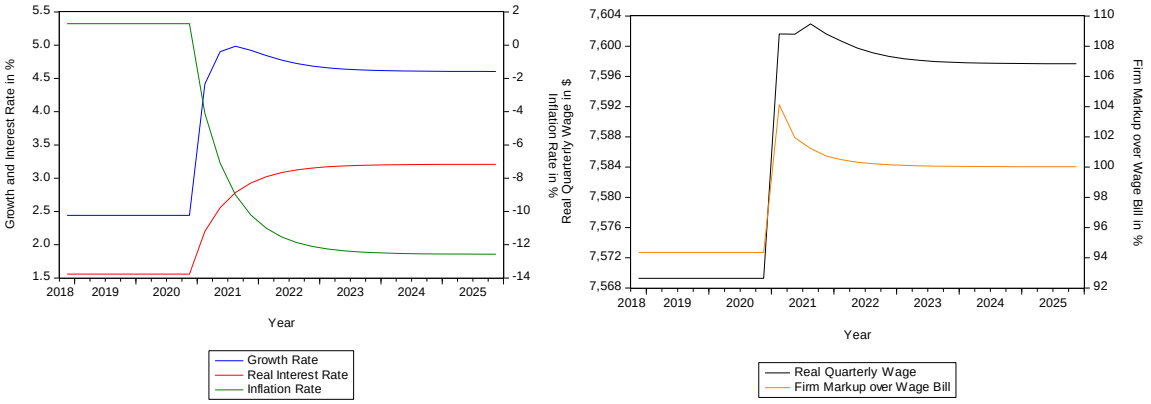



***Table 2.22: Numerical Comparison of an Increase in Productivity to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Productivity | 4.60% | -12.58% | 3.22% | $7,597 | 100.0% |
| Previous Finding | 4.04% | -3.72% | 2.16% | $7,595 | 102.2% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill, the previous finding refers to the equivalent finding in section II the unmodified model

In this simulation, when being compared to the previous section, it can be observed that inflation was more volatile. This is an extreme example of substantial productivity improvements, without labour power responding. It also shows that growth and interest rates are more responsive when accounting for autocorrelation. This is converse to wages and the firms' markup that was found to be less volatile. When examining this finding in conjunction with the previous finding, it would indicate that the AMM would predict significant changes in inflation if labour power or productivity changes occurred independently but would counterbalance the change in inflation if co-occurring.

The last simulation to be conducted in this sub-section is an increase in the bank's markup, observable in figure 2.21. This would be an example of the commercial banks increased their prime interest rates, without a corresponding increase of the central banks overnight rate. This could occur as the banks experienced more market power, or if more of the cost of regulations are passed onto the recipients of loans. This is comparable to the change examined in table 2.9.

***Figure 2.21: Simulation of an Increase in the Banks Power or Regulations on the Banking Sector from Reference Values***

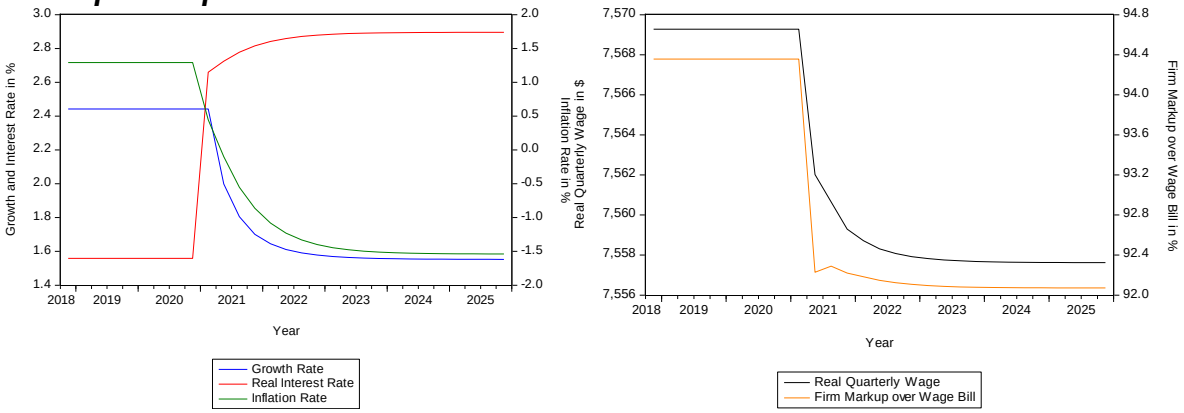



***Table 2.23: Numerical Comparison of an Increase in the Banks Power or Regulations on the Banking Sector to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Bank Markup | 1.55% | -1.55% | 2.90% | $7,557 | 92.0% |
| Previous Finding | 2.03% | 0.34% | 2.67% | $7,562 | 92.4% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill, the previous finding refers to the equivalent finding in section II the unmodified model

One can observe that all variables are more volatile when compared to section II.ii. The interest rates rise faster than previously found but the growth rate, inflation rate, wage level and firms' markup all decrease more than in the version of the AMM that did not account for autocorrelation. This may indicate that when the interest rate spreads between borrowing and lending rates at banks increase, it may have a more substantial adverse effect than previously simulated. In all cases, in this sub-section, it was found that the changed did not affect the direction of the predicted policy effects, but rather the magnitude.

*III.iii. Economic Changes*

This sub-section will examine variables that theoretically are based on confidence in the financial markets, and economy. The first simulation will examine a reduction in "liquidity preference." This can be observed in figure 2.22. Liquidity preference is theoretically a measure of confidence in the financial markets. A reduction, regarding how it has been inversely defined in these essays, would be associated with a "bearishness" in the marketplace, and thus people demanding to hold more money. This is the same economic change that occurred in table 2.10 of the previous section.

***Figure 2.22: Simulation of an Increase in Liquidity Presence (a Bearishness in the Financial Markets) from Reference Values***

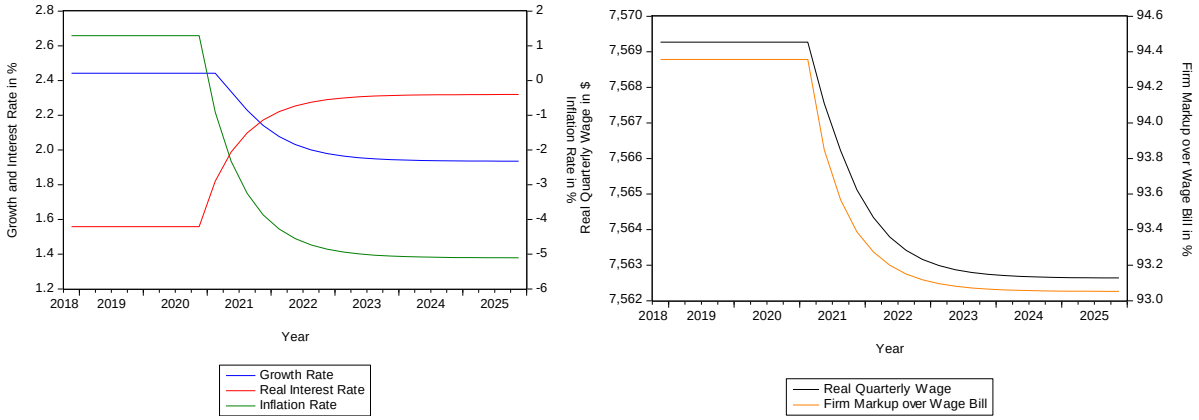



***Table 2.24: Numerical Comparison of an Increase in Liquidity Presence (a Bearishness in the Financial Markets) to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Liquidity Preference | 1.92% | -5.11% | 2.33% | $7,562 | 93.0% |
| Previous Finding | 2.34% | -0.93% | 1.82% | $7,568 | 93.9% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill, the previous finding refers to the equivalent finding in section II the unmodified model

It can be observed that when comparing the effects of the changes in "liquidity preference," the change was found to have more influence on the real economy when accounting for autocorrelation. There is a greater negative effect on the growth rate, inflation rate, wage level, and firm's markup, with a larger positive effect on interest rates. This may indicate that "liquidity preference" may have more real effects on the economy, compared to the previous section where liquidity preference had little effects on real economic variables.

Finally, an examination of "animal spirits" will occur. This can be compared to the changes examined in section II.iii. as reported in table 2.11. Animal spirits have been thought of as a proxy for the agents' confidence in the market, as it is theoretically an indicator of the net autonomous spending of the firms. In this simulation, that can be observed in figure 2.23, will model a decrease in animal spirits. This would indicate that there was a decrease in the overall confidence in the market.

***Figure 2.23: Simulation of a decrease in Animal Spirits (Confidence in the Economy) from Reference Values***

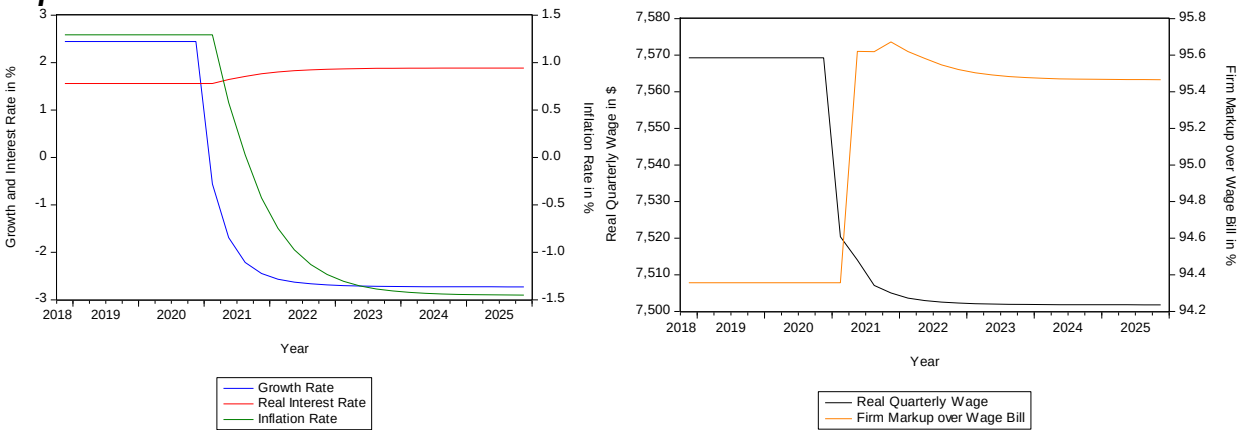



***Table 2.25: Numerical Comparison of a decrease in Animal Spirits (Confidence in the Economy) to the Reference Values***

| | Growth Rate | Inflation Rate | Interest Rate | Wage level | Firm Markup |
|---|---|---|---|---|---|
| Reference Value | 2.44% | 1.29% | 1.56% | $7,569 | 94.3% |
| Animal spirits | -2.72% | -1.45% | 2.55% | $7,516 | 93.8% |
| Previous Finding | -0.34% | 0.62% | 1.64% | $7,524 | 95.4% |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill, the previous finding refers to the equivalent finding in section II the unmodified model

Much like the "liquidity preference" term this "animal spirits" term has more volatile effects on the overall outcomes, when compared to the previous section. The growth rate, inflation rate, and wage level decreased more than in the previous section, while the interest rates increased more than previously found. In this case, the firms' markup also decreased while previously it was found to increase. This may be more consistent with the data, as when a recession occurs in the economy, the data indicates that the firm's markup decreases. This was the only directional finding in the model that changed when accounting for the autocorrelation in the AMM.

These modifications, based on the statistical findings, may increase the accuracy of the model, and give some insight into what changes of variables are more and less sensitive than previously found. Thus, the statistics from the first section may give improvements in the predicting power of the model. Testing to examine the accuracy of predictions will be examined in the final paper. These tests will examine when an economic event occurs if the response by the outcome variables is consistent with the direction the simulations of AMM found. One of the unresolved questions in these previous two sections were limits on government spending, deficits, and debt. The next section will examine any limits and effect on these government policies.

# *IV. Sustainability of Government Deficits*

## *IV.i. Introduction*

The AMM predicts that there is a benefit to the economic growth rate if there is an increase in the deficit. Inevitably, a question of the limit to this concept arises. For example, if a 1% increase in government spending increases the real growth rate, why not increase spending to 100%, 200%, or even 10,000% of GDP. Government debt and the deficit is both a political issue and one brought up in the media frequently. Many discussions revolve around if a government should run a deficit when the government should strive for a balanced budget, and if the debt load is unsustainable. Furthermore, in colloquial settings, one hears the comparison between government and household finances, and this is used as evidence of the necessity of the government achieving a balanced budget. In the economic circles, this discussion has also taken shape with an examination of debt dynamics, and models that are predicting interest rates based on deficits.

This section will examine debt dynamics, finding when debt to GDP is converging to a level, or when it is growing exponentially. Propositions will be proposed on this subject to find if, and when debt is converging. From past research, it is known that if real interest rates on government debt are lower than the growth rates, this will lead to a situation where the debt to GDP will converge to some level. This would then violate transversality and no-Ponzi game conditions, which assumptions are necessary for Ricardian equivalence (Azizi et al. 2012). Transversality condition states that the rate of growth in the economy must be lower than interest rates, and the no-Ponzi game conditions state that government debt must be growing slower than the real interest rate. Section VI.v. will examine when these conditions hold for the Canadian economy.

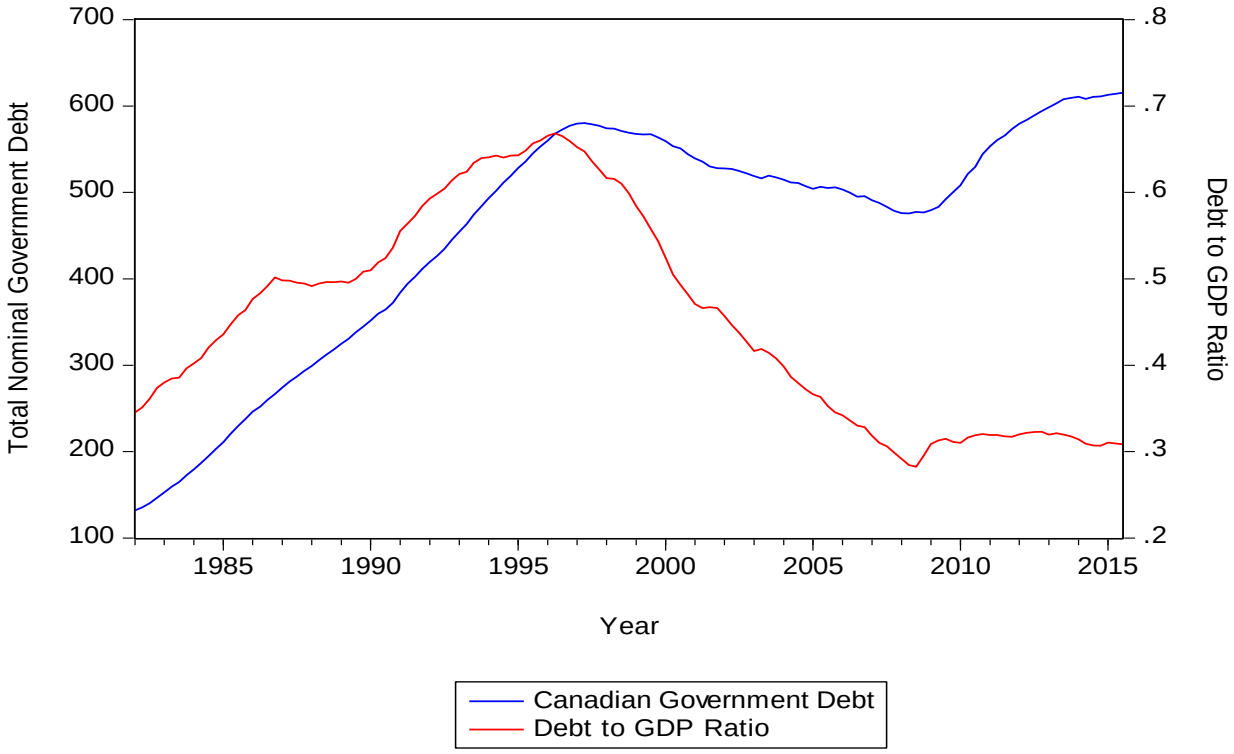
One of the criteria that influence the debt to GDP convergence, and influences determining if it is indeed growing exponentially, is the interest rates on government debt. Thus, an examination of the effect fiscal, and monetary policy will have on the prevailing interest rates in the government debt market will occur in section VI.v. This paper will be examining data in Canada from 1981 to 2015. This paper will also examine when the government was in a sustainable fiscal situation, and when debt to GDP levels were growing exponentially.

The Canadian economy allows for a unique examination of this topic, as there are fewer frictions that could adversely affect the results, compared to other countries. First, Canada is a developed relatively stable country, eliminating large swings in the country's gross domestic

product, that may be experienced in developing countries. Second, Canada is a small country. Thus, it will not have a significant effect on the prevailing interest rates experienced around the world. Third, Canada has full sovereignty over its currency. Theoretically, having sovereignty gives the government the opportunity to print money, and thus may reduce the risk of debt default (Smithin 2013). Additionally, the central bank may hold debt, reducing the effective interest rates paid by the government. This is as debt held at the central bank receives interest payments from the government. Since the Bank of Canada is a subsidiary of the Canadian government, it is effectively paying itself interest, reducing the total interest burden of the government. Finally, Canada has full control over its monetary policy, allowing for an examination of how monetary policy may affect the interest rates that the government itself faces.

Canada's federal debt levels in nominal terms have grown from around 130 billion in 1982 to 615 billion in 2015 as observable in figure 2.24. Additionally, the debt to GDP ratio has been as high as 66% and as low as 28% in this period. It can also be observed that Canada had an extended period of this ratio increasing until the early 1990's, followed by an extended period of this ratio decreasing until the 2008 recession.

***Figure 2.24: Canadian Government Debt, in both Nominal and Relative to Canada's GDP***



This paper will be structured as follows. Section IV.ii. will review some theoretical and empirical work on this subject. Section IV.iii. will examine debt dynamics and assert when debt is converging. Section IV.iv. will examine the data used for the analysis. Section IV.v. will examine the empirical results, and section IV.vi. will discuss some concluding remarks.

*IV.ii. Theory and empirical work on deficits*

There has been much research conducted in the field of government spending. Most of the research currently focuses on theoretically deriving optimal fiscal policy, with less of a focus on the sustainability of fiscal policies over longer business cycles. Sustainability can depend on differentials between the interest rates governments pay on the debt, and the growth rate of the economy, or the size of the primary surplus in comparison to the interest payments on government debt. If real interest rates are less than the real growth rate, this would suggest that the debt to GDP level in the country is converging to a level, and would allow for the government to run something that would violate the no-Ponzi condition[6]. Thus, the government can pay its interest bill with debt, and not have its debt to GDP ratio grow exponentially (Collignon 2012). Many theoretical papers in this field use assumptions to discount this result. A standard assumption is that the government's interest rate is assumed to be higher than the rate of growth in the economy. Thus, the interest growth rate differential is assumed to be positive. Hence, the transversality and no-Ponzi game conditions are satisfied by assumption. This assumption, although makes results simpler, may not hold. This concept was studied by Bohn (2005) who looked at 200 years of fiscal policy in the United States. The study found that in most of the years the growth in the economy more than offset the interest costs. This is significant as it could indicate, in some circumstances, a country may incur a deficit forever, and never experience a debt to GDP ratio increasing to infinity. This assumption will be tested with Canadian data in section IV.v.

Additionally, there is much research examining the effects of the deficit on prevailing interest rates. An essential staple of this research is that it relies on the IS-LM or loanable funds model when testing the interest rates. These articles have divergent results. Many articles find that deficits affect the interest rates. Saleh and Harvie (2005) surveyed the area and found that a majority of the empirical work found a positive correlation between government interest rates and

[6] Unlike a Ponzi schemes run by criminals in the investment community, in this action all obligation will be paid out by the government.

the budget deficit, in the sense that a more substantial deficit correlates with higher interest rates. Counter to these conclusions is the work by Hartman (2007). This research concluded that when exploring data from the United States, the linkage between interest rates and the deficits was inconclusive, but there was evidence that may support the crowding out effect. Additionally, in studies that examined other smaller countries found varying results. For example, Hsing (2009) used the open-economy loanable funds model in the context of government interest rates in Slovenia and failed to find evidence that a deficit had any effect on government interest rates. Much of the research in this area does not include a robust examination of monetary policy when examining deficits and interest rates. As observed in essay one the policy rule that has been effective in Canada is the overnight interest rates at the central banks as it transmits to short-term interest rates in commercial banks. An examination of this monetary transmission mechanism will be expanded to observe the overnight interest rates effects on longer-term debt markets in Canada and will find the relative influence of financial and monetary policy on interest rates in Canada. Evidence of both effects of fiscal and monetary policy on the interest rates in the economy will be tested in section IV.v.

*IV.iii. Modelling Deficits and Methodology*

As in much of the literature, a government budget constraint is needed to model the dynamics of deficits.

$$B_{+1} = G - T + B(1 + r) \tag{2.11}$$

Where $B$ is the level of government debt, $G$ is the level of government spending (not including interest payments), $T$ is the government revenue, and $r$ is the interest rates on government debt. Dividing by the GDP level.

$$\frac{B_{t+1}}{Y_t} = g - t + \frac{B_t}{Y_t}(1 + r) \tag{2.12}$$

Where $Y$ is the level of GDP, $g$ is government spending as a percentage of GDP (not including interest payments), and $t$ is the government revenue as a percentage of GDP. Multiplying through by next year's GDP level.

$$\frac{B_{t+1}}{Y_t}\frac{Y_{t+1}}{Y_{t+1}} = g - t + \frac{B_t}{Y_t}(1 + r) \tag{2.13}$$

Since $\frac{Y_{t+1}}{Y_t}$ is simply $(1+y)$ the equation will become:

$$\frac{B_{t+1}}{Y_{t+1}}(1+y) = g - t + \frac{B_t}{Y_t}(1+r) \tag{2.14}$$

Divide through by $(1+y)$

$$\frac{B_{t+1}}{Y_{t+1}} = \frac{g-t}{(1+y)} + \frac{B_t}{Y_t}\frac{(1+r)}{(1+y)} \tag{2.15}$$

Thus, the change in the debt to GDP ratio depends on both deficits, and the differential between interest rates, and growth. Furthermore, this expression can be manipulated to achieve the convergence level of debt to GDP, as time goes to infinity. Debt to GDP would be converging to some level if $r < y$. In the case where $r \geq y$, this leads to a scenario where debt to GDP is either growing exponentially, decreasing exponentially to have infinite assets compared to GDP (assuming assets of the government receive the same return as government interest rates), or are perfectly stable.

This finding is in line with the findings of Bohn (1995). He proposed that one can observe two cases based on the interest and rate growth differential. One leads to a convergent scenario, and the other will lead to exponential outcomes.

The derivation can lead one to determine the debt dynamics, of the government's debt position. The following propositions, in equation (2.16) through (2.19), states the relationship between growth, interest rates, and deficits. These propositions are under the restriction that interest rates, growth rates, and the primary deficit remain unchanged. Obviously, these restrictions do not hold true in reality. Thus, these propositions just state what the dynamics of the debt to GDP ratio would ultimately converge to, if the current fiscal policy, growth rates, and interest rates are run into perpetuity.

**Proposition 1:**

$$if\ r < y\ \lim_{t\to\infty} \frac{B_t}{Y_t} = \frac{g-t}{r-y} \tag{2.16}$$

**Proposition 2:**

$$(2.17) \qquad if\ r \geq y\ \ and\ (g-t) = (r-y)\frac{B_t}{Y_t} \rightarrow \lim_{t\to\infty} \frac{B_{t+1}}{Y_{t+1}} = \frac{B_t}{Y_t},$$

$$(2.18) \qquad if\ r \geq y\ \ and\ \ (g-t) > (r-y)\frac{B_t}{Y_t} \rightarrow \lim_{t\to\infty} \frac{B_{t+1}}{Y_{t+1}} = -\infty,$$

$$(2.19) \qquad if\ r \geq y\ \ and\ (g-t) < (r-y)\frac{B_t}{Y_t} \rightarrow \lim_{t\to\infty} \frac{B_{t+1}}{Y_{t+1}} = \infty$$

Proposition 1 is stating that no matter the size of the primary deficit, in the case where $r < y$ the debt to GDP ratio will be converging at some level. In this situation, the size of the primary deficit will only influence the level the debt is converging to but will not influence if this convergence will occur. Thus, if a country was under this proposition, it is possible to run a primary deficit forever, without having the debt to GDP ratio expand into infinity.

Proposition 2 examines the case when interest rates on government debt are more significant than the growth rate. The only way to achieve stability is to run a primary surplus, to the extent that it covers the interest payments less the economic growth to achieve a stable debt to GDP ratio. The negative impact on debt to GDP, from economic growth, would be thought of as a "growth dividend" by Bohn (2005). In this instance, a country could be in an overall deficit and still achieve a stable debt to GDP ratio, if there is a primary surplus larger than the cost of interest less the "growth dividend", as in equation (2.18), this will set the country onto a path of having an asset to GDP ratio that would expand into infinity. Thus, the country would grow its assets forever in comparison to its GDP. In the case where a primary surplus was smaller than the interest rates less the "growth dividend," equation (2.19), this would lead to a debt to GDP ratio expanding exponentially into infinity. To achieve a stable debt to GDP ratio or one with the growth of assets in the government, it would almost never require an overall balanced budget. The only condition that would require a balanced budget to achieve stability is if economic growth is zero, and the real interest rate is positive. If a country is in a situation where there is positive economic growth, and the primary budget surplus is less than interest payments, in order to achieve stability in the debt to GDP ratio the country would only have to have a primary surplus the size of the interest payment less the "growth dividend", thus an overall budget deficit.

This may bring up the question, if a country is in proposition one's state would it allow a government to spend with no limit forever. The answer would be, only if it knew interest rates would be less than growth in perpetuity. One can imagine a case where interest rates are lower than economic growth. If a government spending dramatically outpaces its revenue and raises their debt to GDP level, it would put them in a vulnerable place if interest rates increase above the growth rate. As one can observe from Proposition 2, the higher the debt to GDP ratio, the larger the primary surplus would have to be to put the country on a stable path. Section IV.v. will examine which proposition best describes the Canadian economy since 1982.

Furthermore, these propositions suggest that if there is a country that is struggling to pay off the debt it has accumulated in the past, overall government surpluses may not be necessary. If this country is seeking help from an international organization, for example, the International Monetary Fund, an essential aspect to moving that country onto a sustainable path would be a reduction in the interest rate on that country's debt. If the real interest rates on that debt were reduced below the rate of economic growth, that would ensure a country will have their debt to GDP ratio converge to a level, depending on the primary deficit. Reducing the primary deficits in these countries alone would be ineffective as the only other way to reduce the debt to GDP ratio would be to have a primary government surplus that covered the interest payment less the "growth dividend," which may be harder to achieve, and create unanticipated hardships on the population.

### IV.iv. Data and Testing Conditions

The data in this section is obtained from Canadian government sources. These sources included Statistics Canada, and The Bank of Canada, ranging from 1981 to 2015 in quarterly intervals. To test what proposition best describes Canada's positions this study will examine the interest rates on government debt. The growth rates are in real terms as given by Statistics Canada. There are many different interest rates in the Canadian economy, as the duration of government bonds affects the yields of these bonds. The spreads can be observed in figure 2.25. An approximate effective rate of interest for government debt can be calculated. This is based on the total interest paid by the government, divided by the total amount of outstanding government bonds.

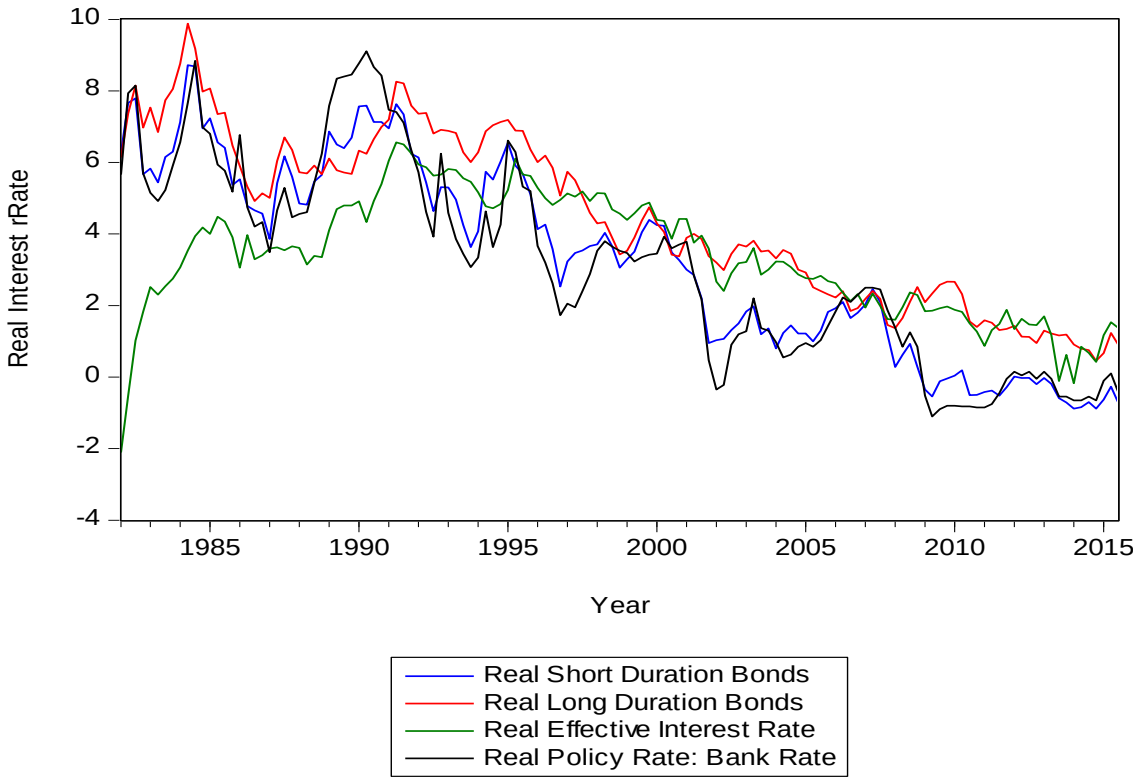
As interest rates change, it does not have an immediate effect on the effective rate, as the interest rates are determined for the entire duration of the bond at issuance. Thus, it takes time for the effective government interest rates to change as bonds reach maturity and are reissued at

current rates. This has been calculated and is observable in figure 2.25. It can be observed from this that, unsurprisingly, short, long and the effective rates movements are correlated, and that these rates also move similarly to the monetary policy rate in Canada called the Bank Rate. This, however, is not the actual effective rate on government bonds. One of the most significant holders of government debt is the Bank of Canada. In the third quarter of 2015, they possessed 96 billion dollars of Canadian government debt, representing over 15% of the total debt outstanding. The process in which the Bank of Canada prints money has allowed for this accumulation to occur. The interest earned on this government debt covers the operating expenses of the Bank of Canada, and the remaining money is then paid as a dividend back to the government. Thus, the interest paid to the bank both reduces expenditures, by eliminating the need for the government to fund the Bank of Canada and increases revenues as the interest is returned to the Government. Hence, the money paid to the Bank of Canada is merely moving around numbers on the government's balance sheet and does not cost the Government the interest that is paid.

The rest of the interest payments are not distributed entirely to the public either. Assuming it is not in a tax-shielded vehicle there may be some tax implications associated with the interest received. The actual effect on revenues is hard to determine as if there were no government bonds available, investors may invest in other vehicles and may also be taxed in some form. The interest rates used in the following analysis will be net of the Bank of Canada's interest payments, as they are cycled back to the government. Thus, interest rates and revenues will be reduced as it should influence the primary deficit and interest payments. However, interest rates will not be adjusted by the tax on interest, as this may be less clear because of the effect of asset substitution.

In order to determine what proposition Canada has been in over the study period, an average yearly deficit rate, interest, and growth rate will be found. The differential will be studied in section IV.v. Differentials will allow one to determine which proposition Canada was facing in each year. This and the previously found propositions will determine the ultimate rate at which the debt to GDP was converging to in every period.

***Figure 2.25: Interest rates in the Canadian Economy, for both the Government and Central bank***




Furthermore, a study of interest rates will occur. These rates will be regressed on an assortment of fiscal policies, monetary policies, and more general government circumstances, to determine what effect policies may have on the interest rates faced by government. The policies will include the size of deficits, size of the debt to GDP, and the Policy rate at the central bank. This will be studied to determine what effect they may have on the previous proposition, as lower interest rates can put Canada on a path to having lower debt to GDP ratios. Further, an examination of the traditional IS-LM and loanable funds framework will occur to determine what effect the inclusion of the monetary policy rate would have on these models and on the traditional research in this area of study.

As shown in essay one Canadian monetary policy arises primarily through the bank rate, at the Bank of Canada. Through this period the Bank Rate was determined by two different methods. Since 1996 the Bank of Canada had full autonomy to set this rate, based on their outlook for the economy. Before 1996, the Bank of Canada had to base their Bank Rate off a 0.25% markup of the 3-month treasury bill. Although this appears to be a market rate, the bank of Canada influences

over this rate. Every week the Bank of Canada held an auction on short-term treasury bills. Institutions submit a sealed bid on these treasury bills and the institutions that bid the lowest yields receive the yields they bid until all bonds are sold. The Bank of Canada can also bid on these bonds. If they bid on them, this will reduce the yield, as a high bid would never get filled. Thus, even when the Bank of Canada did not have full control of the yields before 1996, they could still lower the 3-month treasury yield, intern reducing the Bank rate by bidding on treasury bills (Godbout, Storer and Zimmermann 2002).

*VI.v. Empirical Findings*

The empirical evidence will be examined in two phases. First, there will be an examination of year by year data to determine when the Canadian government budget is in a sustainable position, based on the previous propositions. Second, there will be an analysis of the interest rates paid on government debt.

Table 2.26 displays the yearly sustainability of government debt for the Canadian economy. This table has an average yearly breakdown of the adjusted primary deficit, adjusted interest rate differential, debt to GDP ratio, overall government budget deficit, the convergence point found based on Proposition 1, and 2 in section VI.iii, and the real policy rate at the central bank. The convergence point finds what the debt to GDP ratio is going to converge to as time goes to infinity, assuming the primary deficit and interest rate differential are constant. A negative number indicates that government would be converging to a point where it would be entirely out of debt and have an asset to GDP ratio. Obviously, the economy is not static. Thus, every year has a unique convergence point. This is an indicator of the effect the fiscal policy each year would have on the debt to GDP ratio if run in perpetuity given the growth and interest rates that year. The primary surplus and interest rate differential column are adjusted for interest paid to itself, through the central bank.

Under Proposition 1, growth rates are larger than the effective interest rates on government debt. In much of the literature around government budget deficits, it assumes that the interest rates are greater than the growth rate, to allow for the assumption of no-Ponzi and transversality conditions. The convergence points found in these 16 of 32 periods rage from 2941% debt to GDP ratio, to a 226% asset to GDP ratio. It can also be observed that this ratio was converging to higher

levels in the 1980's, as the debt to GDP was increasing. Since 1996, in the years where the debt to GDP was converging to a level, the highest convergence level was 76%.

***Table 2.26: Sustainability of Government Debt in Canada from 1983 to 2014***

| Year | Primary Surplus/Deficit* | Interest rate differential ** | Debt to GDP ratio | Overall Budget Surplus/Deficit*** | Convergence point **** | Real policy rate***** |
|---|---|---|---|---|---|---|
| 1983 | -3.76% | 3.87% | 39.65% | -6.38% | 97.08% | 5.30% |
| 1984 | -3.76% | 0.97% | 42.87% | -6.87% | 385.99% | 7.51% |
| 1985 | -3.52% | 0.12% | 46.38% | -7.09% | 2941.53% | 5.92% |
| 1986 | -1.55% | -4.01% | 50.17% | -5.28% | ∞ | 5.02% |
| 1987 | -0.69% | 3.61% | 49.46% | -4.42% | 19.01% | 4.48% |
| 1988 | -0.22% | 0.05% | 49.61% | -4.10% | 441.84% | 5.21% |
| 1989 | 0.35% | -3.02% | 50.83% | -4.00% | ∞ | 8.20% |
| 1990 | 0.12% | -6.90% | 53.61% | -4.68% | ∞ | 8.75% |
| 1991 | -0.37% | -6.86% | 58.42% | -5.09% | ∞ | 7.08% |
| 1992 | -0.39% | -4.51% | 61.39% | -4.87% | ∞ | 5.13% |
| 1993 | -0.82% | -2.74% | 63.97% | -5.23% | ∞ | 3.74% |
| 1994 | -0.12% | 0.03% | 64.26% | -4.41% | 442.95% | 3.97% |
| 1995 | 0.79% | -3.48% | 65.99% | -3.84% | ∞ | 5.86% |
| 1996 | 2.16% | -2.41% | 65.95% | -2.31% | - ∞ | 2.81% |
| 1997 | 4.62% | -1.10% | 62.65% | 0.60% | - ∞ | 2.32% |
| 1998 | 4.58% | -3.21% | 59.90% | 0.69% | - ∞ | 3.63% |
| 1999 | 4.32% | 2.68% | 54.32% | 0.82% | -161.30% | 3.37% |
| 2000 | 4.99% | 2.20% | 48.22% | 1.80% | -226.35% | 3.67% |
| 2001 | 3.80% | -5.62% | 46.61% | 1.03% | - ∞ | 2.31% |
| 2002 | 2.99% | 2.55% | 42.74% | 0.73% | -117.18% | 0.38% |
| 2003 | 2.33% | -1.04% | 40.79% | 0.33% | - ∞ | 1.54% |
| 2004 | 2.65% | 2.38% | 37.21% | 0.79% | -111.26% | 0.75% |
| 2005 | 1.70% | 2.72% | 34.53% | 0.05% | -62.40% | 1.07% |
| 2006 | 2.34% | -1.50% | 32.81% | 0.82% | - ∞ | 2.11% |
| 2007 | 2.26% | 1.62% | 29.89% | 0.95% | -139.65% | 2.33% |
| 2008 | 0.99% | -3.13% | 29.53% | -0.21% | - ∞ | 1.08% |
| 2009 | -0.78% | -3.69% | 31.11% | -1.83% | ∞ | -0.83% |
| 2010 | -1.69% | 2.19% | 32.04% | -2.73% | 76.96% | -0.82% |
| 2011 | -0.46% | 3.21% | 31.71% | -1.47% | 14.32% | -0.53% |
| 2012 | -0.20% | -0.94% | 32.30% | -1.05% | ∞ | 0.08% |
| 2013 | 0.10% | 1.87% | 31.77% | -0.65% | -5.47% | -0.25% |
| 2014 | 0.62% | 1.50% | 30.67% | -0.10% | -41.15% | -0.63% |

Note: * is the adjusted primary surplus (total primary surplus less interest and investment income) Negative number indicates a deficit.

** growth less effective government interest rates (adjusted for interest and investment income) Negative number indicates interest rates higher than growth.

*** Unadjusted total government budget surplus/deficit. Negative indicates government budget deficit

**** what level the total debt to GDP ratio is converging to indicated by yellow. ∞ indicates a debt to GDP ratio is on a path that grows exponentially, - ∞ indicates that Debt to GDP ratio becomes negative thus assets grow exponentially, and negative numbers indicate that the government is converging to a point where the government will have assets higher then debts.

***** Inflation adjusted Bank Rate at the Bank of Canada

When the interest rates are greater than the growth rate, that would place Canada under proposition 2. This was observed in 16 periods. In nine of these periods the debt to GDP ratio is growing exponentially, and in seven of the periods, the government was growing assets at an exponential rate. Five of the nine times when debt to GDP was growing to infinity occurred between 1989 to 1993. Since 1996, for the most part, the country experience conditions where the assets were in a situation to grow exponentially when interest rates are higher than growth rates. The year 1996 is a unique case. The country was in an overall deficit, yet because of the effects of the growth rate, and primary budget surplus, this outweighed the interest burden on government debt, allowing the country to be in a position where the asset to GDP ratio was increasing exponentially. Hence, this would indicate a balanced budget would not be necessary to achieve a fiscal policy that eliminated the debt burden for a country. Another finding is that the real policy rate at the Bank of Canada was higher in years where the debt to GDP was growing exponentially. Thus, monetary policy may have been having unintended consequences on government interest rates, increasing the likelihood that the government finances would be in an unsustainable position. This effect will be examined in the following paragraphs.

In half the periods examined the assumption needed for no-Ponzi and transversality conditions were violated. Overall the average interest rate differential was -0.71%, not breaking the assumptions needed for no-Ponzi and transversality conditions. However, when examining only the data post-1996, with the change in monetary policy setting rules, this value was 0.15% meaning on average since 1996 the assumptions needed for no-Ponzi and transversality conditions were violated. This may be due to the way the bank of Canada set interest rates. Over the entire sample the average real policy rate was 3.14%, since 1996 however, the real policy rate was 1.2%. Thus, this lower policy rate may be correlated with the violations of the assumptions needed for the no-Ponzi and transversality conditions.

Testing the fiscal and monetary policies effect on government interest rates will be the focus of the second part of this section. The effective interest rates the governments pay is made up of bonds with ranging maturities and ranging issuance dates. Once issued, interest payments are set for the life of the bond. Thus, changes in interest rates will not immediately impact the amount of interest the government must pay. Hence, the effective interest rates on government bonds, as observable in figure 2.25 will not be a valid measurement for the econometric analysis, since this

rate takes time to change to market interest rates. In this section, two types of government bonds will be tested. Government debt with longer maturities (over ten years) and those with shorter maturities (one to three years). Although not always true, generally these rates move together, and the long rate is higher than the short rate. This allows one to find the effect fiscal and monetary policy will have on both longer and shorter duration government debts.

The fiscal policies tested will be the primary deficit, overall deficit, and the debt to GDP ratio. Furthermore, as the Debt to GDP ratio increases, there may be broader impacts on government interest rates. An exponential will be tested to examine if as debt to GDP increases, does it have a compounding effect on the interest rate. Second, there has been some suggestion that debt to GDP should be kept under a certain level. The European Union has a monetary treaty called "The Excessive Deficit Procedure" that has a condition where members may not have a debt to GDP ratio that exceeds 60% (Antonini, Lee and Pires 2013). Thus, this threshold will be tested, to examine if interest rates are affected by this level. Additionally, from the section above there was data available on the overall sustainability of the debt to GDP ratio. A dummy variable using this information will be tested to determine what effect there may be on interest rates when the debt to GDP ratio converges on infinity.

The policy rate at the Bank of Canada will also be tested. This will help determine how the monetary policy of the central bank can influence the overall interest rates. Additionally, other variables will be tested such as the political party in government at the federal level. Furthermore, the growth rate and the return of the stock market will be tested. Government bonds may be a safer investment than equities. Thus, there may be some correlation of returns in the stock market and government debt.

The first test will examine the short-run effects of the mentioned factors and government interest rates. This will be conducted with the use of first difference regressions. All regressions and a full definition of the variables can be found in tables 2.27 through 2.29. Equation (2.20) is the explanatory equation and equation (2.21) is its first difference which will be tested to determine short-term effects.

$$GBY = \beta_1 + \beta_2 r0 + \beta_n \Gamma_n \tag{2.20}$$

$$\Delta\, GBY = \beta_1 + \beta_2 \Delta r0 + \beta_n \Delta\Gamma_n \tag{2.21}$$

Where $GBY$ it the yield on government bonds (tested for both long and short duration bonds), $r0$ is the real policy rate, and Γ is a matrix of variables that may explain changes in interest rates, and Δ will denotes the variable is in first difference.

Examining tables 2.27 and 2.28, it is observable that for long duration bonds the only statistically significant variables were the monetary policy rate, and the deficits, both primary and overall. The suggestion is that a one percent increase in the Bank Rate at the Bank of Canada would be associated with a 0.27% increase in the interest rates on long-duration bonds. Increasing the deficit by one percent of GDP was associated with a 0.07% increase in government interest rates. All other variables were found to be insignificant at a 10% confidence interval. Thus, the effect of the policy rate may be more influential than the deficit.

When examining short duration bonds, it was found that only the monetary policy and growth rate of the economy were statistically significant. The suggestion is that a one percent increase in the Bank Rate, at the Bank of Canada, would be associated with a 0.58% increase in the interest rates on short duration bonds. A one percent increase in the growth rate was found to be associated with a 0.071% increase in interest rates. Thus, the monetary policy rate may be more influential on short-term government debt.

***Table 2.27: Estimation of Regression on the Interest Rate of Short Duration Government Debt***

| Variable | Independent variable | | | | |
|---|---|---|---|---|---|
| | Shot Bond (1) | Shor Bond (2) | Shot Bond (3) | Shor Bond (4) | Shot Bond (5) |
| Bank Rate | 0.57 (.046)** | 0.57(.045)** | 0.57(.046)** | 0.57(.046)** | 0.57(.05)** |
| Primary Budget | 0.019 (.0407) | | | | |
| Overall Budget | | 0.0213(.0397) | | | |
| Debt/GDP | | | -0.032(2.7) | | |
| Debt/GDP^2 | | | 0.04(2.8) | | |
| Debt/GDP > 60% | | | | -0.06(.28) | |
| Not sustainable | | | | | -0.009(..13) |
| Growth Rate | | | | | 0.077(.035)** |
| TSX | | | | | 0.065(0.41) |
| Government | | | | | 0.065(0.41) |
| Bond (-1) | | | | | -0.045(.061) |
| Constant | -0.026 | -0.026 | -0.020 | -0.02 | -0.034 |
| R squared | .55 | .55 | .55 | .55 | .54 |
| ADJ R squared | .54 | .54 | .54 | .54 | .52 |
| Durbin-Watson | 2.04 | 2.04 | 2.03 | 2.03 | 2.03 |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level, Short Bonds are bonded with duration between 1 and three years, long bonds have a duration of over ten years

**Table 2.28:** ***Estimation of Regression on the Interest Rate of Short Duration Government Debt***

| Variable | Independent variable | | | | |
|---|---|---|---|---|---|
| | Long Bond | Long Bond | Long Bond | Long Bond | Long Bond |
| Bank Rate | 0.27 (.045)** | 0.27(.045)** | 0.26(.045)** | 0.266(.045)** | 0.26(.049)** |
| Primary Budget | -0.081(.040)** | | | | |
| Overall Budget | | -0.0712(.039)* | | | |
| Debt/GDP | | | 0.28(2.7) | | |
| Debt/GDP^2 | | | -0.46(2.8) | | |
| Debt/GDP > 60% | | | | -0.025 (.279) | |
| Not sustainable | | | | | -0.18(.13) |
| Growth Rate | | | | | 0.035(.034) |
| TSX | | | | | -0.59(.40) |
| Government | | | | | 0.23(.22) |
| Bond (-1) | | | | | 0.073(.078) |
| Constant | -0.027 | -.025 | -.005 | -0.03 | -0.052 |
| R squared | .23 | .24 | .21 | .21 | .31 |
| ADJ R squared | .22 | .22 | .18 | .19 | .28 |
| Durbin-Watson | 1.66 | 1.66 | 1.69 | 1.69 | 1.92 |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level
Short Bonds are bonds with duration between 1 and three years; long bonds have a duration of over ten years

***Table 2.29: List of Variable and definition***

| Variable | Definition |
|---|---|
| Short Bonds | Average inflation-adjusted yield for Government of Canada bonds with a duration of one to three years |
| Long Bonds | Average inflation-adjusted yield for Government of Canada bonds with duration over ten years |
| Bank Rate | The Bank of Canadas published Bank rate for overnight loans to Canadian Charter Banks adjusted for inflation |
| Primary Budget | The total government revenue less non-interest payment spending (note different definition in Appendix A as outlined in paper) |
| Overall Budget | The total government revenue less spending |
| Debt/GDP | Total accumulated deficits in Canada to the nominal gross domestic product |
| Debt/GDP squared | Total accumulated deficits in Canada to the nominal gross domestic product squared |
| Debt/GDP over 60% | A dummy variable 0 if Debt/GDP is less than 60%, one is it is greater than 60% |
| Not sustainable | A dummy variable one if the Convergence point in Appendix A is ∞, 0 otherwise |
| Growth Rate | The real annualized economic growth rate for Canada |
| TSX | The natural logarithm of the Toronto Stock Exchange |
| Government | A Dummy Variable 0 if the Conservative Party of Canada or the Progressive Conservative Party of Canada is in power over the government of Canada, one if the Liberal Party of Canada is in power over the government of Canada |
| Bond (-1) | The lagged bond interest rate for the respective Bond |

In all cases, debt to GDP levels themselves, whether the government was in a sustainable position, and the threshold approach were not found to be a significant source of influencing the interest rates on government debt in the short run. Additionally, the political party leading the government, returns on the TSX, and previous interest rates themselves were also not found to be significant.

This suggests that monetary policy is a principal determinant of interest rates on government debt, and lower overnight rates at the central bank are associated with lower interest rates on government debt. Lower interest rates make the debt to GDP level more sustainable as shown in section VI.iii. Additionally, in monetary policy literature, it has been suggested that there should be a real policy rule where the real bank rate should be kept at low but positive levels (Smithin 2009). If this was achieved, it might have an additional benefit of making government debt to GDP levels in a position where they are converging to a level.

To test if the effects have been constant over time a dummy variable can be added to the equation to examine the effects pre and post 1996. 1996 is chosen as this is the year the central bank changed the way it chose monetary policy. Where $LBY$, and $SBY$ are the yields long and short duration bonds. $r0$ is the monetary policy rate, $primdef$ is the primary deficit, $y$ is the economic growth rate, and $p96$ is a dummy variable with the value of 0 prior to 1996, and 1 post 1996.

$$(2.22)\quad \Delta LBY = B_1 + B_2\Delta r0 + B_3(\Delta r0 * p96) + B_4\Delta pdef + B_5(\Delta pdef * p96)$$

$$(2.23)\quad \Delta SBY = B_1 + B_2\Delta r0 + B_3(\Delta r0 * p96) + B_4\Delta pdef + B_5(\Delta pdef * p96) + B_6\Delta y + B_7(\Delta y * p96)$$

***Table 2.30: Estimation of Regression on the Interest Rate of Government Debt, Split by Change in how Central Bank Conducted Monetary Policy.***

| Variable | Independent variable | | |
|---|---|---|---|
| | Long Bond (1) | Short Bond (2) | Short Bonds (3) |
| $r0$ | 0.26 (.048)** | 0.59(.050)** | 0.58(.049)** |
| $r0 * p96$ | 0.007(.048) | -0.06(.105) | -0.06(.105) |
| $pdef$ | -0.16 (.05)** | -0.057(.054) | -0.047(.054) |
| $pdef * p96$ | 0.17(7.98)** | 0.14(.081)* | 0.14(081)* |
| $y$ | | 0.056(.041) | |
| $y * p96$ | | 0.041(.061) | 0.09(.847)* |
| Constant | -0.022(.033) | -0.023(.337) | -0.023(.033) |
| R squared | .26 | .58 | .57 |
| ADJ R squared | .24 | .56 | .55 |
| Durbin-Watson | 1.62 | 2.03 | 2.03 |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level, Short Bonds are bonded with duration between 1 and three years, long bonds have a duration of over ten years

Examining robustness checks in table 2.30 the long and short bond results were examined for the period pre, and post 1996 when fiscal policy in Canada changed from growing debt to GDP ratio to a shrinking one, and the setting of monetary policy moved from a floating rule to an inflation targeting rule. For both long duration and short duration bonds, the effect of the monetary policy was consistent across time, meaning the effect of monetary policy on bond yields did not depend on how the central bank set monetary policy.

When examining the primary budget deficit, for long duration bonds, it was only significant before 1996. In this period there was a steadily increasing debt to GDP level in the economy. This could indicate that only when the debt to GDP ratio is steadily rising, deficits have a short run effect on interest rates. This may be because when the debt to GDP ratio is steadily rising there is a higher risk of a debt default, so investors only require a higher rate of return if there is an extended period of rising debt to GDP and not a short period of temporary primary deficits. When examining short duration bonds, the debt to GDP ratio was only found to be significant post-1996. This coefficient, however, has the opposite sign as one would expect. As deficits are rising, this is correlated with decreasing interest rates. The growth rate only was found to be significant in the post-1996 period. This relationship indicates that as the economy is growing, there are higher interest rates. This could be due to there being more investment opportunities in a growing economy, such that governments need to compete with these investments, and fewer people want to hold money in the relatively safer asset class of short-term government bonds. As previously mentioned the Bank of Canada would only have indirect control over the Bank rate before 1996, post this the bank would have full autonomy over the monetary policy. To examine causality between government bond yields and monetary policy rate a Granger causality test can be conducted.

***Table 2.31: Granger Causality Test, Testing the Linkage Between Monetary Policy and Interest Rates on Government Bonds***

| Test | Granger Causality | |
|---|---|---|
| | Long Bonds (1) | Short Bonds (2) |
| Lags | 4 | 4 |
| government interest rate granger cause policy rate chi-sq/(probability) | 6.28 (.1786) | 8.26* (.0823) |
| Policy rate granger cause government interest rate chi-sq/(probability) | 7.95* (.0933) | 15.94** (.0031) |

Note: ** indicates significant at a 5% level, * indicates significant at a 5% level. Short refers to short duration bonds with a duration between 1 and three years, long refers to long duration bonds with a duration of over ten years. These results based on the optimal lag length deterred by the ACI.

In table 2.31, one can observe the results of the Granger causality test. The policy rate found Granger causality linkages for both long and short-term bonds running from the policy rate to the government interest rate. In the case of long duration bonds, there was no evidence that these rates cause changes in the policy rate. In the short duration bonds, the was a bidirectional linkage meaning that both could be found to be leading the relationship. This bidirectional relationship could be caused by market participants forecasting rate changes and affecting interest rates before they officially change at the bank of Canada. Thus, the monetary policy of the Bank of Canada remained an integral part of influencing the interest rates on government debt and therefore influencing the sustainability of that government debt.

The final analysis will examine why this paper has found different results compared to the traditional literature on this subject. The results of this paper, up to this point has explored short-term relationships of the different policies. The literature on this topic mainly examines either an IS-LM or loanable funds framework to determine the effect deficits have on interest rates, examining longer-term relationships. The monetary policy rates seldom are directly tested in these models. Usually, only some form of the money supply is introduced in the models as a representation of the monetary policy. The non-inclusion of monetary policy rates may introduce some omitted variable bias into the conventional models, as shown in essay one, a critical factor in determining interest rates at banks and the money supply is the overnight rate at the Bank of Canada. The following analysis will use models similar to the conventional literature on this topic.

This will explore if the inclusion of monetary policy rates affects the normal findings, that deficits play a significant role in the determination of government bond yields.

The standard models examine either IS-LM (2.24) or a loanable funds framework (2.25). An example of these types of models is as followed.

$$(2.24) \qquad LBY = B_0 + B_1P + B_2M + B_3DEF + B_4GovSpend + B_5TB + e$$

$$(2.25) \qquad LBY = B_0 + B_1P + B_2M + B_3DEF + B_4SBY + B_5TB + e$$

These are models depicting regression for testing IS-LM and loanable funds theory. Much literature can be found on the theoretical relationships for both the IS-LM and loanable funds frameworks. Thus, this paper will not go into a discussion on these models, but only a short discussion on how these models are tested. Equation (2.24) was tested by Al-Saji (1993). In this model, long-term bond yields were tested against the inflation rate, $P$, the money supply, $M$, the deficit, $DEF$, short term bond rates, $SBY$, and foreign investment which could be thought of as the capital account, $TB$. Equation (2.25) was tested by Celula and Rhodd (1993). These authors tested a similar formula with the exception being they included short term interest rates, $SBY$, and excluded government spending. Because of endogeneity problems both used approaches that included instrument variables. Modifications were made to conform these models to a standard notation across models, as the authors have different definitions for each component of the models.

The analysis below will run a two-stage least square method, on the following formula. OLS analysis may show bias in the analysis because of some endogeneity in the equation.

$$(2.26) \qquad LBY = B_0 + B_1P + B_2DEF + B_3R0 + B_3CAP + e$$

Equation (2.26) does not include a money supply term as it should be accounted for in the monetary policy rate. A change in the interest rate should correlate with changes in the money supply, as this rate should affect loan growth. $CAP$ in this model is the capital account in terms of percentage of GDP. In the two-stage least square the instrumental variables used are consistent with the work by Celula and Rhodd (1993), where an instrument for the deficit is the unemployment rate two periods lag, and the instrument for the inflation rate is the inflation with two periods of lag.

***Table 2.31: Estimation of Long-Term Effects of Deficits, Policy Rates, and of the Interest Rate of Long Duration Government Debt***

| Variable | Independent variable | | |
|---|---|---|---|
| | 2SLS (1) | 2SLS (2) | 2SLS (3) |
| Constant | 0.0355** (.0037) | 0.04** (.0028) | 0.00746** (.00319) |
| Overall Budget | -1.06** (.912) | -0.89** (.078) | -0.12 (.078) |
| Inflation | .67** (.18) | -0.50** (.19) | -0.03 (.070) |
| Capital | -1.96** (.31) | -1.85** (.23) | -0.197 (.17) |
| R0 | | 0.48** (.06) | 0.13** (.04) |
| LTB(-1) | | | 0.75** (.079) |
| R squared | .76 | .88 | .98 |
| ADJ R squared | .75 | .87 | .98 |
| Derbin-Watson | 0.48 | 0.67 | 1.33 |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level, Short Bonds are bonded with duration between 1 and three years, long bonds have a duration of over ten years

In regression (1), monetary policy was not accounted for, as this follows what is tested for in much of the previous literature. The findings in regression (1) are consistent with what has been found in past literature. That being, a more significant deficit is associated with higher interest rates, and higher inflation rates are associated with higher bond yields. The Capital account yielded a negative result meaning that as Canada runs a trade deficit, this is associated with lower bond yields. This could be because foreign beneficiaries of that deficit need to use their Canadian dollars gained from trade. Those gains are invested in the Canadian economy, and one investment they may be making is in government bonds, increasing bond prices and decreasing yields. When the policy rate is included in regression (2) this decreases the effects of all components in the model, meaning that leaving this monetary policy rate out of the model may overestimate the other relationships. In both these previous regressions, the Durbin-Watson statistic indicated that there might be autocorrelation present in the model. In regression (3), a lagged long duration bond rate was included, and this reduced the overall significance of the independent variables in this model. In this regression the budget deficit, inflation, and capital account all become insignificant; Only the monetary policy rate, and the autocorrelation component are significant at a 10% level. This gives evidence that the monetary policy rate is vital to include in these debt models when measuring long-run effects.

*VI.vi. Conclusion*

This section found results on many aspects of government debt. First propositions were made about the sustainability of government debt based on interest rates, growth in the economy and the

primary deficit. It was found that if interest rates were less than growth rates the economy would always converge to some level of debt to GDP. If not, there would be an exponential growth of debt or assets to GDP. This could be a helpful finding for organizations attempting to give third world debt relief. It may not be necessary to forgive the debt, but rather reduce the interest rates on that debt to below the growth rates, allowing the country to converge to a level of debt to GDP, for any given primary deficit.

The state of the world when interest rates are greater, then growth rates are frequently assumed to be an impossibility in much of the traditional macroeconomic literature. This paper tested this assertion and found that half the time, in Canada, there were higher growth rates than interest rates. Additionally, since 1996 there has been a positive interest rate differential, meaning that growth rates have been on average higher than interest rates. This may bring into question the results of models that rely on the assumption that interest rates are higher than growth rates, as the assumption may not be a good representation of the real world, based on the Canadian data. Furthermore, nearly half the time when interest rates are higher than growth rates there was found to be a building of assets, based on the Canadian data. Over this period Canada's financial position was sustainable, with only individual periods, during economic slowdowns, of being under the proposition where debt to GDP was in an exponentially growing situation.

An examination of factors that led to changes in interest rates on Canadian government debt was conducted. It found that increases in the Bank rate set by the Bank of Canada were a significant factor in the increase in the interest rate in both short, and long duration bonds. The fiscal policy of the government played a smaller role in some circumstances and some duration of bonds. Additionally, the policy rate was found to Granger-cause the interest rates on long-duration government debt, and there was a bidirectional linkage between the interest rates and short duration debt. When testing the longer-term relationship between monetary policy, interest rates, and deficits, it was found that the inclusion of the policy rate in IS-LM and Loanable funds frameworks, may improve the overall econometric results. The inclusion of the policy rate was found to decrease the predicting power that government debt has found to have on interest rates in other authors research. This may lend support for keeping the real monetary policy rate at a low but positive rate, as this may have an additional benefit of allowing debt to GDP ratios at the

government to remain on a converging path as the government receive the benefit of lower interest rates on their bonds.

## *V. A Historical Examination of Okun's Law in Canada*

### *V.i. Introduction*

The so-called Okun's law was proposed by Okun (1962). It theorized that an empirical relationship existed between unemployment and economic growth. The suggested theoretical relationship is that if growth in the economy increases by 1%, the unemployment rate will be reduced by less than 1%. This concept relies on the underline assumption that in order to achieve an improved economic growth rate, either productivity per employee or the amount of labour would be required to increase. It was theorized that growth would need to grow faster than the reduction in unemployment as part of the increase in growth can be attributed to increased productivity, as each employed person may work more extended hours, or be more productive. The remaining increase in growth would be due to an increase in more labour becoming employed. Thus, this increase would decrease the unemployment rate if the labour participation rate and population were constant. If, however, there was a growing labour force, this would increase the amount of growth needed to reduce unemployment.

This concept may produce limits to how much real economic growth a country could achieve, given a country has a finite labour supply in each period. The purpose of this section is to examine Okun's law in a Canadian context. Additional to this, an examination of how monetary policy can affect employment will be introduced. The effect of monetary policy on the real labour market, through interest rate channels, will be measured. Furthermore, this paper will examine the limits to growth put on the economy by the amount of available labour. This may provide evidence that running significant deficits for an extended period may have diminishing returns, and possibly will not cause growth to increase without limits.

To examine this limit in a historical context, one can observe a period in history where government spending may have caused the economy to reach a growth limit, based on population. An example of this is WWII. In this period government spending dramatically increased, and the unemployment rate was reduced to 1.4%. This was coupled with increasing growth rates until the unemployment rate was reduced to historically low levels. Along with this, there was a simultaneous increase in the labour force participation, with the first mass-scale introduction of

women into the workforce. This example will be examined in more detail in the following sections.

This section will focus on annual data in Canada, from 1927 to 2015. The relationship between unemployment and economic growth will be found throughout this period. Furthermore, this may set out limits to economic growth based on population. Finally, this section will examine the period since the recession of 2008 and the recovery, or lack of recovery, in employment.

The relationship and stability of this relationship between unemployment and growth have been tested by other authors, mainly in other countries. Work conducted by both Huang and Lin (2006), and Yilmazuday and Yazgan (2009) demonstrated that the Okun coefficient, that determines employment's sensitivity to economic growth might vary over time when examining quarterly data. Both studies based their findings on data from the United States. Knotek (2007) found that there has been a general relationship between unemployment and growth. However, it was not stable at a time when examining the short-term effects of Okun's law. This relationship has been found to be unstable in other countries as well. In a study of Japan, it was found the Okun coefficient had moved in a range between 6.43:1 to 1.03:1[7] when examining short-run effects (Kurosaka 2012). Not all data supports Okun's law, for example, a study by Durech, Minea, Mustea, and Slusua (2014) of the Czech Republic and Slovakia was conducted and failed to find this Okun's law relationship at the regional level. The global structural differences between the countries in the previous literature, and Canada may lead to different results, and further monetary policy was not introduced in these models. Monetary policy may affect firms' investment, as investment may be a function of interest rates, and if investment correlates with employment, there may be a relationship between monetary policy and the unemployment rates. Furthermore, much of the previous work on this subject examines quarterly data, with periods of study in duration as short as three years. This examination of the quarterly relationship may be misleading as individual quarters may contain some volatility, as employers adjust employment levels, and short time periods may not give an excellent representation of the overall relationship. This study will examine annual data and create 20-year periods, thus, eliminate some of the unnecessary volatility. Further, some of the studies held the intercept term constant across the entire sample. This too will

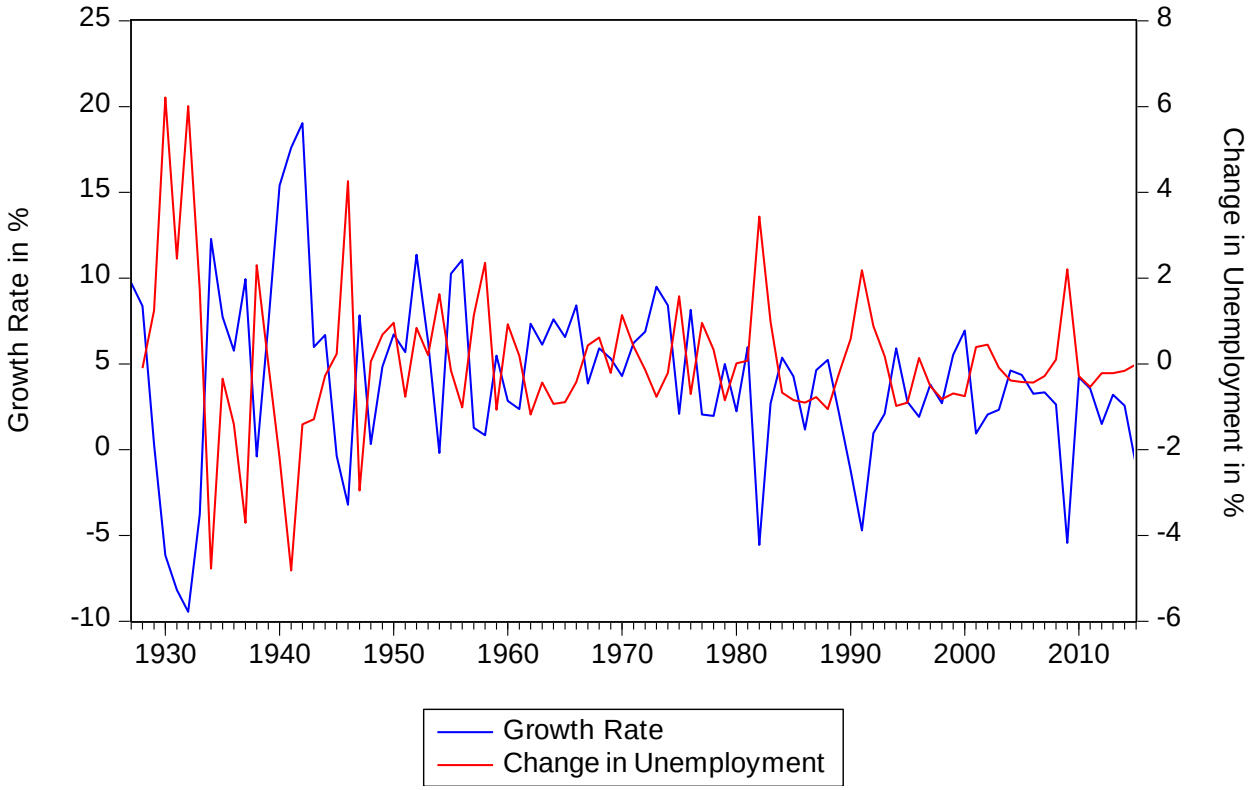
[7] This figure indicate how much economic growth is associated with the reduce unemployment. Thus, a ratio of 6.43:1 would indicate that economic growth would need to increase by 6.43% to be associated with a 1% reduction in unemployment.

be examined to find if changes are happening in the actual Okun coefficient or in the intercept term.

Figure 2.26 displays Canada's unemployment rate and growth rate since 1926. From this figure, one can observe the inverse relationship between the two variables.

This paper will be structured in the following way, section V.ii will examine the model and propose econometric tests, section V.iii will explain the data for this paper, section V.iv will examine the empirical results, and section V.v will hold some concluding remarks.

***Figure 2.26: Canadian Unemployment Rate and the Growth Rate, 1926 to 2015***




*V.ii. Okun's Law Model*

Okun's law relies on the relation between economic growth and unemployment. This concept states to achieve economic growth, either the labour force or the productivity per labourer must increase. This can be demonstrated in equation (2.27).

(2.27) $Y = AN$

This equation consists of the level of real GDP ($Y$), the productivity per laborer ($A$) and the number of employed laborers ($N$). In terms of rate of change (2.28).

(2.28) $$\Delta Y = \Delta A N + A \Delta N + \Delta A \Delta N$$

Thus, an increase in real GDP can be obtained from an improvement of productivity per employed person or a change in the number of employed persons. Given the definition of the unemployment rate, the equation is as follows.

(2.29) $U$=1-N/L

Where $U$ is the unemployment rate in decimal form and $L$ is the total labour force, it can be observed that this can be rearranged into equation (2.25).

(2.30) $$N = L(1 - U)$$

Substituting (2.25) into (2.22).

(2.31) $$\Delta Y = \Delta A L(1 - U) + A\Delta\big(L(1 - U)\big) + \Delta A \Delta\big(L(1 - U)\big)$$

Thus, the change in economic growth is dependent on the change of productivity per employed worker, the labour force, and the unemployment rate. Dividing through by $Y$ one can get this equation in terms of rates[8], where $y$ is the growth rate. Equation 2.27 states that a change in the growth rate can be attributed to a change in productivity, a change in the labour force/unemployment rate, or a combination of both.

(2.32) $$y = \frac{\Delta A L(1 - U)}{Y} + \frac{A\Delta(L(1 - U))}{Y} + \frac{\Delta A \Delta(L(1 - U))}{Y}$$

This introduces the relationship that will be tested to determine the Okun's law coefficient.

(2.33) $$\Delta\, U = \beta_1 + \beta_2 y$$

This equation will determine the relationship between unemployment and economic growth. The $\beta_1$ term is generally positive. This would encompass the amount the unemployment rate would increase if there is no growth in the economy. The $\beta_2$ is theoretically negative, and this term indicates how much the unemployment rate would decrease per 1% change in the growth

[8] denoted by lower case letters

rate. Thus, for there to be a stable unemployment rate the growth rate in the economy would have to equal $\beta_1/-\beta_2$. This will be further modified in the proceeding section to account for other variables.

First one should establish the statistical relationship between the growth rate and the unemployment, and labour force participation rate. This information is needed to determine the short run and long-run effects of Okun's law. Finally, Johansen cointegration tests will be used in the proceeding section to determine if there is the existence of any leading relationships between the variables. Based on the conclusion of Engle and Granger (1987) on the examination of the long-run stable relationship among non-stationary variables, and the paper by Gonzalo (1994) provides evidence that the Johansen methods (Johansen 1991) are a more efficient cointegration procedure.

*V.iii. Examination of Data*

This paper will focus on Canada, examining the data over multiple business cycles. The advantages of Canada are there are less exogenous effects that may be present, than in other countries. Canada is a small developed nation, that has full dominion over its currency, and therefore full dominion over monetary policy (for the second half of the sample). The financial crisis of 2008 occurred in Canadas major trading partner, but, the banking crisis did not directly affect Canada's banking sector. Thus, making the 2008 recession largely caused by an external shock to the Canadian economy, and not one caused by policies in Canada. Hence, in the recovery, there may have been regulatory changes in the Canadian financial sector that may have distorted the job growth pattern. This paper will try to determine if the effect of Okun's law has been constant over periods of economic growth and decline. Furthermore, this will examine the overall effect of this since the recession in 2008.

The data was gathered from Statistics Canada ranging from the years 1927, and 2015 covering 89 annual periods. This includes multiple economic events and will allow for examination of the stability of the relationship over this period.

*V.iv. Empirical Results*

This section will examine the empirical results, based on the data and model previously discussed. An examination of the relationship between the growth, unemployment, and labour participation rate will occur. There will be four tests produced in this section to determine the

relationships between these variables. The first test will be a regression on the growth rate to find if there is any statistical relationship, between the growth rate and unemployment, as well as with the growth rate and participation rate, as the previous section showed a theoretical linkage between these variables. The test will estimate the following equation.

$$(2.34) \qquad y = \beta_1 + \beta_2 U + \beta_3 PAR + \beta_4 y$$

Where $y$ is the growth rate of GDP, $U$ is the unemployment rate as defined as the employment rate as a percentage of the labour force, and $PAR$ is the labour force participation defined as labour force as a percentage of the population older than 15. To find the short run effects, a first difference test will be conducted as displayed in the following equation. This equation is estimated in table 2.32.

$$(2.35) \qquad \Delta y = \beta_2 \Delta U + \beta_3 \Delta PAR + \beta_4 \Delta y_{-1}$$

***Table 2.32: Regression of Growth Rate, on the Unemployment, and Participation Rate***

| Variable | Independent variable |
|---|---|
| | Growth Rate |
| Unemployment | -1.84 (.28)** |
| Participation rate | 0.43 (.67) |
| Growth rate (-1) | -0.42(.092)** |
| R Squared | .29 |
| ADJ R squared | .27 |
| Dickey-Fuller | 1.77 |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level

Table 2.32 indicates that there is a relationship between the growth rate and the unemployment rate. No evidence, however, found a relationship between the growth rate and the participation rate. Increases in the growth of the economy were found not to have a significant effect on an agents' willingness to enter the labour market in the short run. Thus, the participation rate may change for other reasons that may not be directly related to economic growth in the short run. Hence, this also indicates that there is no evidence in the short run that labour leaves the workforce, because of being discouraged from weak economic growth. This information will be used in the second test of Okun's law.

From here one can regress the following formula to calculate the Okun's coefficient for the overall period. In order to test this concept, the following formula can be used.

$$(2.36) \qquad \Delta U = \beta_1 + \beta_2 y$$

This is the original Okun's equation as proposed by Okun (1962). Where $\beta_1$ represents an intercept that demonstrates how unemployment will change if there is 0 economic growth, and $\beta_2$ measures the effect of increasing growth by 1%. There has additionally been the proposal that changes in unemployment may also rely on previous periods growth. Thus equation (2.37) will also be tested.

$$(2.37) \qquad \Delta U = \beta_1 + \beta_2 y + \beta_3 y_{-1}$$

Table 2.33 indicates the Okun's law relationship for the entire sample period. This indicates that there is a negative relationship that does exist in the data between growth and unemployment. The growth rate explained 67% of the variation in the unemployment rate. Note, however, there was no relationship found between last periods growth rate and unemployment. Over this entire sample period, one would see an Okun's coefficient of 3.8. Indicating that a 3.8% increase in the growth rate, is associated with a 1% decrease in the unemployment rate, and the real growth rate would need to be 4.3% to maintain a constant unemployment rate. This seems unreasonable at the current time; thus, an examination of different periods must occur and examine if it is the Okun's coefficient or the intercept that has not been constant.

***Table 2.33: Regression of Okun's Law Equation for 1926 to 2015***

| Variable | Independent variable | |
|---|---|---|
| | Unemployment | Unemployment |
| Intercept | 1.13(.147)** | 1.06(.15)** |
| Growth rate | -0.26 (.023)** | -0.28 (.026)** |
| Growth rate (-1) | -----(-----) | 0.028(.026) |
| R squared | .60 | .61 |
| ADJ R squared | .60 | .60 |
| Dickey-Fuller | 1.9 | 1.96 |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level

In order to examine this concept further, time periods must be created. Five periods will be examined. Before the 1940's, there was a large variation in the unemployment rate, due to the great depression and the beginning of WWII. Between 1940 and 1960 there were post-war changes in the economy. Between 1960 through 1980 the labour force participation rate began to increase

as females entered the workforce. Between 1980 and 2000 an adoption in technology may have increased efficiencies, as computers were introduced in the workforce. If this is true, one would expect to observe a reduction in the Okun's coefficient in this period, as economic growth would lead to fewer reductions in unemployment. Post-2000 an examination of the burst of the tech bubble and great recession's effect on unemployment can be examined. These events may have two different effects on the Okun's Coefficient.

These events could change the intercept; thus, the amount unemployment would change with zero economic growth, or these events could affect the Okun's coefficient itself, changing the relationship of increasing growth and the unemployment rate. In order to test both concepts, dummy variables were created[9]. Along with these variables, the dummy variables were also multiplied by the growth rate, to test the Okun's coefficient for each period. These changes to the model can be examined in equation (2.33). A more in-depth examination of monetary policy, along with control variables will be examined. The control variables in this model will be for inflation, labour participation and autocorrelations observable in equation (2.34). The inflation control would lead to indirect evidence to support cost-push inflation. The concept of cost-push inflation is that if labour's wages are increasing faster than productivity, that will lead to inflation. Thus, unemployment and inflation may be inversely related. This is as unemployment is reduced, there may be wage pressures experienced, and hence, cause cost-push inflation. These results are observed in table 2.34.

$$\Delta U = \beta_1 + \beta_2 y + \beta_n D_i + \beta_n D_i y \tag{2.33}$$

$$\Delta U = \beta_1 + \beta_2 y + \beta_n D_i + \beta_n D_i y + \beta_3 r + \beta_4 \Delta p + \beta_5 \Delta Par + \beta_5 \Delta U_{-1} \tag{2.34}$$

[9] Dummy variables were reacted for each for each period describe above, less one. These were created to test the intercept for each period. The dummy variables take a value of 1 when in sample, and 0 otherwise. This allows for the effects to be isolation of each 20-year period.

***Table 2.34: Regression of Okun's Law Equation by Time Period, with the Use of Controls***

| Variable | Independent variable | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Intercept | 0.67(.23)** | 0.593(.24)** | 0.579(.16)** | 0.619(.16)** |
| Growth rate | -0.29 (.022)** | -0.236 (.058)** | -0.248(.027)** | -0.238(.023)** |
| Intercept 27-40 | 0.53(.338) | 0.831(.36)** | 0.89(.32)** | 0.786(.320)** |
| Intercept 40-60 | 1.027(.28)** | 0.738(.35)** | 0.89(.27)** | 0.824(.258)** |
| Intercept 60-80 | 0.904(.28)** | 0.64(.44) | 0.78(.27)** | 0616(.234)** |
| Intercept 80-00 | 0.019(.306) | 0.14(.36) | -----(-----) | -----(-----) |
| Growth rate 27-40 | -----(-----) | -0.134(.06)** | -0.13(.048)** | -0.113(.043)** |
| Growth rate 40-60 | -----(-----) | 0.0017(.065) | -----(-----) | -----(-----) |
| Growth rate 60-80 | -----(-----) | 0.006(.06) | -----(-----) | -----(-----) |
| Growth rate 80-00 | -----(-----) | -0.072(.089) | -----(-----) | -----(-----) |
| Real Policy Rate (-4) | -----(-----) | -----(-----) | -----(-----) | -0.0469(.027)* |
| $\Delta$ Inflation | -----(-----) | -----(-----) | -----(-----) | -0.101(.031)** |
| $\Delta$ Participation | -----(-----) | -----(-----) | -----(-----) | 0.45(.127)** |
| $\Delta$ Unemployment(-1) | -----(-----) | -----(-----) | -----(-----) | -0.120(.054)** |
| R squared | .69 | .72 | .71 | .79 |
| ADJ R squared | .67 | .68 | .69 | .76 |
| Dickey Fuller | 2.26 | 2.34 | 2.31 | 2.09 |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level

Table 2.34 contains four regressions examining different aspects of Okun's law. Regression (1) examines if the intercept term ($\beta_1$ in equation (2.33)) is constant over time. The results for this show that it has not been constant over time and has changed across the decades. When comparing these terms to the 2000-2015 period, it indicates that the intercept terms were relatively higher, than in the post 2000 period. This means in past decades it took much more economic growth to have a stable unemployment rate for any given Okun's coefficient. This may be due to the participation rate in the economy, which was growing significantly until the early 1980's.

Regression (2) examines if the Okun's coefficient has remained constant across periods. In this case, the regression found that post-1940, the Okun's Coefficient has remained statistically constant. Thus, increasing economic growth has been found to have a constant effect on unemployment since the 1940's. Even with technological changes this variable did not change, lending evidence to the fact that the introduction of what one may think of as productivity improving technologies, like the computer in the 1990's, and robotics in the manufacturing sector, did not cause the relationship between economic growth and unemployment to diminish. If these

technology changes did improve growth, they created reductions in unemployment at the same rate as economic growth had achieved in previous decades. These results depart from what was found by other authors, for different countries and with the examination of quarterly data.

Regression (3) assembles a full, across time model, for these periods, enhanced by what was found in the first two regressions. This indicates that the intercept term had two different phases. In the three periods before 1980 (1927-1980), the intercept terms are statistically insignificant from each other. This means with zero economic growth; the unemployment rate would be predicted to react the same in those periods, mainly increasing by around 1.4%. Post-1980 this number stayed constant as well. This indicates that with zero economic growth the unemployment rate would be expected to increase by 0.58%. The Okun's coefficient, on the other hand, was consistent in all periods post-1940, where for every 1% of growth there was an associated decrease of 0.248% in the unemployment rate. This means that to reduce the unemployment rate by 1%, not considering the intercepts effects, a growth rate of 4% is needed. Hence, there is an Okun coefficient of 4.03:1. Before 1940, however, the economic unemployment rate was more sensitive to the economic growth rate. In this case, the relationship indicates that when a 1% increase in growth rates occurs, one would expect to observe a 0.378% decrease in the unemployment rate. Suggesting, to reduce unemployment by 1% an increase in growth by 2.64% is needed, hence, there is an Okun's Coefficient of 2.64:1.

Regression (4) accounts for monetary policy, inflation, participation, and an autoregressive component. It was found that there was a slight negative relationship between monetary policy and the unemployment rate. This relationship had a four-year lag. Nonetheless, this indicates that a 2% change in the real policy rate at the bank of Canada was associated with a 0.1% change in the unemployment rate. This does not make any assumptions about causality, thus it there is a genuine relationship in this instant, it may be that the bank changes rates based off future expectations of unemployment, or that businesses make hiring decisions based on historical investment that was affected by past interest rates, and the confidence that those rates suggest about the future. Changes in inflation were found to have immediate effects on unemployment. There was found to be a negative correlation between inflation and unemployment. Thus, if unemployment decreased, this was associated with inflation increasing. This may give evidence to support the concept of a cost-push element in the inflation rates. That is as unemployment

decreases, there is a tightening in the labour market, causing wages to rise faster than productivity, increasing inflation. This relationship is not to say inflation is the cause of changes in the unemployment but instead associated with those changes. There was a definite relationship between the participation rate and the unemployment rate. As more labour enters the market, this can increase the unemployment rate. This effect, however, was less than one for one, where algebraically it should have been over one for one if people entered the labour force and employment stated constant. Thus, as the participation rate increases, it does not entirely pass through to the unemployment rate. This may indicate as people enter the labour force this creates jobs in the economy, let it be because of increased diversity of skill sets, or self-employment job creation. Hence, increasing the number of people in the labour market was found to have a relationship with more jobs being available in the economy. Finally, there was a small autoregressive component to the unemployment rate.

The results of the third regression lend information on the growth rates must be achieved to maintain a level of unemployment. Table 2.35 amalgamates all the information found econometrically on the Okun coefficient, zero growth change in unemployment, and the level of growth needed to be achieved to maintain a given unemployment rate. From this table, it can be observed that before the 1940's, the regression indicated that there needed to be 3.8% economic growth to maintain the observed unemployment levels. From the 1940's to 1980's, as women were entering the labour force, and participation rates were rising, the country needed a growth rate around 5%-6%, to maintain the unemployment at a constant rate. Post-1980, as the participation rate stabilized, this rate has decreased to 2.3%. This indicates that currently a much lower rate of growth is needed to maintain unemployment rates relative to previous periods in Canada's history. If the growth rates of the 1940s to 1980s returned to the economy, that would lead to a falling unemployment rate, where eventually the country may hit a limit on the growth, as unemployment would decrease to trivial amounts. When examining the required growth rates in comparison to the actual growth rates achieved in the economy, one can notice that the growth rate in every period seemed to conform to the growth rate needed to maintain a constant unemployment rate. While suggested in the previous analysis, that increasing the labour force participation increased the unemployment, this may be temperate as the growth rate always approximated what was needed to maintain constant unemployment, over more extended time periods.

***Table 2.35: Okun's Coefficients Across Periods, and Sensitivity to Changes in the Growth Rate[10]***

| Period | Implied Effect of Okun Coefficient | Zero Growth Increase in Unemployment | Growth Required for Zero Unemployment Growth | Average Growth Rate |
|---|---|---|---|---|
| **1927-1940** | 2.64:1 | 1.47 | 3.8% | 2.57% |
| **1940-1960** | 4.03:1 | 1.46 | 5.9% | 6.64% |
| **1960-1980** | 4.03:1 | 1.36 | 5.5% | 5.54% |
| **1980-2000** | 4.03:1 | 0.579 | 2.3% | 2.39% |
| **2000-2015** | 4.03:1 | 0.579 | 2.3% | 2.44% |

These results are consistent with findings for other countries conducted by other authors. Tombolo and Hasegawa (2014) found similar results to the findings displayed in table 2.35. Signer and Stiassny (2002) found a smaller result, then in this analysis. There is only a relatively small difference in the effect before the 2000's when comparing to the 1980's and 1990's, meaning, that the labour market reacted as it would be expected to after the slowdown, and recession of the 2000's. There has been some discussion on whether the 2008 recession was a "jobless" recovery. Since the 2008 recession, until 2014, the unemployment rate has decreased by 1.4%, the economic growth, however, would have predicted the unemployment rate to be reduced by only 0.9%. This measure would indicate that the unemployment rate fell faster than the growth rate would have suggested. This difference is due to the reduction in the participation rate since 2008, some jobs have been created, but a large part of the reduction in unemployment has been due to a decrease in the overall participation rate.

A Johansen Cointegration test can be performed to determine if there is cointegration between variables and if there are any leading/lagging relationships. This will be done at annual and quarterly frequencies; quarterly relies on data since 1981. This test between the unemployment rate and growth rate can be observed in table 2.36.

[10] Implied effect of Okun's coefficient is the implied ratio between unemployment and growth rate. Zero growth increase in unemployment is the amount the unemployment rate would be predicated to increase given a zero-growth rate. Growth required for zero unemployment growth is the level of growth that needed to maintain the current level of economic growth rate. Average growth rate is the average growth rate experienced in that period.

***Table 2.36: Johansen Cointegration test and Vector Error Correction Modeling Between the Unemployment Rate, Growth rate and Policy Rate***

| | Growth and Unemployment Quarterly (1) | Growth and Unemployment Annual (2) | Interest and Unemployment Quarterly (3) |
|---|---|---|---|
| Johansen: Trace Statistic | 29.98** | 55.9** | 22.5** |
| VECM: Max Eigen Test | 24.49** | 38.6** | 20.77** |
| VECM: $\Delta U$ Unemployment Error correction term | -0.0085** (.0028) | -0.382 ** (.184) | -0.0804** (.022) |
| VECM: $\Delta y$ Growth Rate Error correction term | 0.0122 (.00775) | -0.157** (.063) | ----- (-----) |
| VECM: $\Delta i_0$ Policy Rate Error correction term | ----- (-----) | ----- (-----) | -0.0808 (0.06) |

Note: ** indicates significant at a 5% level, * indicates significant at a 10% level, Lag length chosen by optimal AIC

Table 2.36 indicates that there is cointegration present between unemployment and growth by the findings of both the trace and max Eigen test. This allows for one to find causality. Examining the error correction terms provided by vector error correction modelling, one finds that in the long run, the unemployment rate is changing to maintain a long run relationship with the growth rate, when examining quarterly data. The period of adjustment was found to be seven quarters. When examining annual data, there is a one-year relationship with bi-directional causality between unemployment and growth maintaining long-run relationships. Over half of the discrepancy between growth and unemployment is accounted for in one year. When the quarterly and annual results are combined, this indicates that the unemployment rate must adjust to the growth rate within the year, as when examining the annual data, one can no longer observe a leading/lagging relationship. Also, it can be observed that the unemployment rate adjusts to maintain a long run relationship with interest rates. This suggests that the unemployment rate follows both the growth rate and the interest rates in the long run. This indicates that the firms may take signals from both the growth rate and the policy rate when making hiring decisions.

This brings up the limits to how much a country can grow, knowing that changing the growth rate will have a long run effect on the unemployment rate. From the Okun coefficient, the growth rate needs to increase by a 4.03% to reduce unemployment by one percent. From this, a forecast

of the growth rate needed to eliminate unemployment in Canada can be conducted. The current unemployment rate as of 2016 is 6.8%, and the current growth rate is 2%. That would imply that there is a maximum growth rate of 29.7% in Canada. That is the predicted growth rate that Okun's law would suggest to employ everyone who is currently looking for a job entirely. Note that as the growth rate is consistently over the zero change in unemployment level (2.3%), this would reduce the unemployment rate, and reduce the theoretical upper limit on growth, as less growth would be needed to reach a zero-unemployment rate. That indicates the limit to the amount of growth that Canada can achieve, over the medium term, without a significant increase in population, participation, or technology changes.

The rate of 2.3% a year plus the 29.7% over the given period would theoretically be the maximum possible growth rate one could expect for Canada in the medium term. If for example that given period was ten years, where there were no significant changes in the population, technology, participation rate occur, compared to historical changes, this would suggest the average maximum growth rate in the Canadian economy, over the next decade, would 5.3%. After that 10-year period of experiencing the 5.3% growth rate, there would theoretically be an unemployment rate of 0%. This limit suggests that no matter how much stimulus is added to the economy, there is a limit to the growth of the nation. This growth rate seems to be in line with growth rates experienced during WWII. When examining growth rates in Canada in WWII, one observes growth rates ranging from 6% to 19%. Note that in this period from 1932-1942 growth went from -9.2% to 19%, as the unemployment rate decreased from 19.3% in 1932 to 1.3% in 1944. As unemployment was reduced to under 2%, the growth rates in Canada also decreased from 19% to around 6%. This may indicate that Canada did reach the theoretical limit in this period.

*V.v. Conclusion*

This section examined the validity of Okun's law in Canada between the years 1927 and 2015. It found that there was evidence to support the linkage between economic growth and employment, but no linkage between the labour force participation, and either economic growth or employment.

The Okun's coefficient indicates a relationship where a 4.03% increase in the growth rate is associated with a decrease in unemployment by 1%. This rate was found to be constant in every

period since 1940. The increase in the unemployment rate, if one experienced zero economic growth, had two distinct time periods. Pre-1980 zero economic growth was predicted to increase unemployment by about 1.4%, as women entered the labour force and the participation rate increased. Since 1980 however, the participation rate has become more constant, and zero economic growth would indicate an increase of unemployment of 0.58%. Thus, a lower growth rate is needed to maintain unemployment levels when comparing later and earlier sample periods.

There was no evidence of a structural change in response to unemployment on economic growth after the 2008 recession, although the participation rate may have artificially lowered the unemployment rate since 2009. Additionally, it was found that in the long run, the unemployment rate was changing to maintain a relationship with economic growth, in quarterly data, and a bi-direction linkage in annual data. This suggests that policies that lead to higher growth will reduce unemployment. Thus it is not necessary for the government to only focus on employment programs, as jobs can be created by better economic growth. Monetary policy was not found to play a significant role in the changes of the unemployment rate, suggesting that monetary policy effects on the growth rate may be more important than its direct effects on the unemployment rate.

## *VI. Conclusion*

This essay was a continuation of the work in this series exploring the Alternate Monetary Model. This essay dealt with three central concepts. First the simulations of economic events. This section was used to predict the economic effect of different government, and central bank policies on various economic variables, using the AMM. This part of the essay found the competing interests of different agents in the economy and found the predicted effect, based on the AMM, for each agent for multiple policies. Of these not all policies were predicted to cause all agents positions to be degraded. There was a prediction that both a reduction in the tax rates and productivity improvements would cause all parties to benefit. Others, however, lead to less universally good outcomes as one group would benefit, at the expense of another[11]. The same simulations with a

[11] The three groups of agents were labour, firms, and rentiers.

model that accounted for autocorrelation were performed. Broadly the same outcomes were found with some noted exceptions.

The second part of this essay examined the limits on government debt. This dealt with the inevitable question of, why not run a massive deficit forever, to grow the economy at a rapid pace. This section proposed two propositions to help allow one to identify if a deficit was sustainable, in the sense that the government debt would not grow infinitely compared to GDP. The data indicated that indeed Canada has been in sustainable positions for most of the past two decades except in the early 1990s. Also, this essay brought into question some of the transversality conditions, that state that real interest must be higher than real growth rates. This was found to be violated in about half of the annual periods, which would bring into questions theories that rely on this concept, like the no-Ponzi condition for government debt, present in many other models. This section also explored monetary transmission between the policy rate at the central bank and the interest rates on government debts for various durations. In the short run, the policy rate was found to be the most influential variable on the determination of bond yields.

A long-term examination of these rates occurred using the standard IS-LM m and loanable funds framework. In much of the previous research conducted by other authors, the policy rate at the central bank was excluded. Since the findings of a strong linkage between interest rates at the central and commercial banks, and endogenous money were established in the first essay, the inclusion of this term should be critical in bond yield determination. When including the policy rate at the central bank, it accounted for much of the variation that previous literature concluded was due to fiscal deficits. This section however counter to previous researchers found the even in the long run monetary policy was critical in yield determination and fiscal policy only had effects in some circumstances.

Finally, there was a study of Okun's law. This examined the relationship between growth and unemployment, and ultimately, theorized a limit to economic growth. This found that there was indeed a relationship between the two. Allowing for a theoretical limit on the rate of growth, as the country has a somewhat fixed population in the short and medium term, thus, once all workers are employed and producing to their fullest, the real GDP cannot be increased past the levels where labour can produce goods. Therefore, in the extreme cases, there would be diminishing returns to running deficits at the government level. Additionally, it was found that as unemployment is

reduced, it will lead to the limit on the growth rate decreasing. This would continue to the point where all members of a population of a country are employed and has maximized individual's productivity. At that point, the growth rate would be limited to productivity improvements.

# Essay 3: Empirical Examination of a Comprehensive Open Economy Model for Canada

## *I. Introduction*

This is the third essay in this series examining the Alternative Monetary Model (AMM). The essay will be extending the empirical findings, and results of the previous essays, by analyzing the exchange rates and net foreign debt position.

The extension of the model will increase the number of equations to eight. This will be examined in the subsequent section, following the work of Smithin (2013; 2018). The new equations model the dynamics of the net foreign debt position, as well as the exchange rates. Further, the impact of a real interest rate rule, at the central bank, will be examined. There has been empirical work conducted on elements of the five equation AMM by various authors (Atesoglu 2004; Atesoglu and Smithin 2006; 2008; Kam and Smithin 2012) however there has not been a full analysis of the additional equations included in the eight equation AMM. The essay will expand this analysis to include the effects of these equations dealing with Canada's relationship with foreign markets. In the previous essays, it has been discussed that there is no substantive evidence from Bank of Canada's publications to support the claim that the central bank current policy tools are effective at maintaining its core mandates surrounding inflation and unemployment as summarised by Rowley and Spotton Visano (2004). This underlines that current neoclassical policy may not be the most effective tool for the Bank of Canada for setting monetary policy using nominal rates. However, one can find evidence supporting a transmission mechanism from the central bank's policy rate to the commercial bank's prime rates as demonstrated in studies by Hendry (1992) and by Clinton and Howard (1994). Further, in the previous essays, it was shown that the policy rate was instrumental in determining interest rates in the economy. This essay will explore the effect of a monetary policy that uses a real policy rate rule instead of the current traditional rules and finds the overall predicted effect on the economy.

Modelling the effects of policy on the economy is an overarching theme in these essays. This essay will examine historical economic events in Canada, and simulate these events using the AMM. Growth, inflation, interest rates, wages, and firms profit share will be compared between the simulated model outcomes, and what was experienced in the real world. This may give some insight into the ability of the AMM to simulate actual economic events. Furthermore, tests will

occur on historical economic events, examining the predicted effect of different policy responses, compared to the actual historical policies.

The essay will be structured in the following way. Section II will focus on the new equations included in the model and their theoretical bearings. Section III will examine the data used in this essay and outline the test that will be conducted in section IV. Section V will much like essay two, use numerical methods to estimate the theoretical change in the AMM with the expanded eight-equation model. Section VI will econometrically examine the empirical evidence of the accuracy of the predictions, and section VII will examine historical economic events in Canada's history using the AMM. Finally, Section VIII will hold some concluding remarks.

## *II. The Model and Theory Behind the Modifications*

### *II.i. The Model*

The eight-equation version of the AMM builds on work by Smithin (2013; 2018). In this, the model is extended to include equations modelling the net foreign debt position, exchange rates, and included a real interest rate rule (Collis, Paschakis and Smithin 2016). The model presented below incorporates findings from the first two essays. The results can be observed in equations (3.1) through (3.8).

(3.1) $$y = g - t + e_0 + e_1 k + e_2 q, \qquad 0 < e_1 < 1 \qquad (Economic\ Growth)$$

(3.2) $$k = a - r - w \qquad (Income\ Distribution)$$

(3.3) $$p = p_0 + p_1(r - r_{-1}) + w_{-1} - a \qquad (Inflation\ Determination)$$

(3.4) $$w = h_0 + t + h_1 y_{-1} + h_2 q, \quad 0 < h_1 < 1 \qquad (Real\ Wage\ Determination)$$

(3.5) $$r = m_0 + m_1 r_0 - (1 - m_1)p, \quad 0 < m_1 < 1, \ m_0 > 0 \qquad (Real\ Interest\ Rate)$$

(3.6) $$r_0 = \frac{r' - m_0}{m_1} + \left[\frac{1 - m_1}{m_1}\right] p \qquad (Stable\ Policy\ Rate\ Rule)$$

(3.7) $$b_{+1} = b + e_2 q + (r - y)b \qquad (Change\ is\ Net\ Foreign\ Debt)$$

(3.8) $$q_{+1} = q + r - r_f + z_0 + z_1 b \qquad (Exchange\ Rate)$$

The definitions of the variables in equation (3.1) through equation (3.8) remain consistent with the previous essays. However, some additional elements have been added to these equations.[1]

In addition to the variables described previously, this model includes new variables in the three additional equations. Equation (3.6) is an interest rate rule for the central bank. This rule fixes the real interest rates at the commercial banks for any given inflation rate. In this equation, the real target for interest rates at the commercial banks ($r'$) is incorporated into the model. This variable describes the chosen real prime rate that the central bank desires to maintain at commercial banks. The derivation can be observed in subsection II.ii.

Equation (3.7) expresses the dynamics of the balance of payments. This equation consists of the net foreign debt position ($b$) as a percentage of GDP. The assumption for this equation is that the currency is under a floating exchange rate regime, like in present day Canada. This equation aims to explain the dynamics of the debt invested in the country as compared to GDP. The position is being affected by both interest rates, and the national growth rate. If real interest rates are greater than economic growth, the country would experience an increase, as it becomes more indebted, when net trade is on average balanced. The derivation of this will occur in the following sub-section.

Finally, equation (3.8) represents the exchange rate dynamics. This equation consists of the real foreign interest rates, exchange risk premium, that accounts for possible fluctuations in exchange rates, and a term to model how sensitive the currency is to the net indebtedness. This equation describes the dynamics that are faced in the currency markets. This will be derived in the following sub-section.

[1] The variables will be defined as the following. The endogenous variable is the real rate of growth of GDP (y), the firm's markup (k), (p) the inflation rate, the natural logarithm of the real wage (w), and the real prime interest rates charged at commercial banks (r). The exogenous variables are total government spending as a percent of GDP (g), total government revenue as a percent of GDP (t), the natural logarithm of the real productivity per worker (a), the real interest rate target for the overnight rate at the central bank ($r_0$), and ($q$) is the exchange rates for the Canadian dollar. In this model, there are also four intercept terms. The intercept terms will be defined as the bank power to mark up over the central banks interest rates interest rates $m_0$ , the social political power of labour capturing all the real wage gains retained by labour $w_0$, The liquidity preference variable capturing the "bullishness" or "bearishness" in the financial markets $p_0$, and the animal spirits variables measuring confidence in the economy $e_0$.

*II.ii. Theory the Model Extensions*

This sub-section will be focusing on deriving the additional equations. Equation (3.6) contains a monetary policy rule for the central bank. In this equation is that there is a monetary policy rule that the central bank could follow, that aims to hold the real prime rate at the commercial banks constant. Equation (3.5) can be rearranged with the policy rates on the left-hand side as displayed in equation (3.9).

(3.9) $$r_0 m_1 = r - m_0 - (1 - m_1)p$$

Dividing through by $m_1$.

(3.10) $$r_0 = \frac{r}{m_1} - \frac{m_0}{m_1} - \frac{(1 - m_1)}{m_1} p$$

Substituting the Bank of Canada's desired interest rates at the commercial banks for the current rates, this equation turns into a function that relies on central bank's preferences. When simplified a real interest rate rule is achieved for the central bank, that holds the real interest rate at the commercial banks constant.

(3.11) $$r_0 = \frac{r' - m_0}{m_1} - \frac{(1 - m_1)}{m_1} p$$

This policy rule targets the real interest rates at commercial banks. Thus theoretically, if this rule was followed the real prime rate at the commercial banks may be targeted at any level the bank of Canada desires.

The second equation to be examined is debt dynamics. Equation (3.7) is derived from the balance of payments theory. Equation (3.12) is the balance of payments formula.

(3.12) $$OF = BOP = CA + KA$$

Equation (3.12) consists of the official financing ($OF$), which is commonly known as the change in the foreign exchange reserves, the balance of payments ($BOP$), and the capital ($KA$) and current accounts ($CA$).

In a floating exchange rate regime, the holding of foreign reserves is not necessary, and this is insignificant, relative to the other accounts. If assumed to be zero, then the equation simplifies to the following.

(3.13) $$OF = BOP = 0$$

(3.14) $$KA = -CA$$

Thus, the current account is the negative of the capital account. Hence, the total change in net foreign indebtedness can be derived from the current accounts. The change in net indebtedness can be represented by the following equation.

(3.15) $$B_{+1} - B = (IM - EX) + r'B$$

This equation considers the net indebtedness ($B$), imports ($IM$), Exports ($EX$), and average return of the net indebtedness ($r'$), adjusted for the returns from foreign assets, and returns of domestic liabilities. Equation (3.16) divides through by $Y$ to change terms in a percentage of GDP.

(3.16) $$\frac{B_{+1}}{Y} - b = (im - ex) + r'B$$

Defining the lower case letters as a percentage of GDP. Changing into consistent time periods, it simplifies to.

(3.17) $$b_{+1} - b = (im - ex) + (r' - y)B$$

If exports and imports are a function of the exchange rate, then the equation can be transformed into the following, where $\dot{q}$ is a transformed version of the exchange rate with an average of 0.

(3.18) $$\theta\dot{q} = im - ex$$

(3.19) $$b_{+1} - b = \theta\dot{q} + (r' - y)b$$

This may or may not lead to the country being in a sustainable position regarding net foreign debt. It could lead to two possible time paths based on the state of the economy. One, where the country is on a path to have the net foreign investment reach a stable level of net foreign assets to debt, or two, a situation where the country's foreign assets are increasing or decreasing to infinity. This is a static forecast, where interest rates, growth, imports, and exports are held constant. In the real world, these values are not constant, but this gives an idea of what path a country is on for any given period.

**Proposition 1:**

(3.20) $$if\ r' < y\ \lim_{t\to\infty} \frac{B_t}{Y_t} = \frac{im - ex}{r' - y}$$

**Proposition 2:**

(3.21) $$if\ r' \geq y\ \ and\ (im - ex) = (r' - y)\frac{B_t}{Y_t}\ \rightarrow \lim_{t\to\infty} \frac{B_{t+1}}{Y_{t+1}} = \frac{B_t}{Y_t},$$

$$(3.22)\ \ if\ r' \geq y\ \ and\ \ (im - ex) > (r' - y)\frac{B_t}{Y_t} \rightarrow \lim_{t\to\infty} \frac{B_{t+1}}{Y_{t+1}} = -\infty,$$

$$(3.23)\ \ if\ r' \geq y\ \ and\ (im - ex) < (r' - y)\frac{B_t}{Y_t} \rightarrow \lim_{t\to\infty} \frac{B_{t+1}}{Y_{t+1}} = \infty$$

Proposition 1 would be the stable path where the net foreign debt is converging to some level of debt/asset, compared to GDP. This assertion indicates that the net foreign assets/debt to GDP will reach some level, all things being equal, and the current account deficits will never lead to the country having its net foreign debt burden grow forever, in debt to GDP terms. This, however, is based on interest rates being smaller than growth rates. Under proposition 2 when real interest rates are higher than economic growth, the country is either building foreign assets of foreigners are building assets in the domestic market. This is not sustainable as these assets will continue to grow to infinity based on how large the current account surplus is. It is known that the net trade is not static and may depend on exchange rates. With a build in the net debt position, this may lead to changing net export values, affecting the level of net debt that would be expected to achieve as time goes to infinity. This brings up the question of how the exchange rates may react to by changes in net foreign debt as will be examined in the equation (3.8).

Examining how equation (3.8) is derived. Examining covered interest parity conditions, it implies the following formula.

$$(3.24)\qquad i - i^* = (E - F)/E$$

This approximately equals

$$(3.25)\qquad i - i^* = \ln E - \ln F$$

Equation (3.25) includes the current domestic nominal interest rates ($i$), the current nominal foreign interest rate ($i^*$), the spot exchange rate ($E$), and the future nominal spot exchange rate next period ($F$). The future exchange rate is not known and is estimated by the future rate. This forecast may contain some error; thus, the exchange rate next period will be equal to equation (3.26).

$$(3.26)\qquad \ln F = \ln E_{+1} + z$$

This incorporates risk or a premium ($z$) into the future contract. Substituting this into (3.21) and one achieves.

$$(2.27)\qquad i - i^* = \ln E - \ln E_{+1} + z$$

Moreover, in real terms.

(2.28) $$r' - r^* = q - q_{+1} + z$$

Where $z$ can be made up of factors that are from changes in net debt ($z_1$) and other factors ($z_0$).

(3.29) $$z = z_0 + z_1 b$$

Substituting (3.29) into (3.28) and rearranging.

(3.30) $$q_{+1} - q = r' - r^* + z_0 + z_1 b$$

Thus, this derives the equations in the eight-equation version of the AMM as presented in work by Smithin (2013; 2018) and, Collis, Paschakis, and Smithin (2016). This model incorporates a feedback look that will affect the net trade and exchange rates. Thus, the net foreign debt may influence exchange rates, and exchange rates may influence net trade, which influences net foreign debt. This will be examined in the following sections.

## *III. Data and Econometric Techniques*

This essay will use Canadian data obtained from Statistics Canada, and OECD resources. The data consist of 136 quarterly data points from the years 1981, to 2014. This maintains consistency with the previous essays. Additionally, Canada is an optimal country to examine the effects of trade and exchange rates. This is because Canada is a small open economy that relies heavily on international trade. Since Canada has a floating exchange rate and is relatively small, it should not have much effect on international interest rates. New variables were introduced into this model and are defined in the following paragraphs.

The current account balance represented the net impact of exports and imports for Canada. This data also allowed for the finding of the net external debt position, based on cumulative current account balances, along with the net investment position in 1981. Thus, allowing for the finding of the total indebtedness as a percent of GDP. The current account was in a range of a minimum of a deficit of 4.8%, to a surplus of 3.6% of GDP, with the net external debt ranging from a minimum of 12.1% indebted to a maximum of 46.2% of GDP. Finally, foreign interest rates have been added to this model. The interest rates used in this analysis is the real prime interest rates at commercial banks in the United States, as a proxy for the world interest rate. This real interest rate ranged from 0.34% to a maximum of 12.9%.

The use of Canada is essential. Frist this model relies on a floating exchange rate as a stabilizing factor. Thus, a country with a fix or adjustable peg currency systems would be unsuited for this analysis. This would eliminate many countries, for example, the countries that use the euro or

manipulate their currency. Second Canada is a small economy that has limited impact on world markets. This is an added benefit to testing this model, in comparison to a large country. Finally, the data is collected from an unbiased government agency, which eliminates the problem of data manipulation.

The econometric techniques used in the essay are following the same methodology as the previous essays. In order to achieve unbiased estimators, first difference regressions will be used. This will not restrict the intercept terms to one value, as the intercepts in this model are found to be nonstationary. Additionally, cointegration tests will be performed. The Johansen cointegration test, along with vector error correction modelling will determine if variables are converging in the long run and if a stable relationship exists. This is based on the finding of Engle and Granger (1987) on their research for testing a long-run stable relationship between non-stationary variables, and by the work of Gonzalo (1994) who proves the Johansen methods (Johansen 1991) is the preferred cointegration process. The equation that will be tested is presented in the next section.

## *IV. Empirical Tests and Results*

This section will econometrically test the equations introduced in the eight-equation model. Equation (3.6) is a rule for the central bank concerning monetary policy and not an economic relationship. Thus, the equation will not require econometrics. The Following analysis will focus on equation (3.7) and (3.8).

(3.31) $$b = b_0 + b_1 q + b_2 b_{-1} + (r - y)b$$

Equation (3.31) examines the relationship between the net external debt position, and the exchange rates, controlling for both the autoregressive component, the interest rates, and the growth rates. In order to find a short-term relationship between the variables, a first difference regression will be used, as displayed in equation (3.32). This equation has been modified to stay time consistent while correcting for any autocorrelation.

(3.32) $$\Delta b = b_{00} + b_1 \Delta q_{-1} + b_2 \Delta b_{-1} + (r - y)\Delta b_{-1}$$

Examining equation (3.31), the $b_2$ and $b_3$ coefficients will be unbiased estimates for both equation (3.31), correcting for stationary concerns. Furthermore $b_0$ may not be fixed to one value, as it accounts for the increase or decrease in the net debt position. The results of this first difference regression can be observed in table 3.1.

***Table 3.1: Estimation of Regression for the Net External Debt Position in Canada***

| **Independent Variables** | **Dependent Variable** |
|---|---|
| | $\Delta r$ ($R^2$=.65, Adjusted $R^2$=.64) |
| | Durbin-Watson Statistic 2.20 |
| $\boldsymbol{b_{00}}$ | .000154 (.00034) |
| $\boldsymbol{\Delta q_{-1}}$ | .0337** (.0124) |
| $\boldsymbol{\Delta b_{-1}}$ | .771** (.0508) |

*Notes: **indicates statistically significant result at a 5% level*

** indicates statistically significant result at a 10% level*

The independent variables account for 65% of the variation in the net foreign debt position. The exchange rate term in this regression was estimated to be positive suggesting, at least in the immediate period, after a currency appreciation, there is a relationship with a reduction in the net external debt position. This may be due factors that affect trade. Since this is one period, three-months in duration, the value of imports and exports may not have time to react to the change in currency valuations. This would lead to a short-term increase in the dollar amount of the exports and a decrease in the dollar amount of imports lowering net indebtedness. A second explanation could be there is a change in investment demand. This is at least a short run factor affecting the net external debt position. Theoretically, this variable is supposed to be equal to the negative of the $e_2$ term in equation (3.1) measuring the effect of the exchange rate on economic growth. That variable was found to be -0.064, thus when examining the error terms of these two coefficients, one lacks evidence counter to the assertion that these coefficients are the negative of each other. There is also autocorrelation present in the net external debt position. This indicates that the best predictor of the change in indebtedness next period, is the change this period. This finding, along with figure 3.1, the graph depicting net external debt position as a percentage of GDP for Canada, suggests that the country may have long periods in the building of, and the contracting of net indebtedness.

***Figure 3.1: Net External Debt Position as a Percentage of GDP and Exchange Rates in Canada***

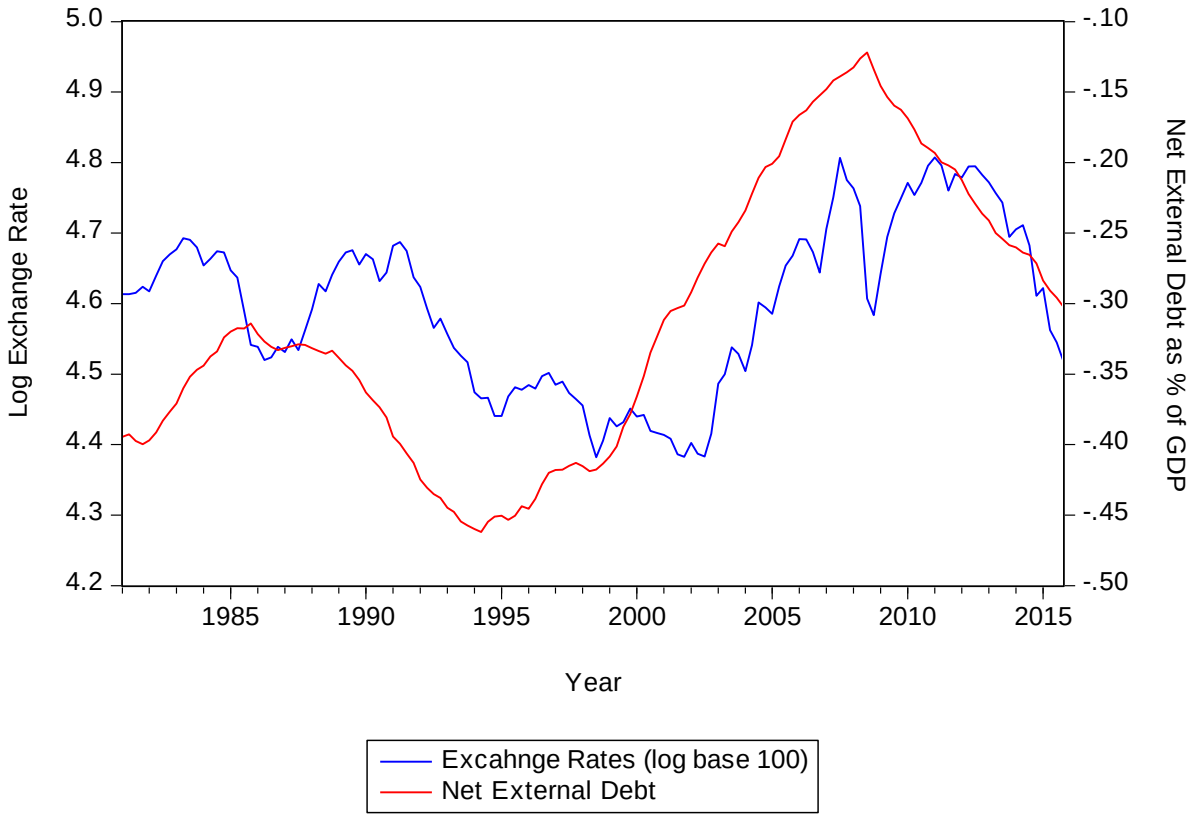



Figure 3.1 displays the net external debt position over four business cycles. First, before 1985, there was a building of assets in Canada. After about 1985 this position started to erode into the recession of the early 90's. Post 1996 the overnight interest rates at the Bank of Canada were relatively consistent, and economic growth occurred in Canada. This was associated with a reduction in the net indebtedness, until the recession of 2008. Since the recession, the indebtedness started to increase. From the figure, it appears this may be leading the exchange rates, which will be examined in the following paragraphs.

Equation (3.8) incorporates the exchange rates equation, displayed in equation (3.33). This is comprised of the change in the exchange rate, the differential between the real interest rates of Canada, and the foreign interest rate[2], the risk premium, and net external debt position term.

(3.33) $$q_{+1} = q + r - r_f + z_0 + z_1 b$$

Equation (3.33) will be tested in first difference to find the short-term relationship between variables, and account for any stationary issues. Equation (3.34) will be measured by regression.

[2] represented by the rate in the United States

(3.34) $$\Delta q = z_{00} + z_1 \Delta b_{-1} + z_2(\Delta r_{-1} - \Delta r_{f-1}) + z_3 \Delta q_{-1}$$

***Table 3.2: Estimation of the Regression for the Exchange Rates in Canada***

| **Independent Variables** | **Dependent Variable**<br>$\Delta$r ($R^2$=.11, Adjusted $R^2$=.10)<br>Durbin-Watson Statistic 1.95 |
|---|---|
| $\boldsymbol{z_{00}}$ | -.000213 (.00034) |
| $\boldsymbol{\Delta b_{-10}}$ | 0.843** (.39) |
| $\boldsymbol{\Delta r_{-1} - \Delta r_{f-1}}$ | 1 (----) |
| $\boldsymbol{\Delta q_{-1}}$ | 0.26 (.092)** |

*Notes:* ***indicates statistically significant result at a 5% level*
** indicates statistically significant result at a 10% level*
*Where z2 is assumed to be one as per the theoretical model*

The regression accounted for 11% of the variance in the exchange rates. This indicates that other factors affect the exchange rates outside of current interest rate differentials, net external debt, and autocorrelation. These factors may be more directly related to trade, macroeconomic events, speculation, or various other factors in the short run. All these factors will be encompassed in the $z_0$ term of equation (3.33) which will be discussed in the following paragraph. In this case, the net external debt did not cause a simultaneous reaction to the exchange rates. The optimal lag length was 10, suggesting like above, that exchange rates take some time to adjust to changes in the net indebtedness. The autocorrelation was significantly smaller in this case as well thus indicating that changes in exchange rates may not depend on previous changes, to the extent that there may be more volatility across periods. From this regression, one can bring the found coefficients back into equation (3.33) rearrange algebraically and find values for $z_0$. This term represents any long-term error that occurs when using the first difference coefficients and can be observed in graphical form in figure 3.2. This term could be thought of as the liquidity preference for a countries currency.

***Figure 3.2: $z_0$ The Theoretical Currency Risk Premium Across Time for the Canadian Dollar with a Zero Average.***


Figure 3.2 displays the currency "risk premium" the model predicts for Canada. This can be thought of as the inverse of liquidity preference for the country's currency, where higher numbers indicate greater demand for the currency and a higher value for the exchange rate. This value has had various trends. Until 1994 this rate was relatively constant. In this period, the United States, and Canadian monetary policy were statistically cointegrated as demonstrated in work by Atesoglu and Smithin (2008)[3]. This may have caused some stability in the country liquidity preference term, in the earlier period. This trend was broken in the late 90's, where there was a slight increase in this premium. This trend reversed in the late 90's and decreased until the recession of 2008. In this period the "risk premium" term went to approximately zero, in the great recession. Investors may have moved away from the Canadain dollar as the recession occurred and oil prices fell to low levels. This premium has begun to increase since 2008, although it remains at a lower level.

[3] Atesoglu and Smithin (2008) found to support Canadian and the United States monetary policy being cointegrated until 1988 where Canadian interest rates followed those on the United Sates. Post 1988 there has been more evidence of independence in Canadian monetary policy.

The relationship between the exchange rates, and the risk premium can be examined by the cointegration between the two. There is an expected relationship between these variables, given the risk premium accounts for the exchange rate in its calculations. When examining a Johansen cointegration test and vector error correction modelling one can examine if there is a leading or lagging relationship between the two variables. Table 3.3 holds the results of these two tests.

***Table 3.3: Johansen Cointegration Test Between the Exchange Rates and the Risk Premium***

| | |
|---|---|
| Johansen: Trace Statistic | 15.49** |
| Johansen: Max Eigenvalue | 14.38 |
| VECM: Δq Exchange Rates | -0.155**<br>(0.04) |
| VECM: Δz0 Risk Premium | -0.160**<br>(0.042) |

*Notes: **indicates statistically significant result at a 5% level*
*Optimal lag found by AIC was found at 1*

The test in table 3.3 indicates that there is evidence to support cointegration between the two variables, and the vector error correction modelling indicates that there is a bi-directional relationship, in the long run. This finding indicates that both the exchange rate and the risk premium is changing in the long run to maintain the relationship. This relationship states that over 30% of the disequilibrium between the two variables is corrected within a three month period.

Johansen cointegration test and vector error correction modelling (VECM) will examine the net external debt position and the exchange rates. This will be conducted to determine if there is any evidence of cointegration and if there is a leading relationship between these two variables. The results of this test can be observed in table 3.4.

***Table 3.4: Johansen Cointegration Test Between the Exchange Rates and the Net External Debt Position***

| | |
|---|---|
| Johansen: Trace Statistic | 17.61** |
| VECM: Δq Exchange Rates | -0.0731**<br>(0.019) |
| VECM: Δb Net External Debt Position | -0.0089**<br>(0.00425) |

*Notes: **indicates statistically significant result at a 5% level*
*Optimal lag found by AIC was found at 3*

These tests indicate that there is cointegration between the two variables. This means that they do tend to move simultaneously. Further, the vector error correction modelling indicates that both are adjusting to maintain a long run relationship. This finding indicates that both the exchange rates were found to influence the net external debt position, and the net external debt position will influence the exchange rates, in the long run. This lends evidence to support the model, as in the model both terms are interdependent. These findings will be used when simulating the Canadian economy in section V.

## *V. Numerical Methods of the Eight-Equation Alternative Monetary Model*

This section will examine simulations of the Canadian economy, using the eight-equation model of the AMM. Different policy decisions and economic events will be examined. The predicted effect these actions would have on seven economic variables will be determined. The model will consist of eight equations, as observed in equations (3.35) through (3.42).

(3.35) $y = e_0 + e_1 k + e_2 q + e_3(g - t) + e_4 y_{-1}$ $(Economic\ Growth)$

(3.36) $k = a - r_{-1} - w_{-1}$ $(Income\ Distribution)$

(3.37) $p = p_0 + p_1 r + p_2(w_{-1} - a) + p_3(p_{-1})$ $(Inflation\ Determination)$

(3.38) $w - t = h_0 + h_1 y_{-1} + h_2 q + h_3 w_{-1}$ $(Real\ After\ Tax\ Wage)$

(3.39) $r = m_0 + m_1 r_0 - (1 - m_1)p,$ $(Real\ Interest\ Rate)$

(3.40$a$) $r_0 = r'_{CB}$ $(Centearl\ Bank\ Rate\ Rule)$

(3.40$b$) $r_0 = \frac{r' - m_0}{m_1} + \left[\frac{1 - m_1}{m_1}\right] p$ $(Stable\ Policy\ Rate\ Rule)$

(3.41) $b = b_0 + b_1 q + b_2(r - y)b + b_3 b_{-1}$ $(Change\ is\ net\ debt)$

(3.42) $q = z_0 + z_1 b_{-1} + z_2(r - r_f) + z_3 q$ $(Exchange\ Rate)$

This system of equations encompasses all the aspects of the original AMM, with some augmentations. Note equation (3.40a) and (3.40b). Equation (3.40a) is a real interest rule that fixes the real interest rate at the central bank at the desired level. (3.40b) is a more restrictive rule that fixes real lending rates at the commercial banks to any desired level ($r'$). Thus, this rule removes real interest rate fluctuations at the commercial bank level. The former may be more realistic as

the central bank may not be able to control the commercial banks' lending rates, the latter would reduce volatility in the interest rate markets. In some circumstances, this would also reduce effects on outcome variables. In these simulations, the less restrictive rule will be examined, with the more restrictive rule being examined in select cases. Although either rules are not followed currently, these simulations are incorporating this to observe how the AMM predicts the economy would respond differently if the rule was implemented.

In order to analyze the simulations, values for the variables need to be determined and to determine the values of all the variables and coefficients; the simulations will use first quarter of 2013 as a reference point. Table 3.5 has the values for every variable, and coefficient needed for the simulations. Some were adjusted for the autocorrelation, thus maintaining consistencies from the econometrics to simulations.

***Table 3.5: Variables and Coefficients in the AMM for the Base Year 2013[4]***

| | | | |
|---|---|---|---|
| $e_0 = 0.04975$ | $e_1 = 0.403$ | $e_2 = -0.064$ | $e_3 = 1$ |
| $e_4 = 0.464$ | $p_0 = 0.6455$ | $p_1 = -0.77$ | $p_2 = 1$ |
| $p_3 = 0.582$ | $h_0 = 11.953$ | $h_1 = 0.216$ | $h_2 = -0.115$ |
| $h_3 = -0.247$ | $m_0 = 0.021$ | $m_1 = 0.881$ | $b_0 = -0.217$ |
| $b_1 = 0.0337$ | $b_2 = 1$ | $b_3 = .771$ | $z_0 = 3.678$ |
| $z_1 = 0.843$ | $z_2 = 1$ | $z_3 = 0.26$ | $t = 0.38$ |
| $g = 0.398$ | $a = 10.09$ | $r_f = 0.016335$ | $r' = 0.0153$ |
| $r'_{CB} = 0.004737$ | | | |

Variable $r'_{CB}$ is the target real interest rate for the bank rate at the central bank. Variable $r'$ is the central bank's target rate, for the prime rate at commercial banks. In these simulations, the rates used are the observed real bank rate at the Bank of Canada, and real prime rate at the commercial banks, for the first quarter of 2013. These will be the real rates that the central banks will ensure will be prevailing at the Bank of Canada, or commercial banks, depending on the simulation, by changing the policy rate in accordance to the stable rate rule of equation (3.40a) and (3.40b). The real policy rate will be maintained at -0.47% in the simulations unless specified, in which case the real prime rate at commercial banks will be maintained at a rate of 1.53%. This is not advocating

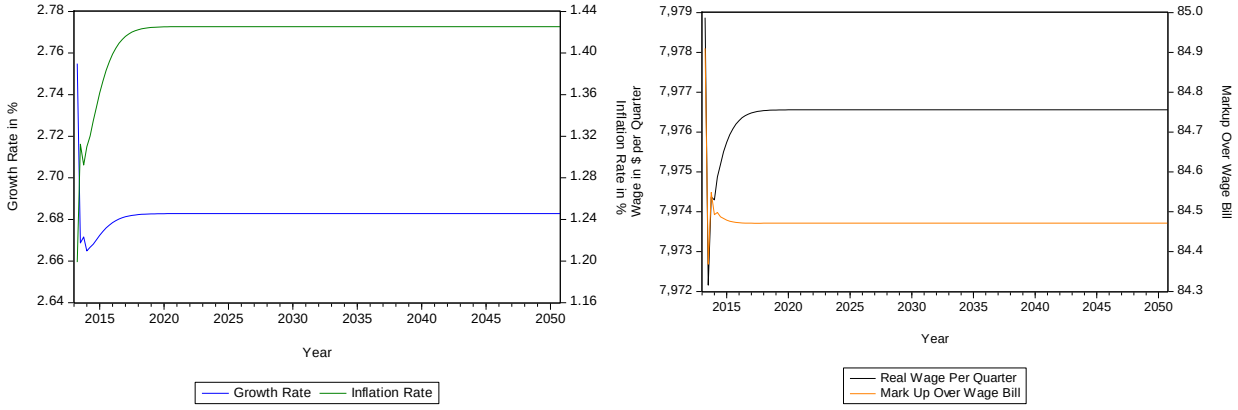
[4] Note that the only data needed from the real world is the net government deficit, productivity, and foreign interest rate. In this case, the foreign interest rate used is the prevailing prime interest rate at commercial banks in the United States. The rest of the observations were found in the econometrics and adjusted for consistency in both this essay and essay 1.

for this rate; however, this will be the rate that the comparisons will be made against, as it was the real rates experienced in the first quarter of 2013. The first simulation will establish a base line case and reference values.

There will be seven outcome variables that are of interest. These are the GDP growth rate ($y$), inflation ($p$), real prime rate ($r$), real quarterly wage in dollars ($w$), average aggregate firm markup ($k$), net external debt position ($b$), and the exchange rates ($q$). Note that the exchange rates have been normalized to one. This represents the Canadian dollar compared to a basket of world currencies, based on their trade weight with Canada. These simulations have the underline assumptions that all variables, confidence indicators, and coefficients remain unchanged from 2013 levels, unless otherwise indicated. This allows for the predicted effects of the AMM to be found for policies and economic events, as each policy will be simulated individually, and all other variables will be held constant.

Figure 3.3 is the baseline scenario, and adjustment paths for the variables to converge to there "steady state." Table 3.6 establishes reference values for comparison purposes. These outcome variables are approximately equal to both what is observed in the economy in the first quarter of 2013, and the values in the simulations of essay 2.

***Figure 3.3: Simulation of the Baseline of the Canadian Economy, Based on the level of Economic Variables from 2013***



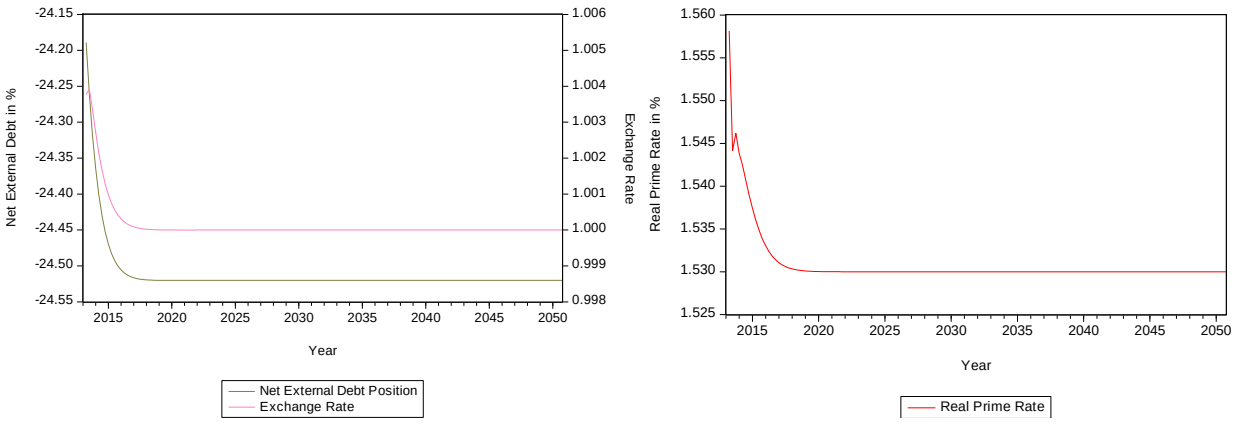



***Table 3.6: Values for Determined Variables in Baseline Simulation***

| | $y$ | $p$ | $r$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | 1.53% | $7,976 | 84.4% | -24.5% | 1.00 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

Table 3.5 displays the reference values used to find the predicted effects of policy decisions, as determined by the AMM. These will be compared to the other simulations that occurred in the previous essay, when applicable.

*V.i. Fiscal and Monetary Policy*

This sub-section will examine fiscal, and monetary policies. These are policies controlled by the government or government agencies. Thus, the government can respond to economic events by changing these policies. The policy changes that will be examined are austerity, tax reductions, a balanced budget reduction in the size of government, and a change in monetary policy.

The first policy to be examined is one of reducing the government's budget. This is commonly defined as austerity. In figure 3.4 one can observe the predicted effects of a 5% reduction in spending, at all levels of government. Thus, the government's budget is being reduced from 39.8% to 37.81% of GDP. Table 3.7 numerically displays the predicted changes. There is not a corresponding reduction in the tax rate. Thus, the government increases revenue moving from a deficit of 1.8% of GDP to, a surplus of 0.19% of GDP.

***Figure 3.4: Simulation of an Austerity Policy from Reference Values***

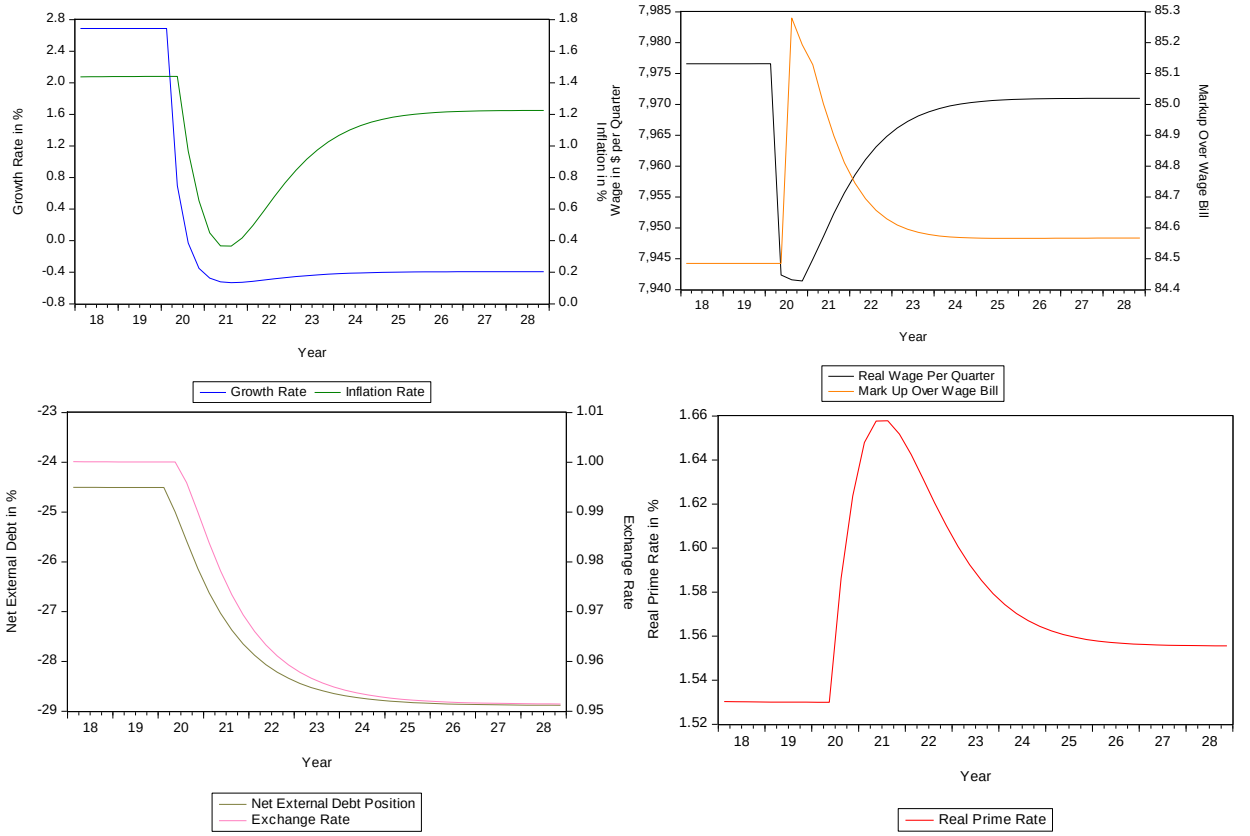



***Table 3.7: Numerical Comparison of an Austerity Policy to the Reference Values***

| | $y$ | $p$ | $r_0$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | 1.53% | $7,976 | 84.4% | -24.5% | 1.00 |
| Austerity | -0.39% | 1.23% | 1.55% | $7,970 | 84.6% | -28.9% | 0.95 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

From this simulation, one can observe the AMM predicts a policy of austerity causing both the growth and inflation rate to decrease. The country would become more indebted internationally, and the exchange rate would depreciate. The commercial bank interest rates were found to increase marginally. In this simulation, firms are marginally better off, with labour on average receiving a marginal reduction of real income. Thus, the AMM predicts that an austerity policy would reduce economic growth rates, while marginally having adverse effects on labour, and a positive effect on firms.

The next policy to be examined is a reduction in the tax rate. The tax rate will be reduced from 38% to 36.01%, thus being equivalent to the austerity policy previously examined. In figure 3.5 one can observe the results of this change, and in table 3.8 the changes are numerically depicted.

This is not paired with a reduction in government spending. Thus, this is an increase in the deficit from 1.8% of GDP, to 3.79% of GDP.

***Figure 3.5: Simulation of a Tax Reduction from Reference Values***

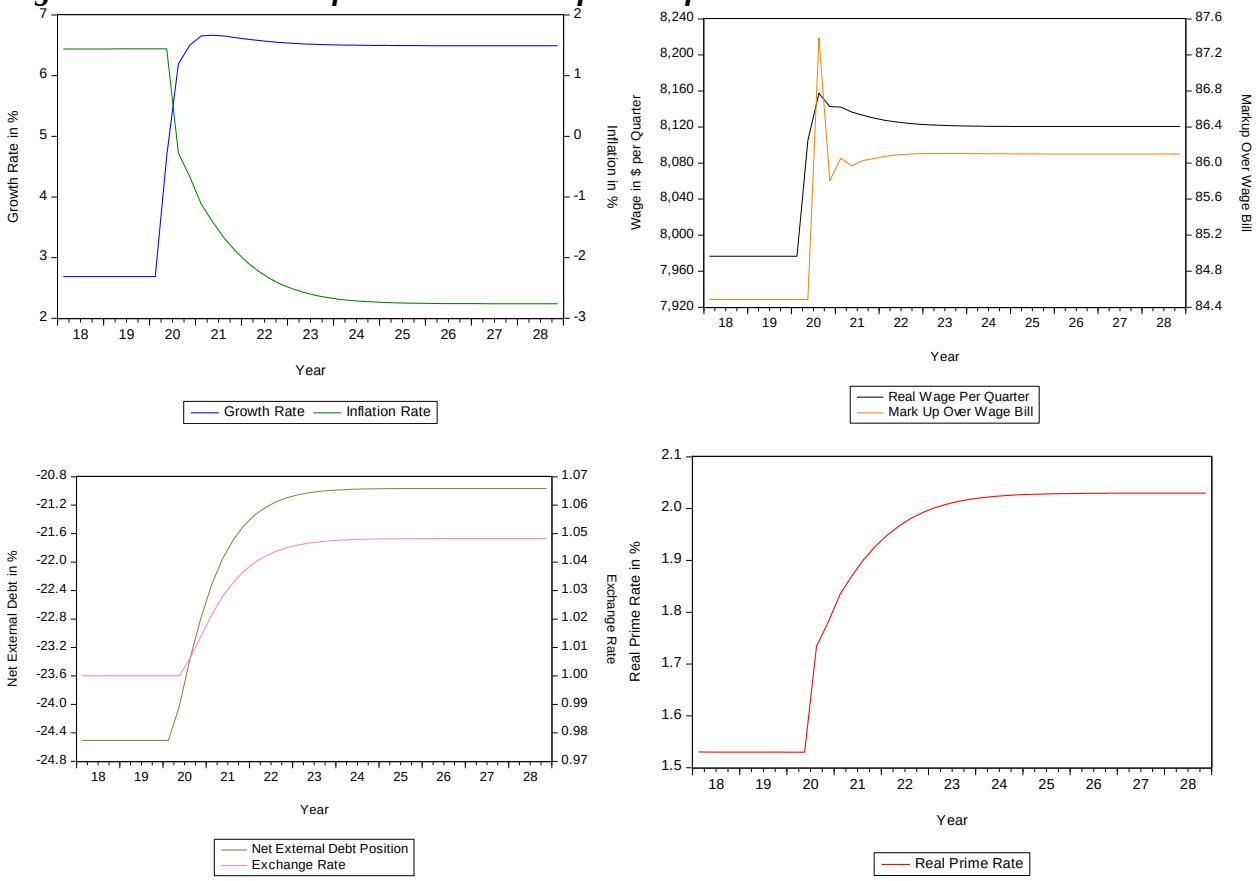



***Table 3.8: Numerical Comparison of Tax Reduction to the Reference Values***

| | $y$ | $p$ | $r$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | 1.53% | $7,976 | 84.4% | -24.5% | 1.00 |
| Tax Reduction | 6.45% | -2.75% | 2.03% | $8,120 | 86.1% | -20.9% | 1.05 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

This simulation displays why tax reductions may be a popular policy. The AMM predicts in these simulations that both firms and labour, benefit from these changes. The growth rate in the economy increased, and the inflation rate decreased. This caused an appreciation in the exchange rate, a decrease in the net external debt position, and the prime rate at commercial banks increased. This policy was not paired with a spending reduction; thus, this policy would expand the overall deficit. This would be thought of as a stimulus package, but with the expanding deficits, there may be sustainability concerns, as addressed in essay 2.

The balanced budget multiplier has been a contested issue in economics. Figure 3.6 and Table 3.9 demonstrates the balanced budget multiplier, as predicted by the AMM. The predicted balanced budget multiplier based on the analysis of the AMM is found to be negative. This simulation accounts for both the previous changes, a reduction in government spending by 5%, accompanied by an equivalent decrease in taxes. This would be an example of government reducing spending, and taxes at the same time. Note, however; this analysis does not include any benefit society may achieve from the creation of public goods.

***Figure 3.6: Simulation of the Combined Effects of a Reduction in Both Taxes and Government Spending from Reference Values***

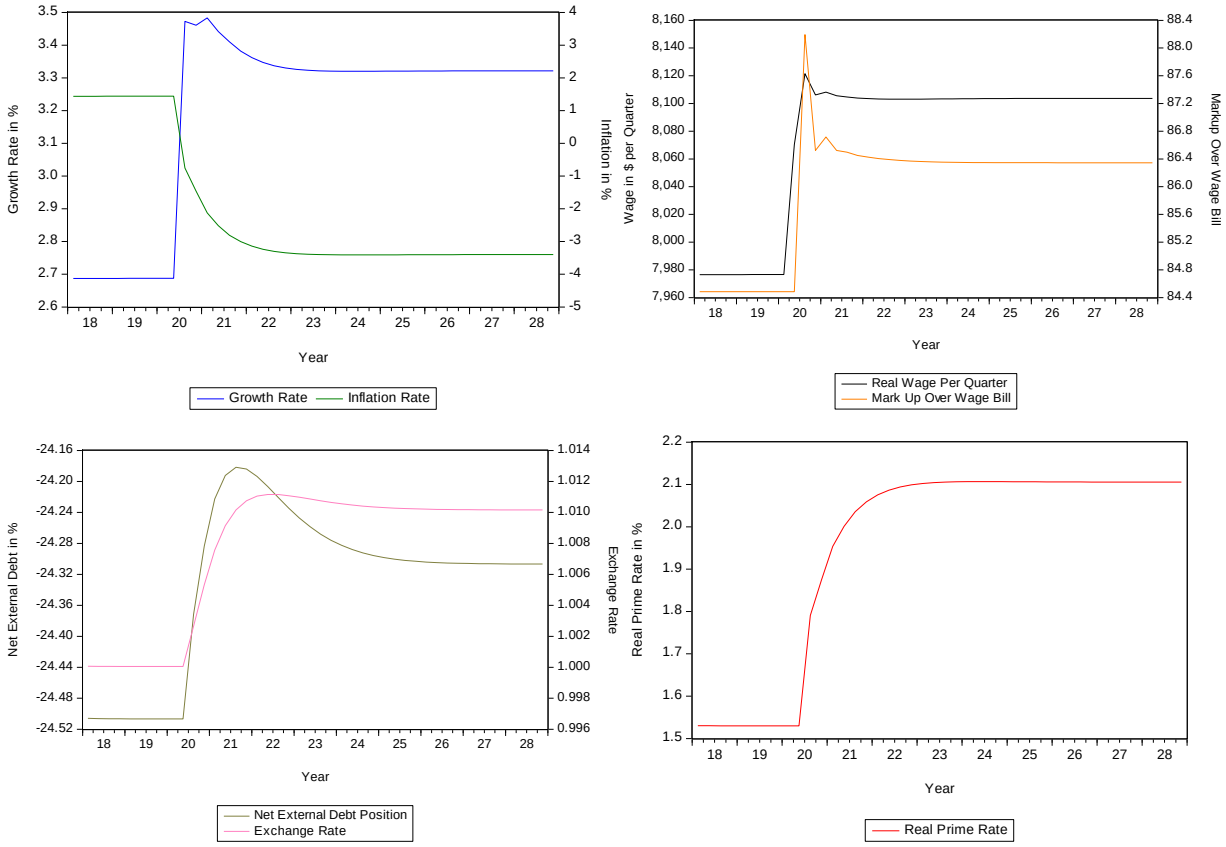



***Table 3.9: Numerical Comparison of a Reduction in Both Taxes and Government Spending to the Reference Values***

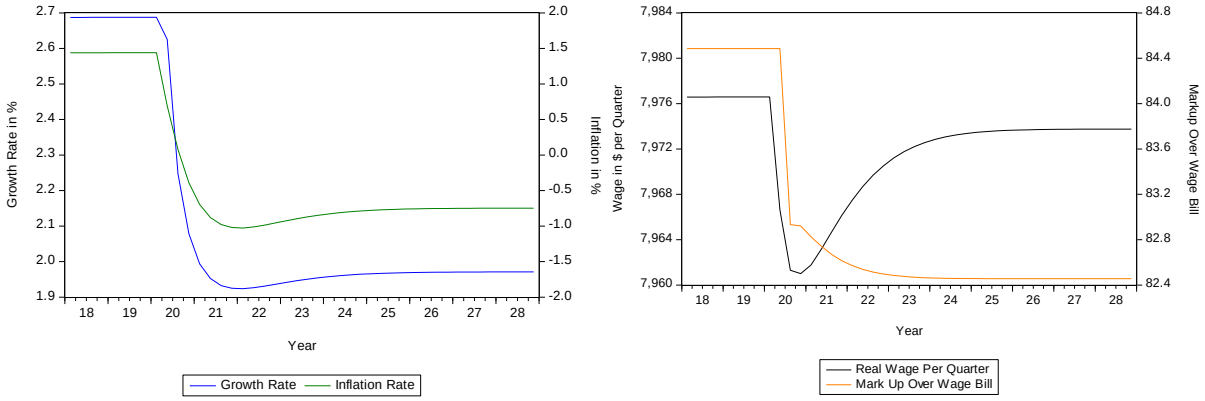
| | $y$ | $p$ | $r$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | 1.53% | $7,976 | 84.4% | -24.5% | 1.00 |
| Combine | 3.32% | -3.39% | 2.11% | $8,103 | 86.3% | -24.3% | 1.01 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

This simulation depicts the benefits of governments being well-organized, as predicted by the AMM. Both labour and firms benefit from a decrease in the size of government. Note this may not call for no government, as it does not consider the benefits that labour and firms may receive from public goods[5]. Reducing taxes and spending was predicted to benefit all agents in this model while increasing the growth rate and decreasing the inflation rate. Additionally, this caused the net external debt to be reduced and a slight appreciation in the exchange rate. The prime rate at commercial banks was found to increase in this simulation.

The final policy to be examined is a change in the target bank rate, at the central bank. Up to this point, this analysis assumed that a rule fixing the real policy rate at the central bank at negative 0.47% had been followed. In this simulation, the central bank will increase this target rate by 1% to 0.53%. Thus, this is simulating a tightening of the monetary policy. One can observe the simulation in figure 3.7 and table 3.10.

***Figure 3.7: Simulation of an Increase of the Policy Rate at the Central Bank from Reference Values***




[5] If government spending increases efficiencies, and productivity it may have secondary benefits to the country as displayed in the productivity simulation, in the following sub-section.

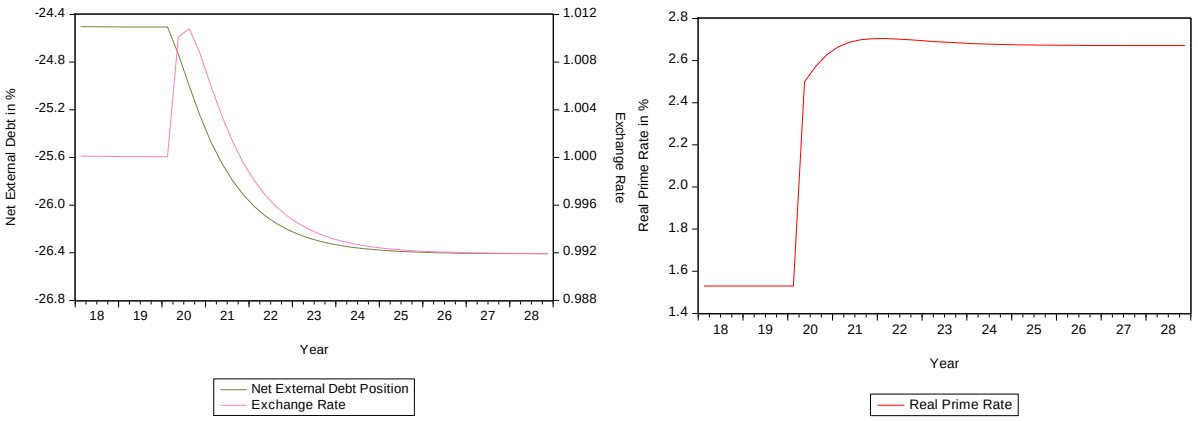



***Table 3.10: Numerical Comparison of an Increase of the Policy Rate at the Central Bank to the Reference Values***

| | $y$ | $p$ | $r$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | 1.53% | $7,976 | 84.4% | -24.5% | 1.00 |
| Target Rate | 1.94% | -0.75% | 2.67% | $7,973 | 82.4% | -26.7% | 0.99 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

The central bank is increasing the interest rates, a typical contractionary monetary policy to affect inflation may be found to have unintended consequences. It was predicted to reduce the growth rate, cause a small reduction in wages, and a reduction in the firm's markup. Thus, this makes both labour, and firms worse off. This increase in the real policy rate was predicted to increase the real prime rate at commercials bank by more than 1%. Inflation did indeed decrease; there was an adverse effect on the net external debt position and small depreciation of the currency. This depreciation of the currency was the overall effect of the policy. The initial effect was an appreciation of the currency, like more traditional models, but the AMM predicted this would reverse. This would lead to depreciation because of the secondary effects of slowing growth rates and an increasing net foreign debt position.

*V.ii. Labour, Productivity, and Commercial Banks*

This sub-section will examine labour power, productivity, and bank power by simulation using the AMM, to predict effects of changing relative powers in the economy.

The first transformation to be examined is an increase in labour power, which is a measure of labour's ability to achieve real wage gains. Labour power could be thought of being impacted by labour legislation, such as anti-union laws, or the minimum wage. The simulation will increase labour power by 5%. Thus, unions and labour would be able to achieve real wage gains. Note, this

change would be affecting the average power of labour. Thus some, but not all labour groups, may experience enhanced power. Additionally, this would be some action that gave more power to labour, with no effect on productivity. Figure 3.8 and table 3.11 will display this simulation.

***Figure 3.8: Simulation of an Increase in Labour Power from Reference Values***

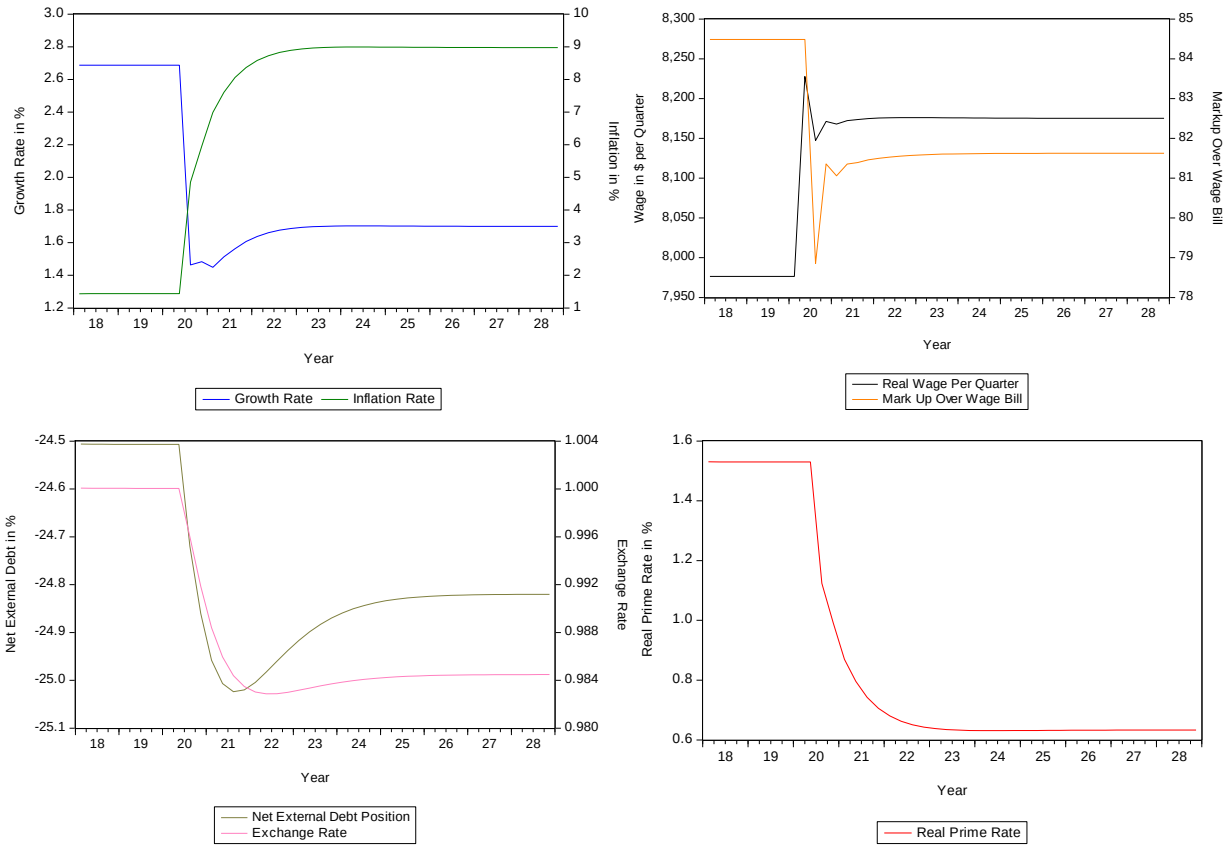



***Table 3.11: Numerical Comparison of an Increase in Labour Power to the Reference Values***

| | $y$ | $p$ | $r$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | 1.53% | $7,976 | 84.4% | -24.5% | 1.00 |
| Labour Power | 1.70% | 8.97% | 0.63% | $8,175 | 81.6% | -24.8% | 0.98 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

The increase in labour power, with no increase in productivity, was predicted to benefit labour, at the expense of other agents. It was predicted to cause a significant increase in real wages, but, reduced the growth rate, and the firm's markup. The inflation rate was increased, due to the cost-push inflation, and the commercial banks reduced their real interest rates. This would show why labour relation legislation is a controversial subject, as labour and firms have opposing interests.

This also caused a depreciation in the exchange rate and an increase in the net external indebtedness.

Productivity has been defined as GDP produced in the previous quarter, per working employee. The next simulation will examine a 5%, increase in productivity. Thus, every employed person is now producing 5% more than in the previous quarter. In the real world, generally, an increase in productivity occurs with the change in technology. A historical example of this would be the introduction of computers, the assembly line, or automation, which caused substantial gains in productivity over several periods. The simulation of this can be observed in figure 3.9 and table 3.12.

***Figure 3.9: Simulation of an Increase in Productivity from Reference Values***

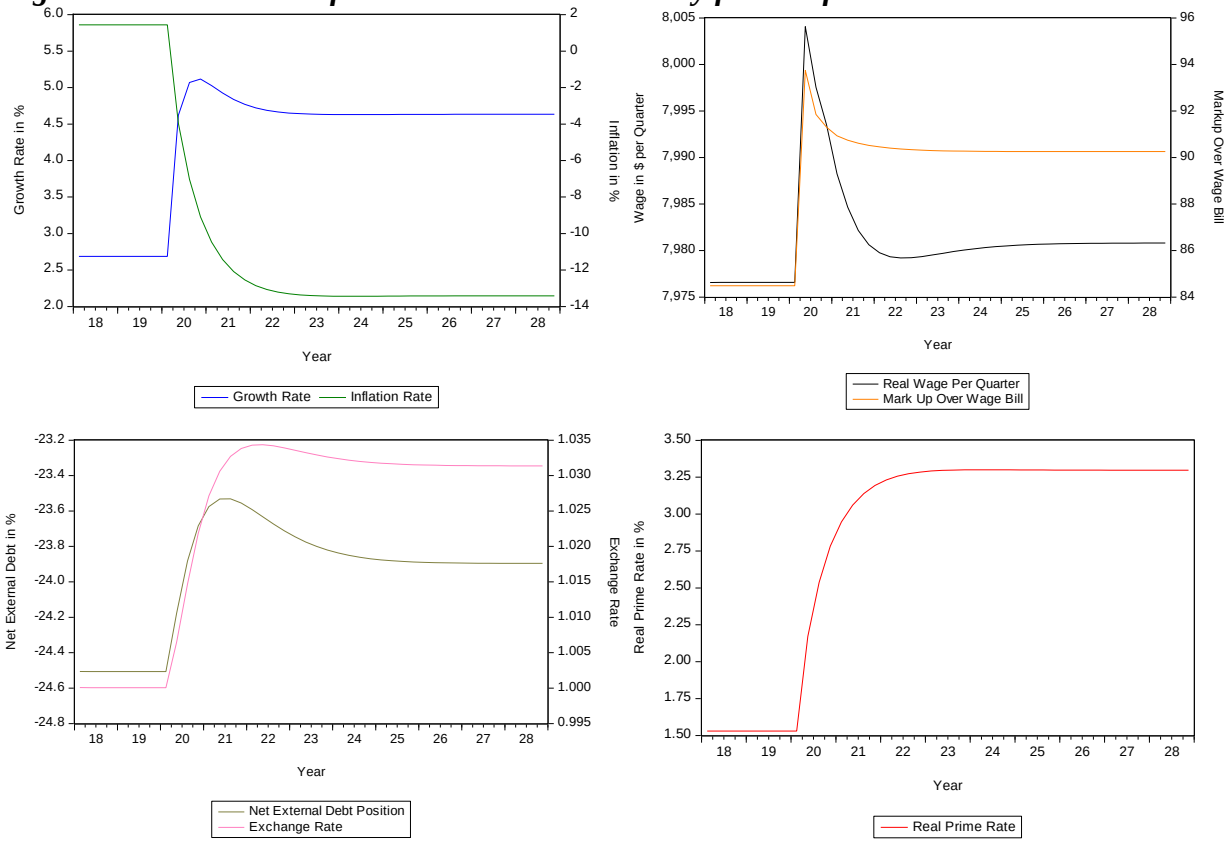



**Table 3.12:** ***Numerical Comparison of an Increase in Productivity to the Reference Values***

| | *y* | *p* | *r* | *w* | *k* | *b* | *q* |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | 1.53% | $7,976 | 84.4% | -24.5% | 1.00 |
| Productivity | 4.63% | -13.41% | 3.29% | $7,980 | 90.3% | -23.8% | 1.03 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

The increase in productivity can be observed to benefit all agents, but a more significant proportion of this benefit accrued to the firm, compared to labour. Contrasting the previous findings of labour power changes, where other than labour, all agents positions were reduced. This can demonstrate that if an increase in labour power were coupled with the increase in productivity, this would offset losses by the firms found in the labour power simulation. Additionally, that would keep the majority of the benefit of the productivity improvement, from accruing to only the firm. The productivity improvement also increases growth rates, decreased inflation, and the commercial bank increased their real prime interest rate. This also caused a decrease in the net indebtedness and an appreciation of the dollar.

The final simulation in this sub-section is an examination of the bank markup. This has previously been defined as the power of banks to increase their markup on the spread between the interest rates charged on loans and paid on deposits. This simulation will increase the markup of the banks by 1%, as displayed in figure 3.10 and table 3.13.

***Figure 3.10: Simulation of an Increase in the Banks Power from Reference Values***

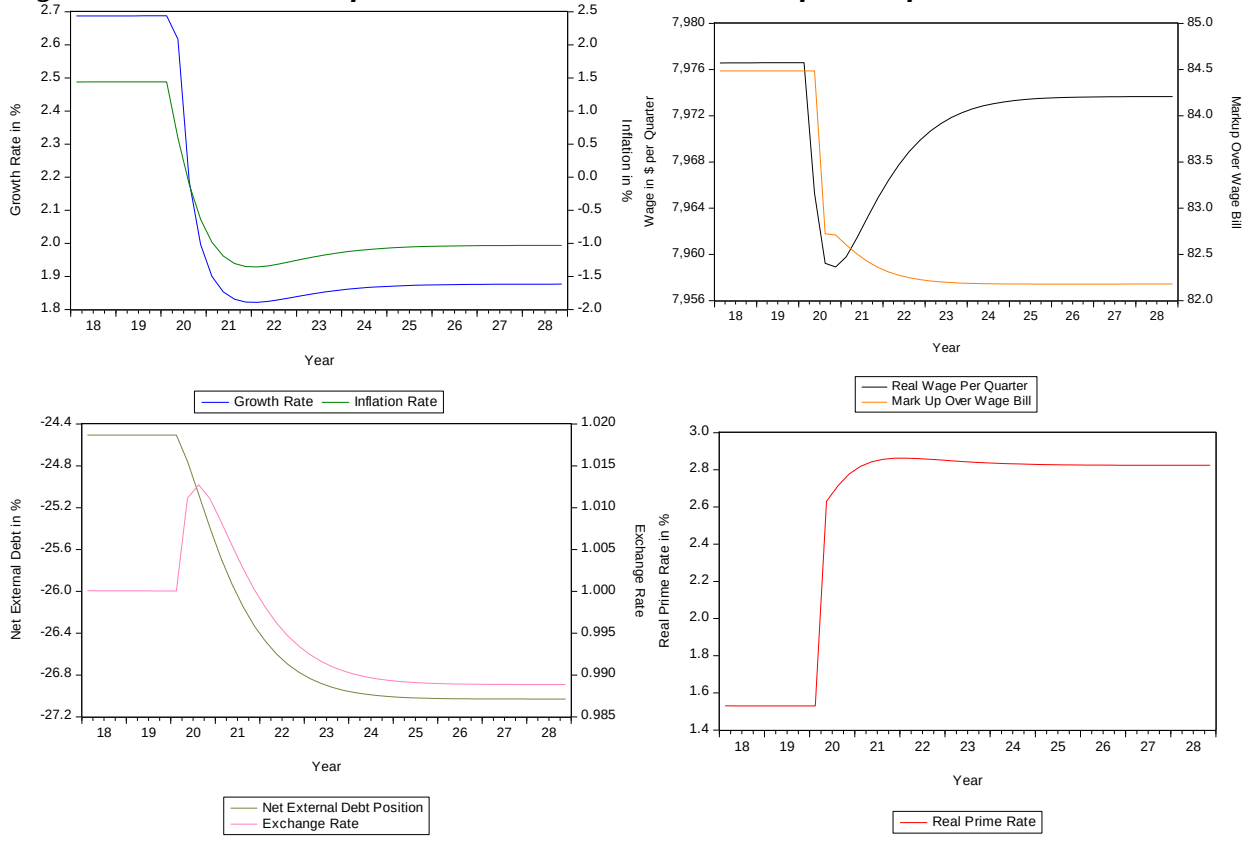


***Table 3.13: Numerical Comparison of an Increase in the Banks Power or Regulations on the Banking Sector to the Reference Values***

| | $y$ | $p$ | $r$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | 1.53% | $7,976 | 84.4% | -24.5% | 1.00 |
| Bank Markup | 1.87% | -1.03% | 2.82% | $7,973 | 82.2% | -27.0% | 0.99 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

In this simulation, an increase in the bank power variable increases the prime interest rate, while causing growth and inflation rates to decrease. Firms experienced the majority of the impairment, as profit shares decreased to a more considerable extent, in comparison to wages. Additionally, there was a notable increase in the net foreign debt position and a slight depreciation in the exchange rate. This is under the central bank rule that held the policy rate at a constant real level. A more restrictive rule could be examined, that holds the real prime rate constant at commercial banks, as observed in equation (3.40b). In order to achieve this, the central bank would have had to reduce the real policy rate to allow for the increased commercial banking interest rate spread. This real policy rate would hold the prime rate at commercial bank constant at 1.53%. This can be observed in figure 3.10a, and table 3.13a.

***Figure 3.10a: Simulation of an Increase in the Banks Power from Reference Values***

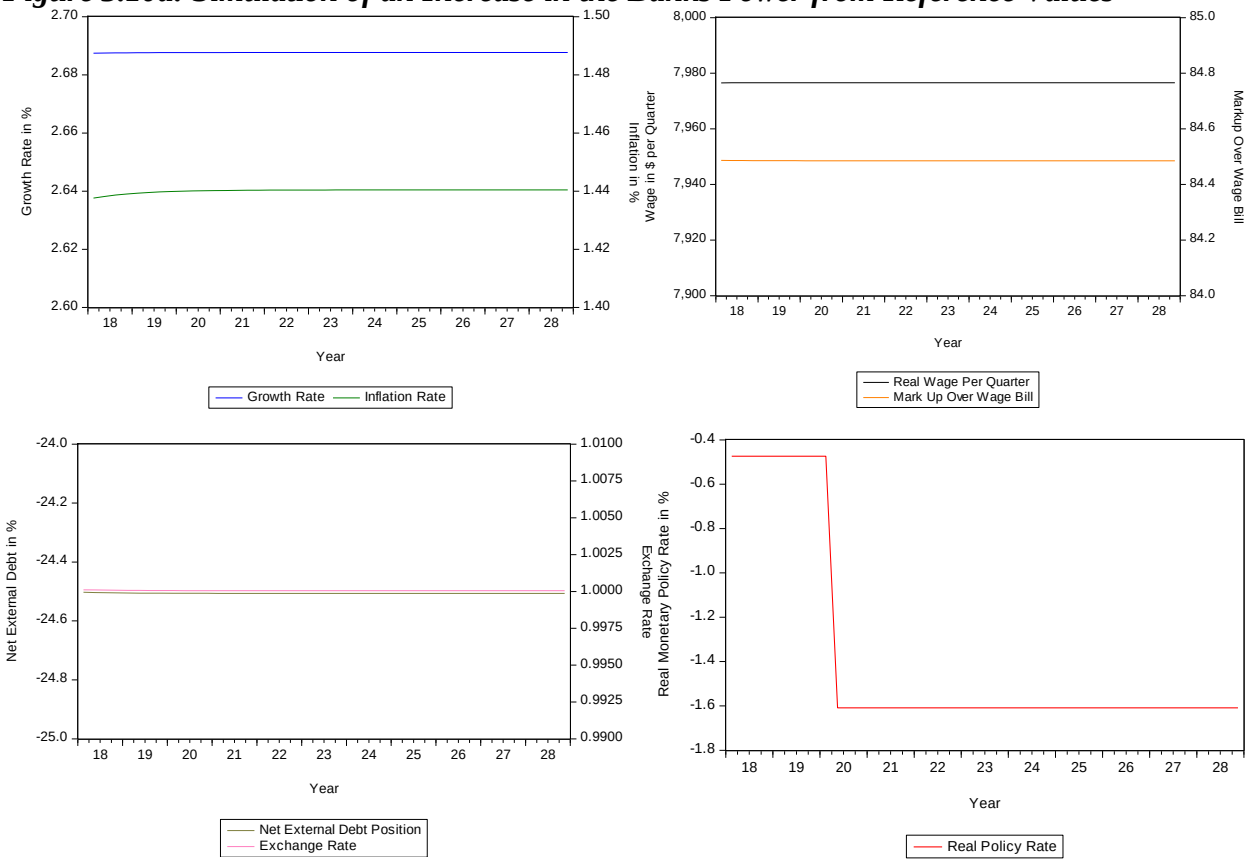


***Table 3.13a: Numerical Comparison of an Increase in the Banks Power or Regulations on the Banking Sector to the Reference Values***

| | $y$ | $p$ | $r_0$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | -0.47% | $7,976 | 84.4% | -24.5% | 1.00 |
| Bank Markup | 2.68% | 1.44% | -1.61% | $7,976 | 84.4% | -24.5% | 1.00 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

In this simulation, there was no change in the overall real economy. This is a function of the central bank following the rule of keeping the commercial real bank rate stable, by reducing the real policy rate, at the same time as an increase in the commercial bank's markup. This change in monetary policy made the change at the commercial banks not have any effect on any real variables. As observable in figure 3.10a when not followed, both labour, and firm's positions were negatively impacted, and economic growth was reduced. This demonstrates that the real prime interest rate rule may limit volatility in the prime rate at commercial banks and reduce fluctuations in the real economic outcome variables. If this rule were followed, regulations would also have a less distortionary effect, as the monetary policy would compensate the commercial bank's interest rate differentials, if any new costly regulations were enacted.

*V.iii. Changes in Confidence*

This sub-section will examine changes in economic variables dealing with confidence and outlook in the market. A method of estimating these variables were proposed and tested in essay 1. These variables are "liquidity preference," which can be thought of as confidence in the financial markets, and "animal spirits," a measure of future expectations.

The first simulation will examine a variation in the "liquidity preference." This variable theoretically relies on the demand and supply of money and can be thought of as an indicator of the bullishness or bearishness in the market. The simulation being examined in figure 3.11, and chart 3.14, is a small increase in the bearishness of the financial markets. Thus, an increase in the overall liquidity preference (the inverse term decreasing in value).

***Figure 3.11: Simulation of an Increase in Liquidity Presence (a Bearishness in the Financial Markets) from Reference Values***

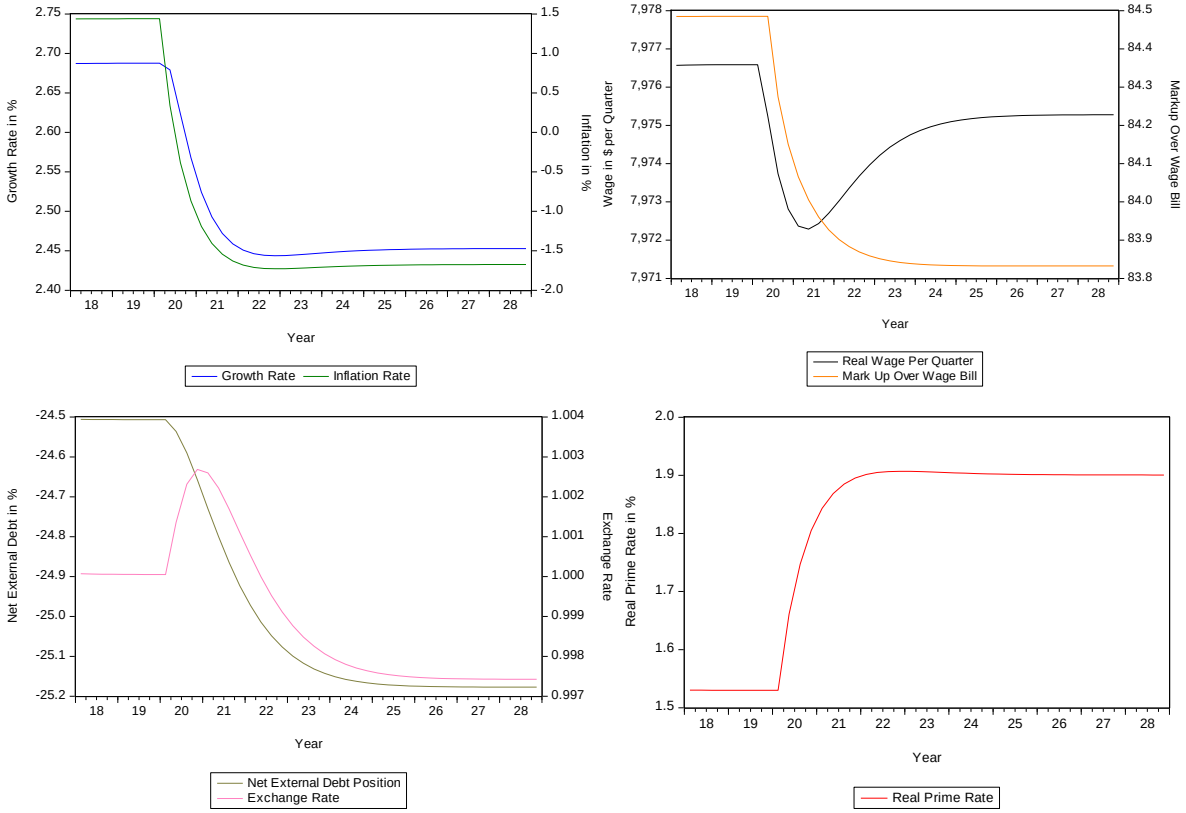



***Table 3.14: Numerical Comparison of an Increase in Liquidity Presence (a Bearishness in the Financial Markets) to the Reference Values***

| | $y$ | $p$ | $r$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | 1.53% | $7,976 | 84.4% | -24.5% | 1.00 |
| Liquidity Preference | 2.45% | -1.67% | 1.90% | $7,975 | 83.8% | -25.1% | 1.00 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

In this simulation, the decrease in liquidity preference caused the growth rate to decrease and the real prime interest rates to increase. Additionally, this loss of confidence had a marginally adverse effect on wages and the firm's markup. In this simulation, the country became more indebted, and no meaningful change occurred in the foreign exchange market. A decrease in liquidity preference is associated with bearishness in the financial markets. Even though there was no immediate effect on real variables, in the real world, this still caused a decrease in the growth rate. Thus, the financial markets had an adverse effect on the real economy. However, if a more restrictive monetary policy rule were followed, where the central bank implemented policies to hold constant the commercial banks real prime rate, as observed in equation 3.40b, this would

cause fewer distortions in the real economy. The effect of a decrease in liquidity preference, when the central bank is using a monetary policy rule of holding the commercial banks' prime rate at a constant of 1.53%, can be observed in figure 3.11a, and table 3.14a.

***Figure 3.11a: Simulation of an Increase in Liquidity Presence (a Bearishness in the Financial Markets) from Reference Values***

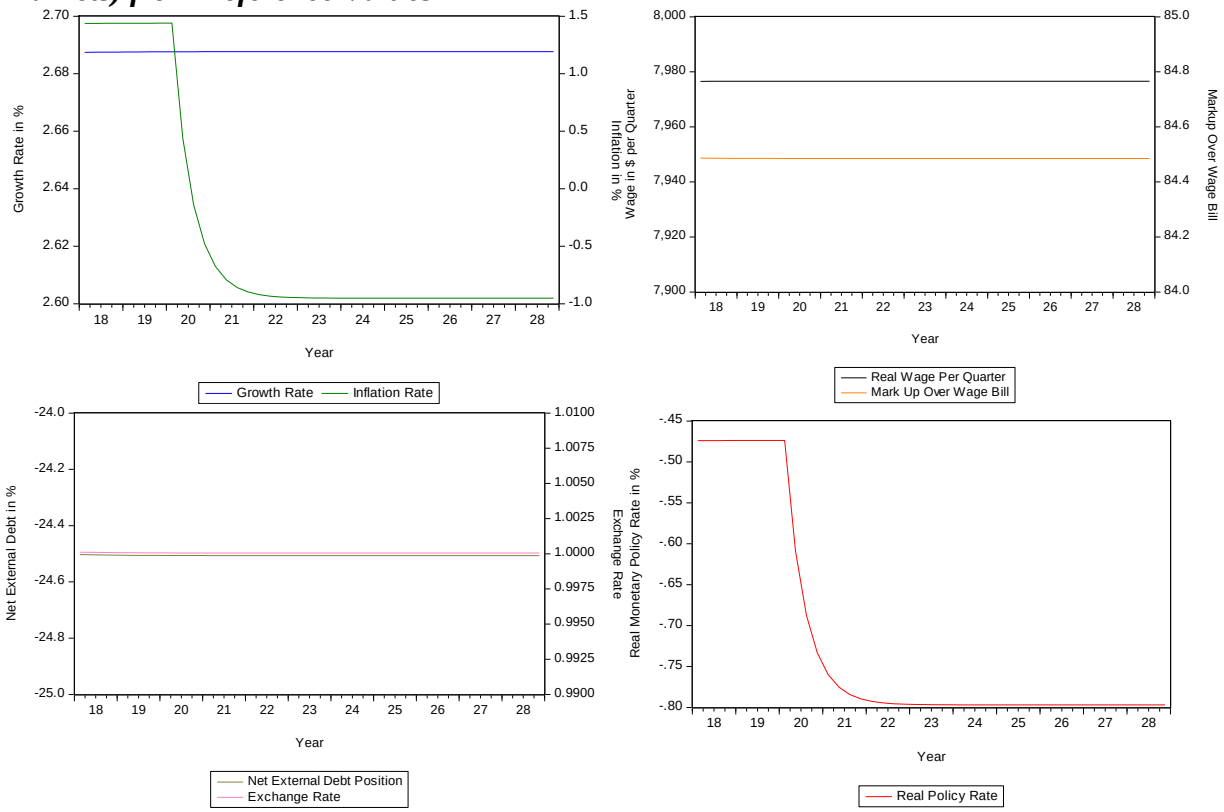



***Table 3.14a: Numerical Comparison of an Increase in Liquidity Presence (a Bearishness in the Financial Markets) to the Reference Values***

| | $y$ | $p$ | $r_0$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | -0.47% | $7,976 | 84.4% | -24.5% | 1.00 |
| Liquidity Preference | 2.68% | -0.95% | -0.80% | $7,976 | 84.4% | -24.5% | 1.00 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

Much like bank power, changes in liquidity preference now has muted effects on the economy, compared to the simulation in figure 3.11. This is because of the effects of the monetary policy interest rate rule. In this case, only inflation and the policy rate are affected by changes in sentiment in the financial market. Figure 3.11 displays the case where there is no interest rate rule, and it is observable that this change was simulated to have real effects, on real economic variables. It was found to reduce growth, wages, and firms profit markup. Thus, this interest rate rule, and limiting volatility in the real prime interest rates at commercial banks, as predicted by the AMM, insulate

the real economy from changes in financial markets. As confidence changes in financial markets, this does not change the real prime interest rates in the commercial banks, and thus, does not have effects on real growth rates, wages, or the firm's markup.

A second confidence indicator to be examined is "animal spirits." This variable has been theoretically defined as a measure of the confidence in the economy. Empirical evidence was found to support this claim in essay 1. In this simulation, a small reduction of the animal spirits variable was examined, and the simulation can be observed in figure 3.12 and table 3.15. A reduction in this variable would indicate that agents have a pessimistic view of the future economy, and therefore, firms would reduce their investment, while agents in the economy may increase their savings.

***Figure 3.12: Simulation of a Decrease in Animal Spirits (Confidence in the Economy) from Reference Values***

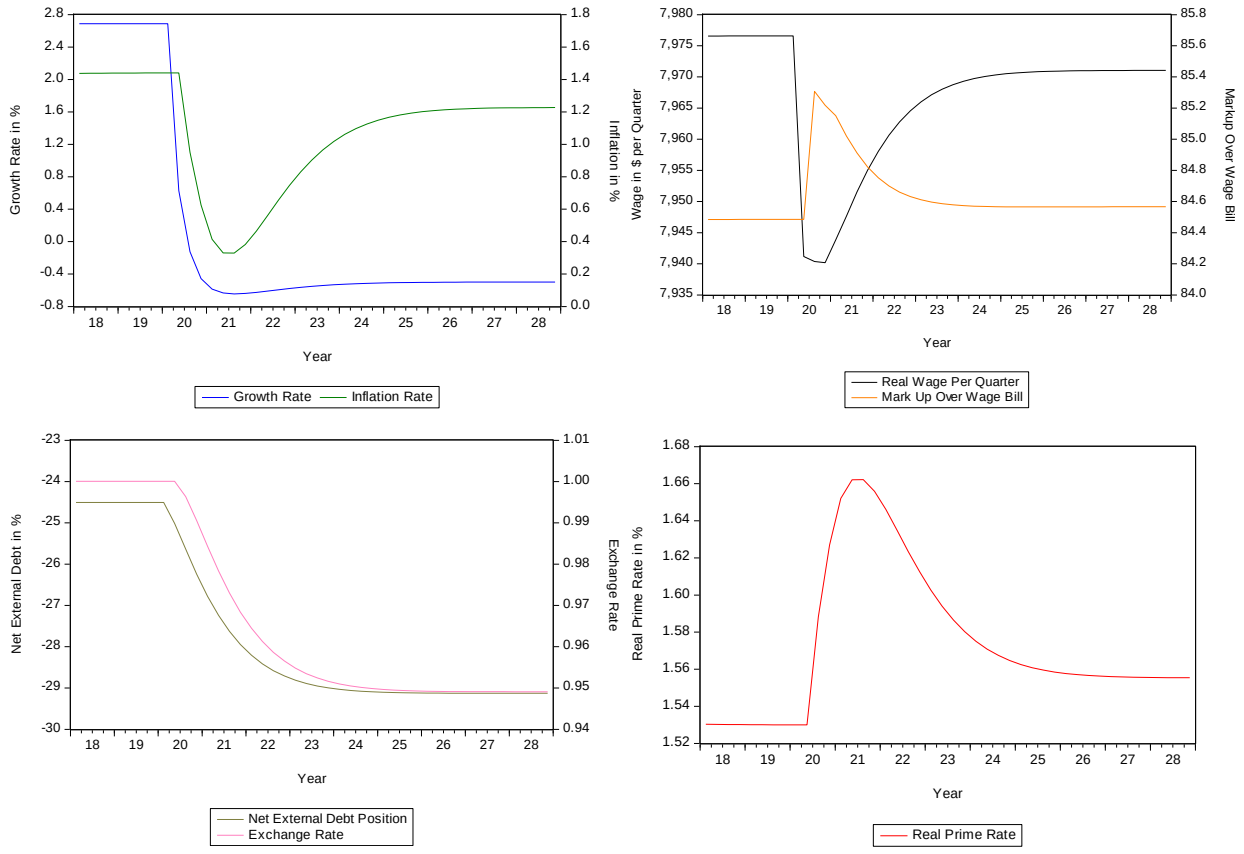


***Table 3.15: Numerical Comparison of a Decrease in Animal Spirits (Confidence in the Economy) to the Reference Values***

| | $y$ | $p$ | $r$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | 1.53% | $7,976 | 84.4% | -24.5% | 1.00 |
| Animal Spirits | -0.49% | 1.22% | 1.55% | $7,971 | 84.5% | -29.1% | 0.95 |

Note: rates are in real terms, the wage rate is in constant dollar for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

This modest reduction in the animal spirits was found to reduce economic growth. It also was simulated to have a negative impact on wages, and a slight positive effect on the firm's profit share. This simulation predicts that the inflation rate would decrease slightly, with net external debt increasing. This also was found to depreciate the currency. The pessimistic outlook for the economy was a self-fulfilling prophecy, with less investment, and more savings there was less economic activity. Thus, the AMM would predict the animal spirits term, that is psychological, would influence real economic variables, especially the growth rate of the economy.

*V.iv. Exchange Rates*

This section will use simulations to examine factors that have direct effects on the exchange rate. These will deal with the exchange rate "risk premium," which encompasses all other factors that effects exchange rates, and foreign interest rates.

The first simulation will examine a variation in the "risk premium." The "risk premium" could be thought of as the inverse of liquidity preference of the currency. Moreover, it would account for all macroeconomic effects on exchange rates from abroad, speculation, and other factors outside of the trade, and interest rates effects. This simulation will examine a substantial decrease in this risk premium. This significant decrease would be thought of as a bearish sentiment of the Canadian dollar, not caused by any changes in real economic, or confidence changes in the Canadian economy. This is observable in figure 3.13 and chart 3.16.

***Figure 3.13: Simulation of a Decrease in Currency Risk Premium from Reference Values***

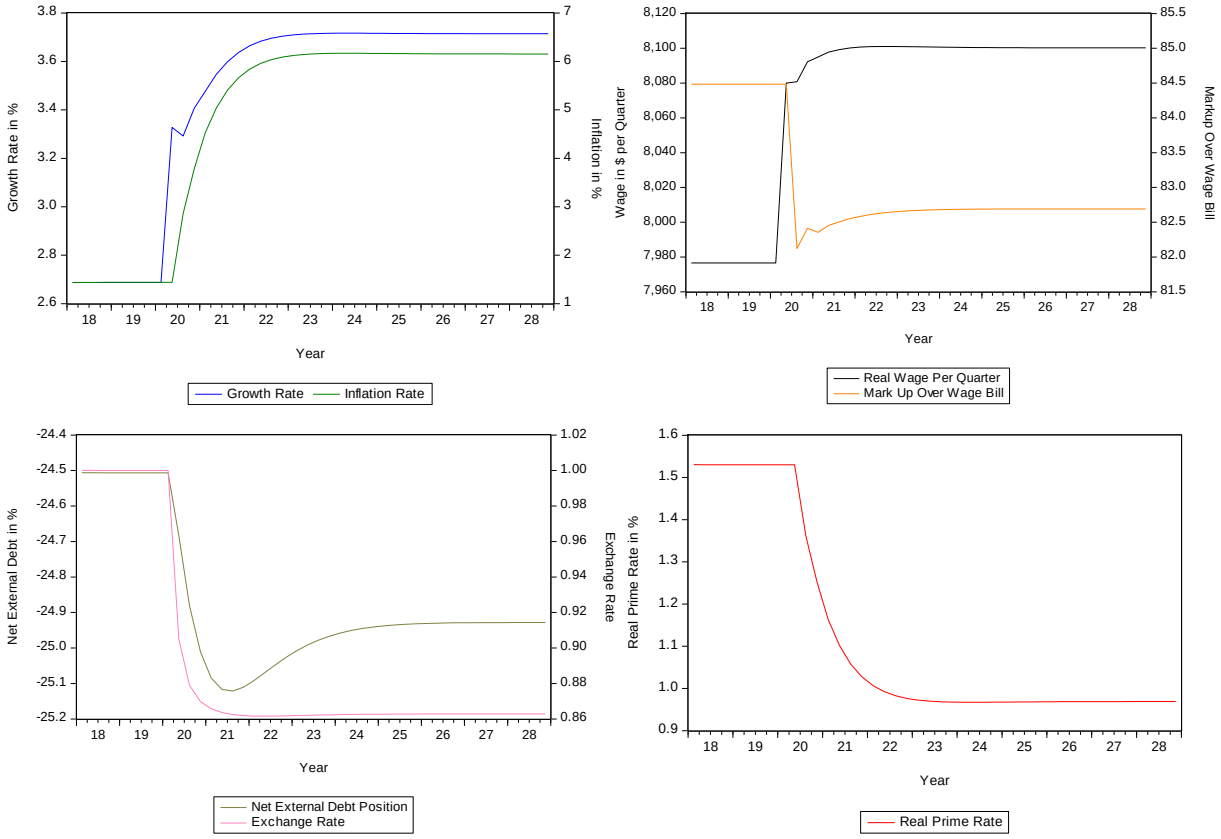



***Table 3.16: Numerical Comparison of a Decrease in Currency Risk Premium or Liquidity Preference of the Currency, to the Reference Values***

| | $y$ | $p$ | $r$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | 1.53% | $7,976 | 84.4% | -24.5% | 1.00 |
| Exchange Rates | 3.71% | 6.15% | 0.96% | $8,100 | 82.7% | -24.9% | 0.86 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

This decrease in the "risk premium" or bearishness in the Canadian dollar caused a depreciation of 14%. In this case, the depreciation of the dollar caused economic growth and inflation to both increases as Canadian produced goods become relatively cheaper. The prime interest rates on commercial bank decrease, further increasing the economic growth rate. Furthermore, this bearishness in the Canadian dollar increased wages in the domestic currency but had an adverse effect on the overall profit markup at firms. Note that the wages only increased in Canadian dollar terms. Regarding the foreign currency, the wages are lower, meaning labour becomes relatively less expensive with the depreciation in the dollar, compared to foreign labour costs. The net external debt position also increased. This simulation displayed that the AMM predicted that not

all groups are enhanced by a depreciation of the currency. Domestic firms that do not export would experience a reduction in their markup, without any compensation from the depreciated currency.

The final simulation will examine the effect of an increase in the foreign interest rates, with no change to the domestic interest rate policy. In this simulation, the foreign interest rate is increasing by 1%, from 1.6335% to 2.6335%. This could be thought of the action of the Federal Reserve increasing the federal fund's rate, causing the American banks to increase their prime interest rate. This is observable in figure 3.14 and table 3.17.

***Figure 3.14: Simulation of an Increase in Foreign Interest Rate from Reference Values***

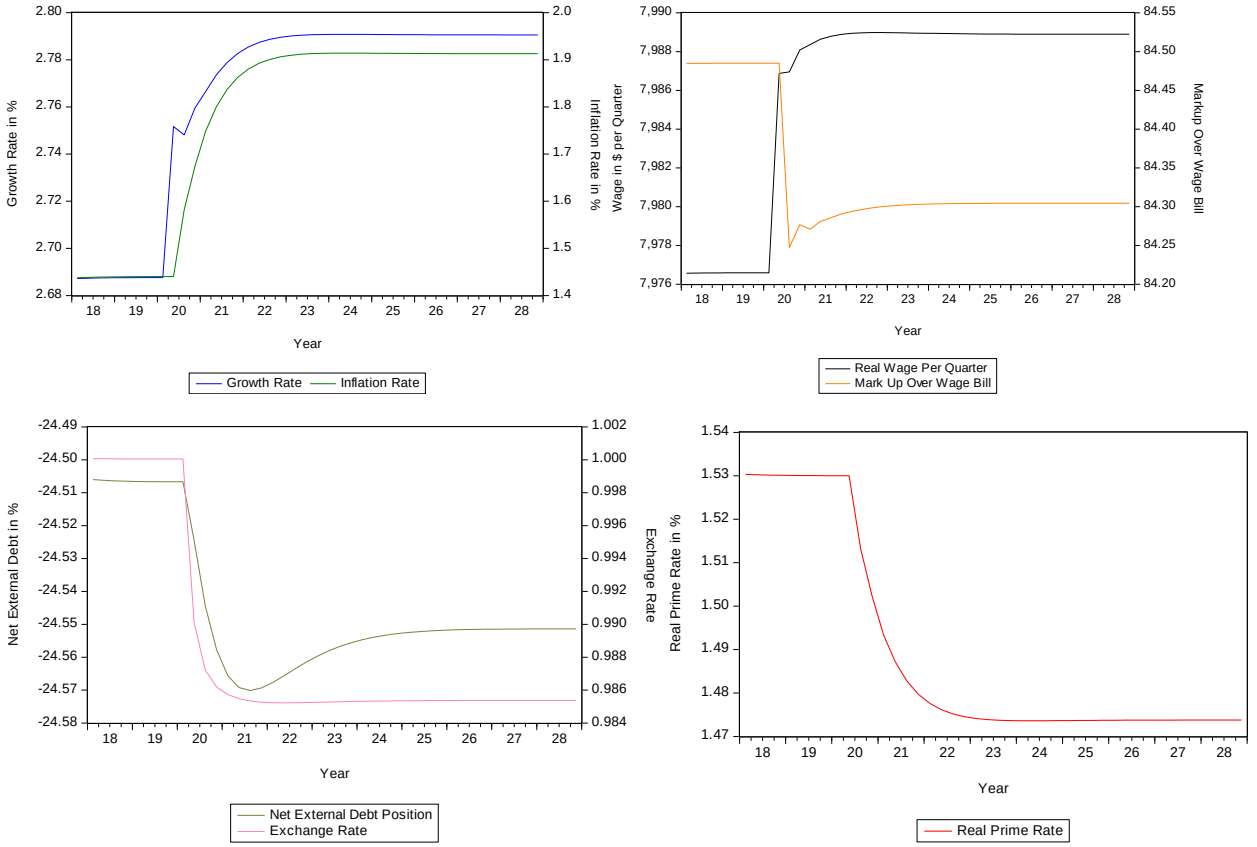



***Table 3.17: Numerical Comparison of an Increase in Foreign Interest Rate to the Reference Values***

| | $y$ | $p$ | $r$ | $w$ | $k$ | $b$ | $q$ |
|---|---|---|---|---|---|---|---|
| Reference Value | 2.68% | 1.43% | 1.53% | $7,976 | 84.4% | -24.5% | 1.00 |
| Foreign Interest | 2.79% | 1.91% | 1.43% | $7,989 | 84.3% | -24.5% | 0.99 |

Note: rates are in real terms, the wage rate is in constant dollars for average employee after tax for one-quarter of work, the markup is as a percentage of the wage bill

In this simulation, the increase in foreign interest rates would be predicted to have a beneficial effect on the growth rate, increase domestic inflation, and decrease the domestic real interest rates in Canada. This would benefit labour with marginally higher domestic wages, while marginally reducing the profit share of firms. There would be no significant change in indebtedness, and this action caused a depreciation of the domestic currency. If the interest rate changes were of a more significant magnitude, that would have a more considerable effect on the exchange rate and a more noticeable effect on both labour's wage and the firm's profit markup. Further, higher foreign interest rates were predicted to stimulate the domestic economy.

These simulations displayed the predicted effect of different policy changes when using the AMM. The simulations also explored two different policy rules at the central bank. The less restrictive policy rule where the central bank held the real policy rate constant, and a more restrictive rule where the policy rate was changed to maintain a constant real prime rate at commercial banks. These simulations made predictions on multiple outcome variables in the economy using the AMM, and the following section will examine if there is short-term econometric evidence to support the predicted simulations. This will examine the accuracy of the overall prediction and examine if there is evidence to support the directional changes in each event.

## *VI. Testing of the Predictions Found by Numerical Methods of the AMM*

### *VI.i. Summary of Numerical Method Predictions*

This section will examine the validity of the predictions made by the AMM. Throughout essay two and three there have been many predictions, made through numerical methods, of the effects different policies and events would have on five key economic variables. In each case, a prediction has been made about the effects on economic growth, inflation, interest rates, after-tax wages, and the profit markup at the frim level. Thus, in this section, the effects of the different policies and events will be econometrically tested. These policies and events that were previously tested were of government budget measures, monetary policy, labour power, productivity, bank power, liquidity preference, and animal spirits. The predicted effects, found in the previous simulations, can be observed in table 3.17. This table displays if a change in the variable is predicted to have a positive, or negative relationship with the outcome variables.

***Table 3.17: The Predicted Made Using the AMM Effects of the Policies and Economic Events on 5 Key Economic Variables***

| Variable | Growth | Inflation | Real Interest | Wages | Firm's Markup |
|---|---|---|---|---|---|
| **Taxes** | - | + | - | - | - |
| **Government Spending** | + | + | - | + | - |
| **Balanced Budget Multiplier** | - | + | - | - | - |
| **Monetary Policy: Bank Rate** | - | - | + | - | - |
| **Labour Power** | - | + | - | + | - |
| **Productivity** | + | - | + | + | + |
| **Bank Power** | - | - | + | - | - |
| **Liquidity Preference** | + | + | - | + | + |
| **Animal Spirits** | + | + | - | + | - |

*Note: Growth is the real economic growth rate in the economy, the real interest is the real prime rate at commercial banks, wages are the real after-tax wage per quarter per employed person, profit markup is the firm's markup over there labour cost*

Table 3.17 indicates the association each variable was found to have, through numerical methods. For example, in the case of the taxes, it was found that the AMM predicted a negative relationship between an increase in the tax rate and economic growth, the real interest rate, wages, and the firm's markup, and a positive relationship between an increase in the tax rate, and the inflation rate. In each case these relationships can be tested through econometric techniques, to examine if there is evidence to support the theoretical and simulated relationship when compared to real-world data.

*VI.ii. Econometric testing of the Relationships in the AMM*

This sub-section will separately empirically test each of these policies, and economic events, to find their relationship with the outcome variables in the AMM. This will indicate how accurate the AMM was at predicting the correct direction of changes in the outcome variables. In order to test this, the same Canadian data set will be used testing quarterly data, in a range from 1981 to 2015. This data was collected from Statistics Canada and OECD resources.

The simulations examined the immediate effects of the variables. Thus the short run effects must be tested empirically. This can be achieved with first difference regressions, examining relationships in the short run. Equation (3.43) gives an example of the following regressions that

will examine the relationships between the variables. In this equation, the term $\Delta DEP_n$ represent all the policies and events that will be tested. These will be tested on economic growth ($y$), inflation ($p$), the policy rate at commercial banks ($r$), after tax wages ($w-t$), and the profit markup ($k$). Furthermore, the following regressions will also need to account for necessary control variables to ensure the measure is accurately depicting these relationships. This is represented by the $CON_i$ term, which embodies multiple control variables, to enhance the precision of the overall findings. These control variables are composed of the other variables present in the model. Note that this test is not making any statements about causality or the magnitude of the effects, only examining if there is evidence to support if a measurable relationship between variables exists, when controlling for other factors in the model.

$$\Delta DEP_n = B_0 + B_1\Delta y + B_2\Delta p + B_3\Delta r + B_4\Delta(w-t) + B_5\Delta k + B_i\Delta CON_i \tag{3.43}$$

Tables 3.18 through 3.20 contains the regressions testing the relationship between the different policies/events, and the five outcomes that are of interest. This examination will attempt to find unbiased relationships, to isolate the direct, and indirect effects of these policy changes.

***Table 3.18: Regression of Government and Central Bank Policies and Economic Events and their Estimated Directional Effects on the Five Main Outcome Variables***

| Variable | Independent Variable (Economic Policies and Events) | | | | |
|---|---|---|---|---|---|
| Outcome Variables | Taxes (1) | Government Spending (2) | Budget Multiplier (3) | Monetary Policy (4) | Monetary Policy (5) |
| Intercept | -.0002(.0002) | -.0001(.0004) | .0005(.0005) | -.0001(.0002) | -.0013(.0006) |
| Growth | -0.19(.036)** | 0.43(.06)** | -0.12(.67)* | ---(---) | -0.10(.13) |
| Inflation | 0.14(.059)** | -0.27(.11)** | -0.29(.17) | ---(---) | -0.09(.19) |
| Real Interest | -0.15(.029)** | -0.006(.15) | -0.53(.25)** | 1.08(.029)** | ---(---) |
| Wage | -.048(.020)** | 0.31(.08)** | -0.51(.05)** | ---(---) | -0.75(.14)** |
| Firm Markup | -0.06(.022)** | -.17(.04) | -0.20(.04)** | ---(---) | -0.37(.06)** |
| Controls | YES | YES | YES | YES | YES |
| R squared | .945 | .74 | .64 | .93 | .48 |
| ADJ R squared | .941 | .72 | .61 | .93 | .44 |
| Durbin Watson | 1.58 | 2.33 | 1.91 | 2.26 | 1.93 |

*Note: Growth is the real economic growth rate in the economy, the real interest is the real prime rate at commercial banks, wages are the real after-tax wage per quarter per employed person, profit markup is the firm's markup over their labour cost. ** indicates a 95% confidence interval, * indicates a 90% confidence interval*

***Table 3.19: Regression of Labour Power, Productivity, and Bank Power, and their Estimated Directional Effects on the Five Main Outcome Variables***

| Variable | Independent Variable (Economic Policies and Events) | | | | |
|---|---|---|---|---|---|
| Outcome Variables | Labour Power (6) | Labour Power (7) | Productivity (8) | Bank Power (9) | Bank Power (10) |
| Intercept | -.0001(.0002) | .0017(.0009) | 0.0001(.0006) | .00008(.0001) | .00002(.0002) |
| Growth | ---(---) | -0.03(.11) | 0.33(.057)** | ---(---) | -0.038(.046) |
| Inflation | ---(---) | 0.344(.16)** | -0.27(.009)** | ---(---) | 0.096(.068) |
| Real Interest | ---(---) | -0.04(.019)** | 0.024(.011)** | 0.063(.028)** | ---(---) |
| Wage | 1.10(.044)** | ---(---) | 0.53(.048)** | ---(---) | -0.06(.048) |
| Firm Markup | ---(---) | -0.23(.053)** | 0.098(.031)** | ---(---) | -0.18(.023) |
| Controls | YES | YES | YES | YES | YES |
| R squared | .97 | .88 | .82 | .11 | .11 |
| ADJ R squared | .97 | .87 | .81 | .07 | .04 |
| Durbin Watson | 1.47 | 1.50 | 1.51 | 2.42 | 2.43 |

*Note: Growth is the real economic growth rate in the economy, the real interest is the real prime rate at commercial banks, wages are the real after-tax wage per quarter per employed person, profit markup is the firm's markup over their labour cost. ** indicates a 95% confidence interval, * indicates a 90% confidence interval*

***Table 3.20: Regression of Animal Spirits, and Liquidity Preference, and their Estimated Directional Effects on the Five Main Outcome Variables***

| Variable | Independent Variable (Economic Policies and Events) | | | |
|---|---|---|---|---|
| Outcome Variables | Liquidity Preference (11) | Liquidity Preference (12) | Animal Spirits (13) | Animal Spirits (14) |
| Intercept | .001(.0006) | .0002(.0005) | .00008(.0006) | -1.005(.0007) |
| Growth | ---(---) | 0.27(.09)** | 0.63(.07)** | ---(---) |
| Inflation | 1.02(.17)** | ---(---) | ---(---) | -1.16(.27)** |
| Real Interest | ---(---) | -1.03(.078)** | ---(---) | -1.02(.13)** |
| Wage | ---(---) | -0.27(.05)** | ---(---) | 0.03(.05) |
| Firm Markup | ---(---) | 0.15(.058)** | ---(---) | -020(.073)** |
| Controls | YES | YES | YES | YES |
| R squared | .60 | .70 | .73 | .65 |
| ADJ R squared | .58 | .68 | .72 | .62 |
| Durbin Watson | 1.82 | 2.12 | 2.12 | 2.45 |

*Note: Growth is the real economic growth rate in the economy, the real interest is the real prime rate at commercial banks, wages are the real after-tax wage per quarter per employed person, profit markup is the firm's markup over their labour cost. ** indicates a 95% confidence interval, * indicates a 90% confidence interval*

Table 3.18 through table 3.20 estimates the relationships between government policies, and economic events, compared to the five main outcome variables. The main finding in this section is examining if any short-run relationship is present when controlling for a variety of other effects. This analysis will be focusing on if the direction of the predicted effects, found econometrically, change in the same direction as the simulated effects, rather than examining relative sizes,

magnitudes, or causal relationships, to examine if there are any inconsistencies with the simulated results. Table 3.21 summarizes the information, from both the numerical method simulation and the econometrics, to examine the accuracy of the theoretical predictions.

***Table 3.21: Comparison of the Directional Relationship from Simulation, compared to the Directional Relationship Found Econometrically***

| Variable | Growth | Inflation | Real Interest | Wages | Firm's Markup |
|---|---|---|---|---|---|
| **Taxes** | - | + | - | - | - |
| **Government Spending** | + | + | - | + | - |
| **Balanced Budget Multiplier** | - | + | - | - | - |
| **Monetary Policy: Bank Rate** | - | - | + | - | - |
| **Labour Power** | - | + | - | + | - |
| **Productivity** | + | - | + | + | + |
| **Bank Power** | - | - | + | - | - |
| **Liquidity Preference** | + | + | - | + | + |
| **Animal Spirits** | + | + | - | + | - |

*Note: Growth is the real economic growth rate in the economy, the real interest is the real prime rate at commercial banks, wages are the real after-tax wage per quarter per employed person, profit markup is the firm's markup over their labour* cost. Dark green indicates same direction change at a <90% confidence, light green indicates same direction change at a >90% confidence, dark red indicates different direction change at a <90% confidence, light red indicates different direction change at a >90% confidence.

Examining table 3.18 one can observe that the tax policy was estimated to have associations with all outcome variables, as theoretically hypothesized. That is a negative relationship with growth, real interest rates, wages, and the firm's markup, and a positive association with inflation. All terms were found to be statistically significant. When examining the relationship between government spending, and the outcome variables there was one inconsistency found. The inconsistency was found in the directional change in the inflation rate. In this case, inflation was found to have a negative relationship in the short term, where the relationship between government spending and inflation, in the simulations, was found to hold a positive relationship. This may indicate that more research is needed on the relationship between government spending and inflation.

The government budget multiplier's test was conducted by summing the spending and revenue, as a percent of GDP. The only inconsistency found was the inflation indicator. This inconsistency was affected by the previous finding of the effect of government spending, but in this regression, the inconsistency was found not to be statistically significant. When examining the bank rate, it is necessary to estimate it in two stages, to account for the significant correlation between interest rates at commercial banks, and the central bank. The second stage of this regression examines the indirect effects of the interest rate mechanism, on the other outcome variables. In this, the findings were consistent with the theory, and numerical methods findings. Note, however, growth and inflation were related in the direction as the AMM would theoretically predict, but these findings were not statistically significant at a 10% confidence interval.

Table 3.19 explores the relationship between labour power, austerity, and the bank's power with the five primary outcome variables. Since labour powered measures the real wage gains made by labour it is highly correlated with wages. Hence the regression is required to be estimated in two stages. In these regressions, the variables reacted in the same directions as found in the numerical methods. In this estimation, the effect on the growth rate was found to have the correct relationship but was statistically insignificant. When examining the productivity regression, all variables were found to maintain the relationship as theorized and all were statistically significant. When examining bank power, a two-stage regression was needed to account for the high degree of correlation. The inconsistency found with inflation was not statistically significant. Where it had been found through numerical methods to have a negative relationship, econometrically it was found to have a non-statistically significant positive relationship.

Table 3.20 explores the relationship between liquidity preference and animal spirits with the five primary outcome variables. Liquidity preference has a high degree of correlation to the inflation rate, and animal spirits have a high degree of correlation with the economic growth, hence in both cases, there is the need for two-stage regression. In the case of liquidity preference, all variables were found to be consistent with the numerical methods. Additionally, all findings were found to be statistically significant. In the animal spirits regression, one inconsistency was found with inflation. In this case, the regression indicated a negative relationship between animal spirits and inflation in the short run.

The overall accuracy of the model, compared to the econometrics was as followed. Of the 45 predictions made, 41 were found to be associated with changes in the correct direction, when being compared to the theory, giving these predictions an accuracy rate of 91%. In two of the 45 (4%) predictions, there was statistically significant evidence contradicting theoretical predictions made by the AMM. In 33 of the 45 (73%) of the predictions, there was statistically significant evidence to support the assertions made by the AMM. The only inconsistencies found in the model were between economic policies/events and their relationships with inflation. Meaning more research must be conducted to examine this relationship.

## *VII. Historical Events*

This section will examine historical economic events. These events will be simulated using the AMM, and the results of this simulation will be compared with the actual outcome of the economic event. This will indicate the model's capability of accurately simulating real-world events. Along with these simulations, the effects of implementing different policies will be examined using the AMM, and the predicted effects on the outcome will be compared to the actual events. One in sample event and three out of sample events will be examined. The in-sample event that will be explored is the 2008 recession. The out of sample events is a great depression, World War II, and the stagflation crisis of the 1970's. The data points for this were found in the historical statistics of Canada, assembled by the Social Science Federation of Canada, and Statistics Canada. This data gives yearly indicators on the primary variables of the AMM, for the years in question. The in-sample simulation of the great recession, where all the constructed exogenous variables are known, will be examined first.

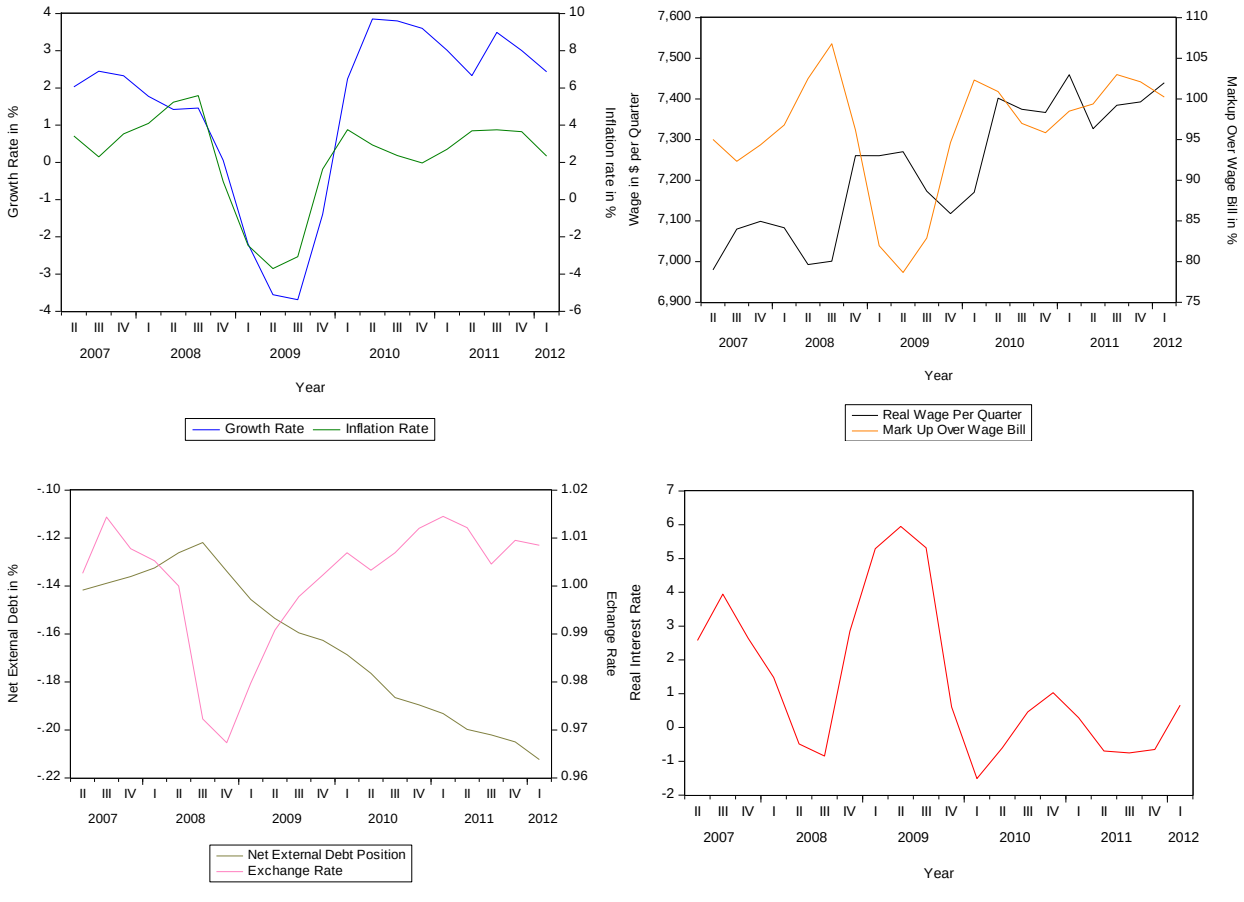
### *VII.i. The Great Recession*

An examination of the primary variables will be conducted, followed by a simulation using the AMM to examine how efficiently it can replicate real-world events. Finally, the predicted the effect of alternative policies would be conducted. This will allow for a prediction of how the overall economy would have reacted to a different set of policies, based on the findings of the AMM. Since this is an in-sample simulation, the exogenous constructed variables, for example, "animal spirits" and "liquidity preference," are known in all periods.

"The great recession" occurred in 2008. In this period, there was a financial crisis where the credit market ceased to function as intended, and the banking system received emergency funds in

the United States. Canada experienced secondary effects from this event. Figure 3.15 displays the time paths of growth rates, inflation rates, the real wage rates, the firms' markup, net external debt positions, exchange rates, and real interest rates. The growth rate in Canada went negative for most of the year of 2009, followed by a rapid recovery; this followed the same pattern as the firm's markup. The inflation rate decreased from above 4% to below -2%. Note this inflation rate is based on the chain-weighted index. In this period, it is more volatile than the CPI. The same analysis could be used with the CPI. This would only affect the scale and not the overall conclusions in the model. Wages were found to increase throughout, with periods of volatility as the unemployment rate was increasing. The net foreign debt position moved in a downward trajectory, and the country became more indebted in this simulation. The exchange rates were found to depreciated, followed by an appreciation. The real prime interest rates decreased from above 4% to below 0% before the recession, then increased to over 6%.

***Figure 3.15: 7 Economic Indicators Time Paths Over the "Great Recession"***



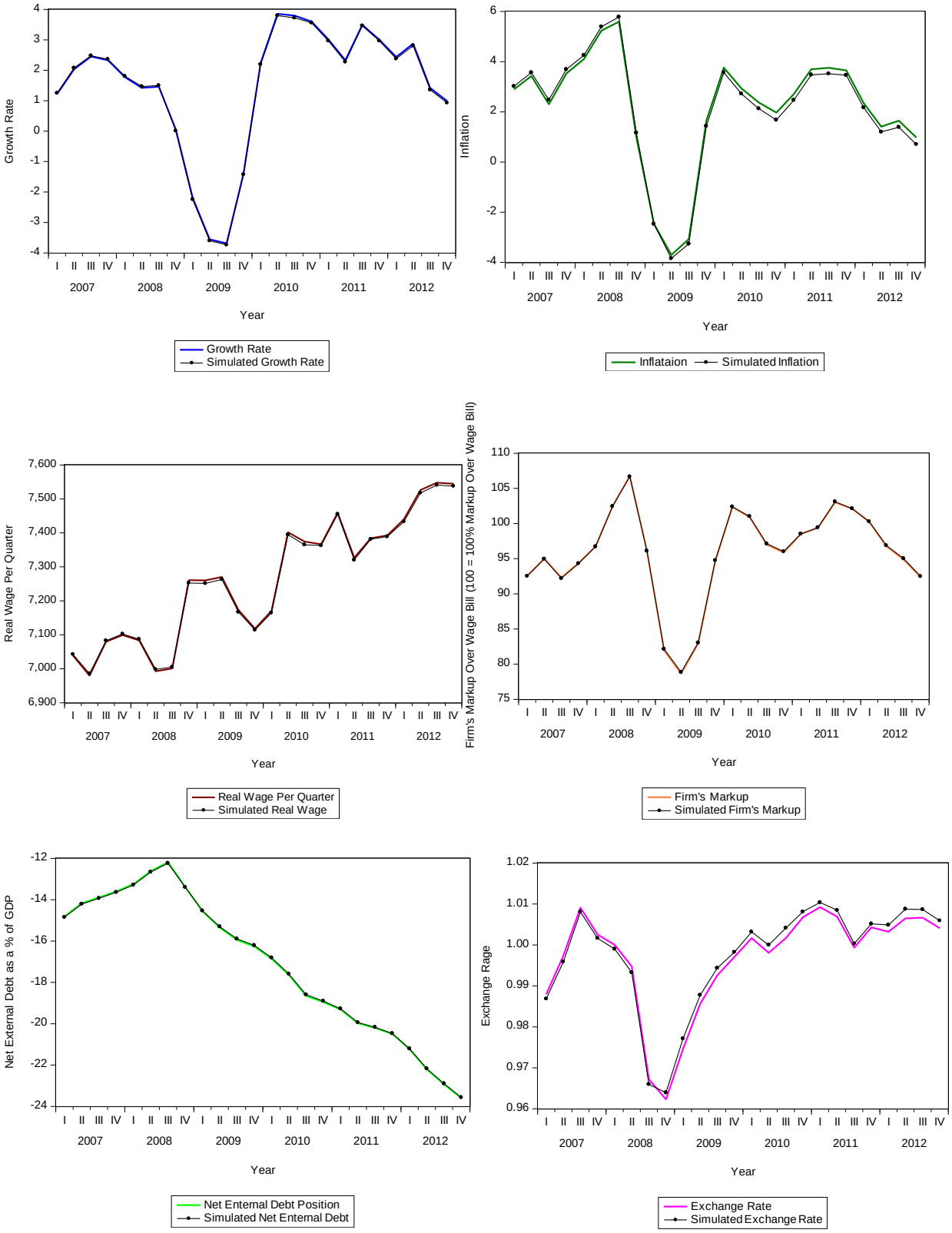
To simulate this scenario, one needs to input all the known exogenous variables. Since it is an in-sample event, the estimations for the constructed exogenous variables have previously been conducted. In previous essays, external factors may change with these constructed exogenous variables. Proxies for the theoretical definitions of the constructed exogenous variables will be compared to the found constructed exogenous variables for the out of sample tests, to ensure that the constructed exogenous variables are indeed changing as expected.

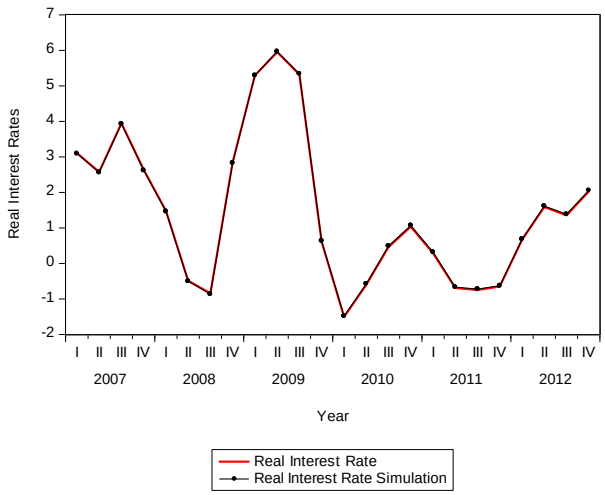
In this period, government fiscal policy used spending as a tool to stimulate the economy, in the aftermath of the financial crisis. Spending increased 5% of GDP within a year of the recession. During the same period, taxes remained constant, leading to a deficit at all levels of government of 5% of GDP. The monetary policy of the Bank of Canada reduced the real policy rate into negative rates, leading to the real prime rate at commercial banks falling to a value near 0%. Animal spirits were found to fall throughout the sample, and liquidity preference was found to have a sharp drop followed by a recovery in 2009. Productivity per worker was stagnant in this period, and there were some gains for the average wage for labour. This may have been due to below average wage earners losing their employment, at a higher rate than above average wage earners. Business markups experienced a steep decline, followed by a recovery, and there was a temporary depreciation of the exchange rate. Both inflation and growth declined in this period.

Simulations can be produced to compare how accurately the simulations can produce the same results as what occurred in the observed data set. Part of this model relies on the constructed exogenous variables being a good representation of their definition. As observed in essay 1, for the 2008 recession these indicators may be good representations of their definitions.

In figure 3.16 one can observe the actual paths for the economic variables (solid colour lines) and the simulated lines (black lines with dots).

***Figure 3.16: Simulations Compared to Actual Time Paths in The Great Recession***



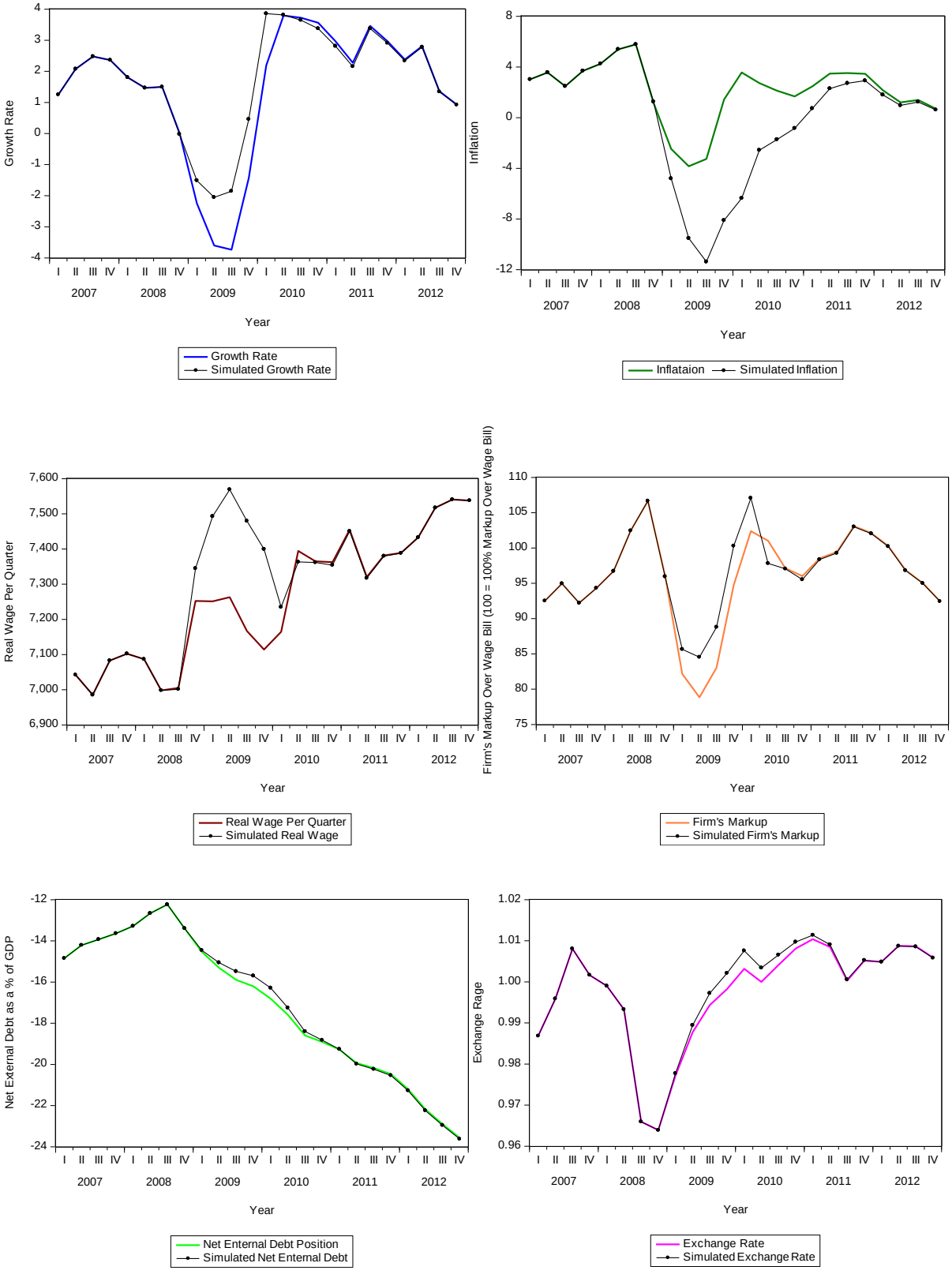



As one can observe in figure 3.16, the model can simulate the overall endogenous variables with a high degree of accuracy. This is partially due to the constructed exogenous variables, maintaining the observed levels in the actual data. Therefore, it was critical to examine if these constructed exogenous variables are indeed what they were theorized to be, as observable in essay 1. The primary findings were that in the recession, there was evidence that animal spirits decreased. This would support the assertion that these simulations are accurate as the constructed exogenous variables changed in line with their definitions. To be examined next is what the AMM would predict occurred in the outcome variables a different policy was implemented during the 2008 recession.

In this recession, the policy response was to stimulate the economy with an increase in government spending. Additionally, there was a reduction of the nominal policy rate, but no real policy rule. The simulation that will occur will be one that will examine the effect of a same magnitude tax reduction and an implementation of a real policy rate rule.

The first simulation will examine how the AMM would predict the economy to respond to a tax reduction. What was observed in the data was an increase in government spending? The policy that will be examined is one of the government creating a tax cut of the same magnitude, meaning, holding the deficit fixed and implementing an equivalent tax cut, while holding spending constant regarding the percentage of GDP, at a 2008 q2 level. At the highest point, the deficit was 4.2% of GDP. In these simulations, this policy will be examined until the year 2010 when it would be reversed to the actual data. The results of this simulation can be observed in figure 3.17. In this figure, the solid lines are the actual observed data; the black dotted lines are the predicted changes.

***Figure 3.17: The Predicted Effects of a Tax Reduction, During the Great Recession, with the use of AMM***



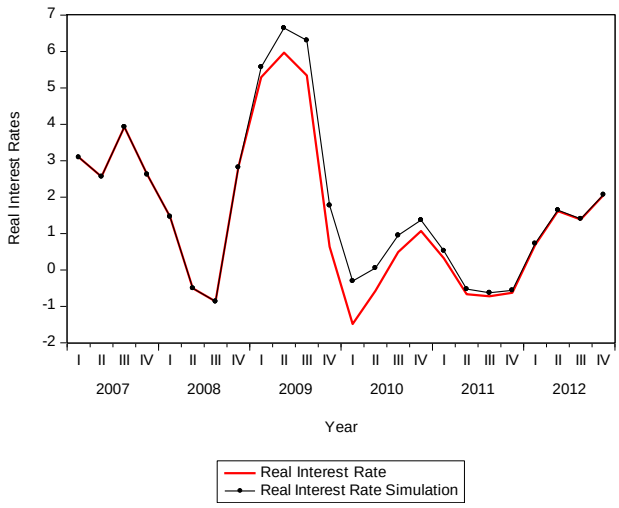
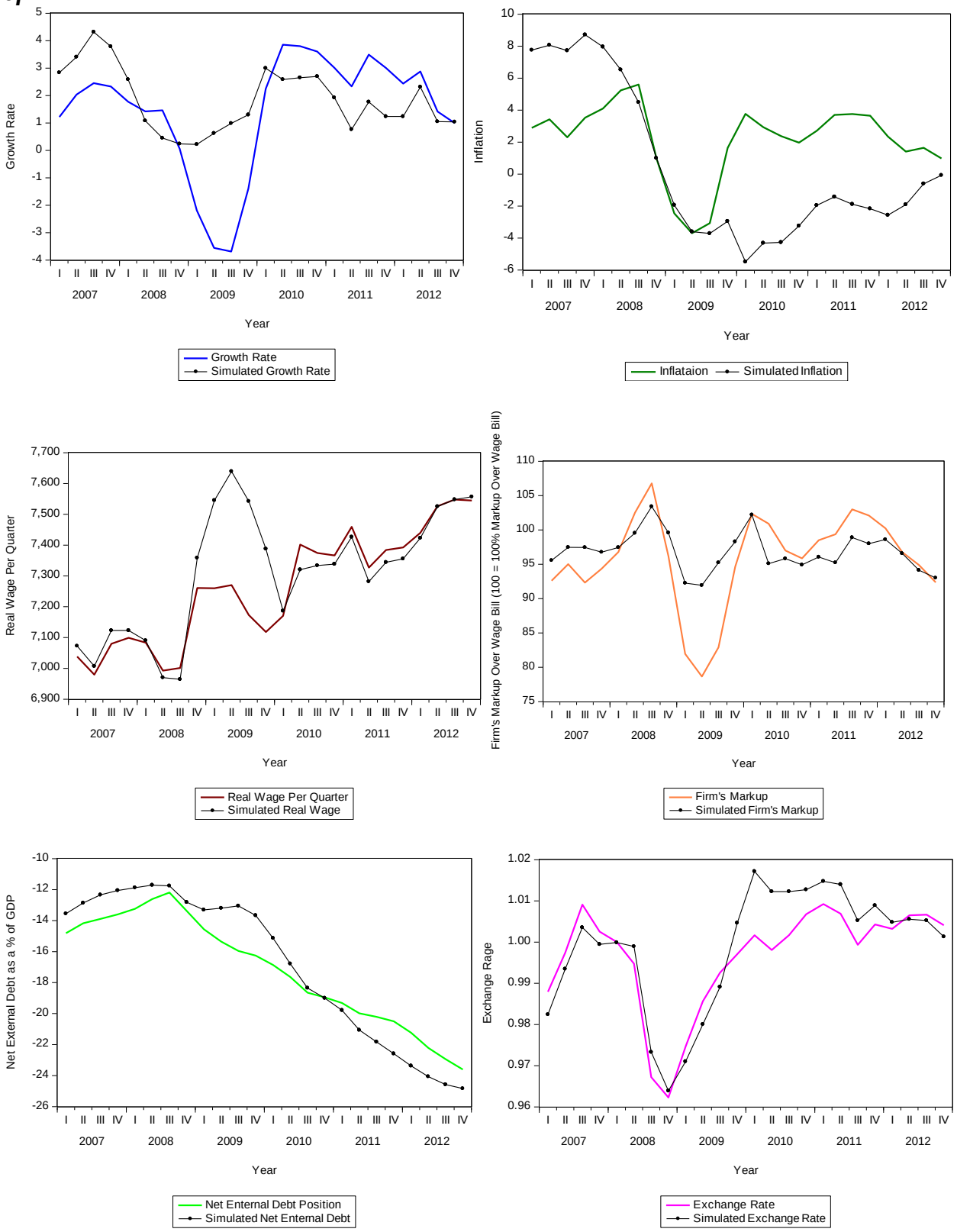
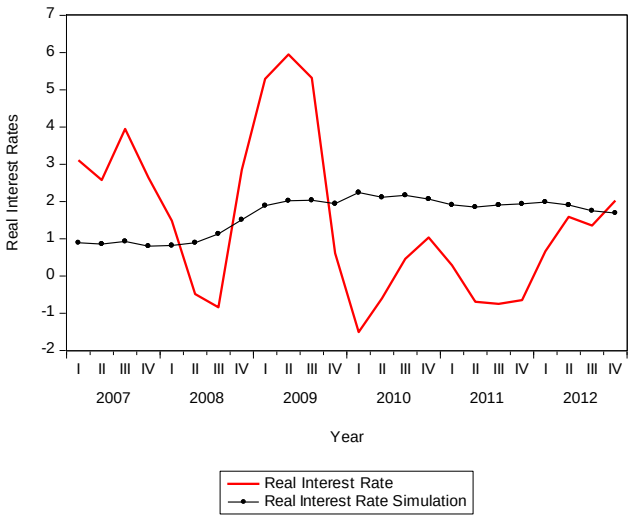



Figure 3.17 displays the predicted implications of changing the form of stimulus, from increasing spending to a tax reduction, while maintaining an equivalent deficit. In this case, it was observed that the recession was predicted to be narrower with growth falling to negative 2%, instead of negative 3.7%. The second consequence of these actions would be that it was a deflationary event, which at least temporarily, caused some deflation to occur. This policy also had a desirable effect on both after-tax wages and firm's profits. As these policies were unwound, and taxes were restored to eliminate the deficit, the labour and firm positions were reduced to the observed variables. This policy, though predicted by the AMM to be beneficial, may be hard to reverse politically, after the recession, as taxes would need to increased back to levels that were observed in the data. There was not a significant effect on the exchange rate, net external debt position, or interest rates. In this case, one can observe that interest rates were very volatile as the central bank was not following a real interest rate rule. The next simulation will expand this simulation to include a real interest rate rule.

There were two interest rate rules examined in this essay. The less restrictive one held the real overnight policy rate at the central bank constant, and the more restrictive rule held the prime rates at commercial banks' constant through monetary policy. In this simulation, the less restrictive rule will be examined as observable in figure 3.18. This rule holds the real policy rate at the central bank at a fixed level. The level chosen for this simulation is -0.5%. This rate was used as it was the average real policy rate at the central bank in this sample period.

***Figure 3.18: The Predicted Effects of Both a Tax Reduction and Implantation of a Monetary Policy Rule that Holds the Real Policy Rate Constant, During the Great Recession, with the use of AMM***

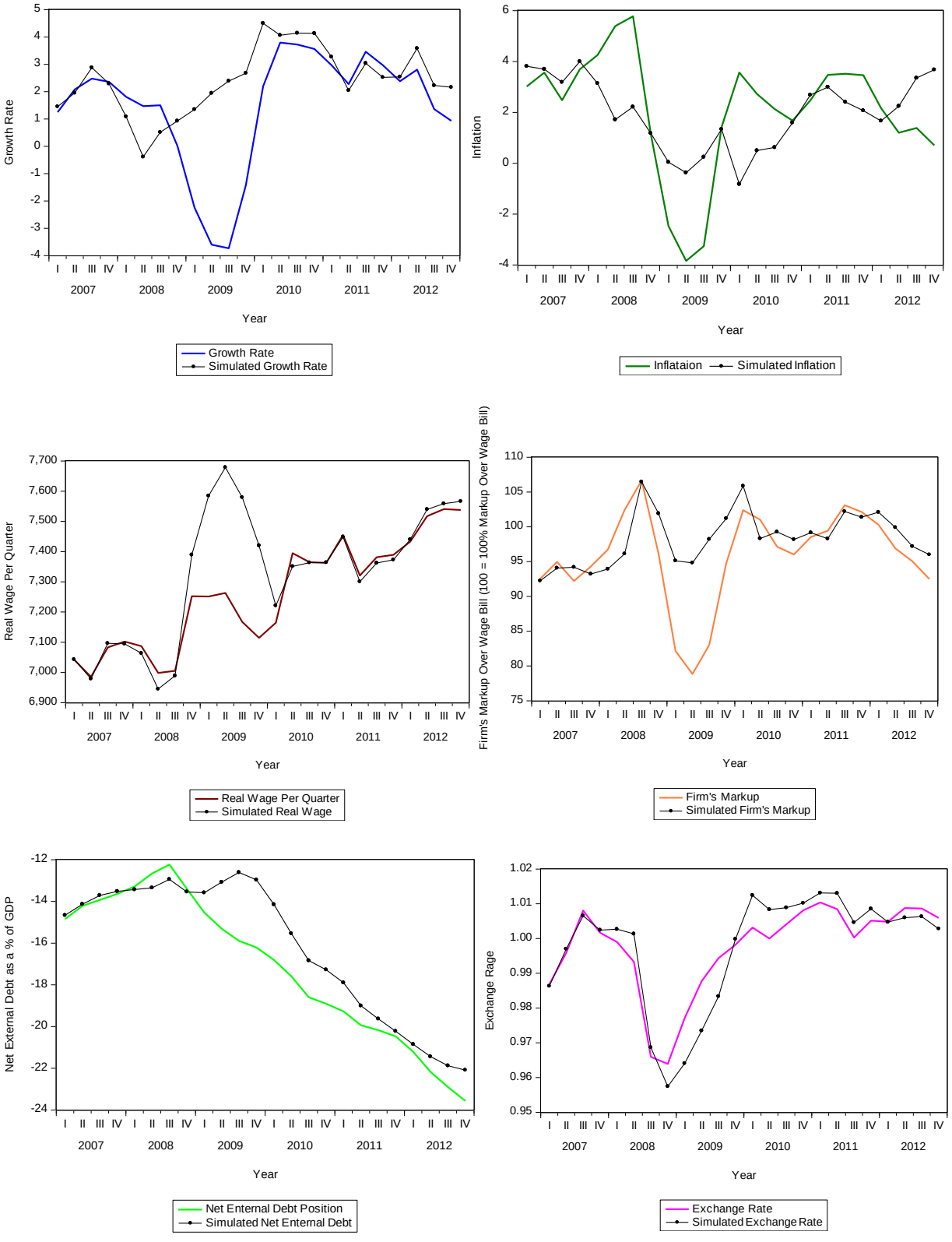


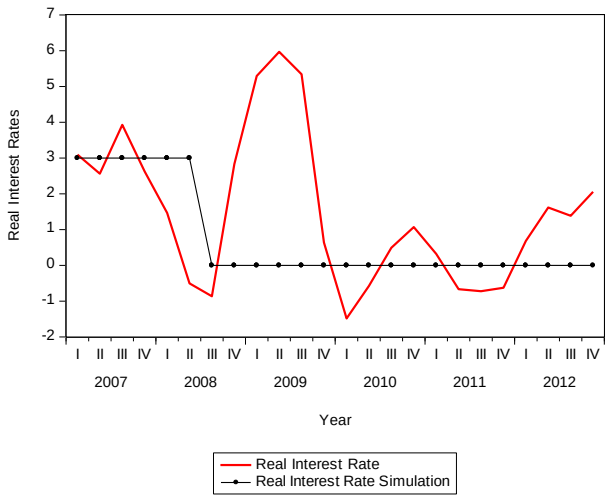



In the simulation, it was found that the real policy rate increased the growth rate of the economy, to a point where it avoided the recession. This was achieved by the reduction in the volatility of the real prime rate at commercial banks. These changes caused labour and firms to be better off during the recession, with a slight negative impact in the years after the recession. This is due to the increase in the real interest rates post 2010, compared to the actual interest rates experienced after the recession. This policy also had a positive effect on the inflation rate before the recession, and adverse effect post-recession. Both the effect on inflation, and the effect on the wages and firm's markup can be attributed to the level chosen for the real policy rate. Over the recession the real policy rate was volatile, it was higher than the average policy rate before the recession and less than the average policy rate after the recession. If the averages of the policy rate were conformed to the actual data for pre and post-recession, this would mitigate the differentials in all three variables as demonstrated in the following simulation. Finally, these policies changes only had marginal effects on debt and the exchange rate.

The final simulation in this section will incorporate the more restrictive monetary policy rule, which includes an interest rate rule proposed earlier in this essay, as observed in equation (3.6). This rule holds constant the real rate of interest at commercial banks, maintained through changes in monetary policy. In this simulation, the target for the central bank's real interest rate before the recession will be 3%, and post the recession 0%, in line with interest rates in the actual data. In figure 3.18a the solid coloured lines represent actual observed data, and the black dotted line measures the predicted changes from the new policy, using the AMM.

***Figure 3.18a: The Predicted Effects of Both a Tax Reduction and Implantation of a Monetary Policy Rule that Holds the Commercial Bank's Real Prime Rate Constant, During the Great Recession, with the use of AMM***






In this simulation, both the tax cut and the real interest rate rule were implemented, and it was predicted to improve the growth rate. In this case, the AMM forecasts that the economy would have never gone into recession, as the real interest rates do not rise in 2008 and 2009. Further, this had a consequence on inflation. In this case, the economy never experienced a bout of deflation, as observed in the simulation without the interest rate rule. Additionally, both labour and firms are better off as the wages are improved, and the firm's markup has increased. The exchange rate is only marginally different, and the net external debt has decreased relative to the simulation with no interest rate rule. Finally, the interest rate rule removed the volatility in the real interest rate.

This grouping of simulations examined an in-sample event and compared three alternative policies. First a tax reduction. This policy was predicted by the AMM to have a positive effect on growth, but only partially mitigated the recession. A side effect of this policy was a significant bout of deflation and distorted the wages and markups of the firms. When it is combined with the interest rate rule, this increased the growth rate, stopping the country from entering the recession, and ended the deflationary policy caused by the tax reduction. This shows the theoretical benefits of a real interest rate rule, based on the AMM, as it eliminates the volatility in this rate. Finally, this real interest rate rule was found to improve the outcome for both labour and firms. In the next three sub-sections, out of sample events of the great depression, WWII, and the stagflation crisis will be examined.

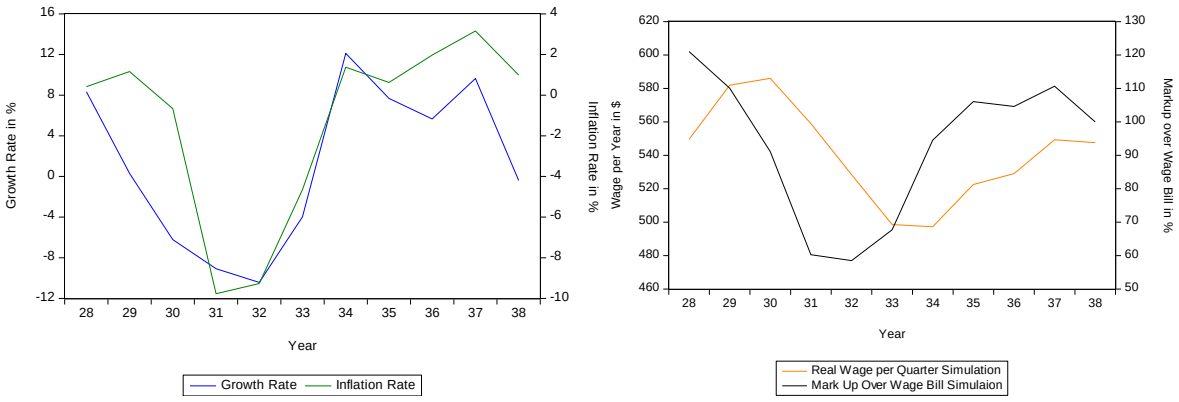
*VII.ii. The Great Depression*

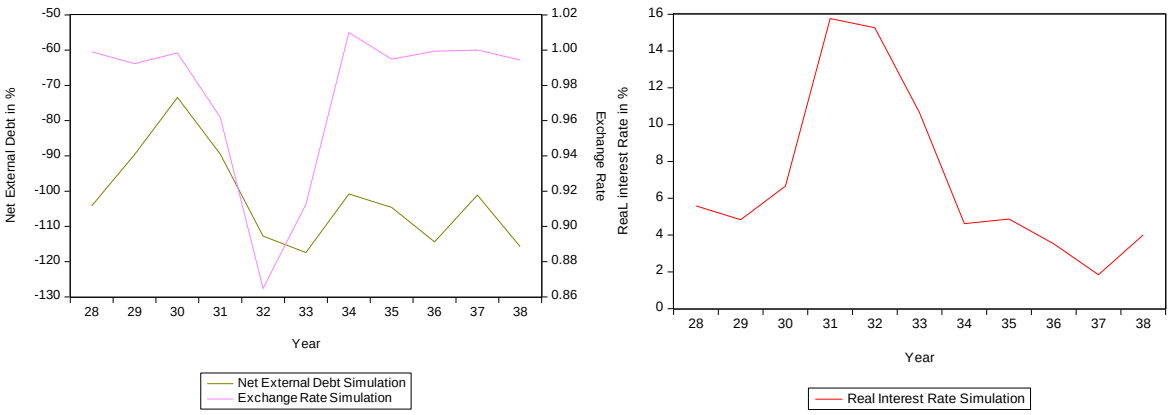
This sub-section will examine the great depression, using the AMM. Note this section is based on the coefficients found in the 1981-2015 period, due to data is more consistent and frequent in

this period, compared to data collected in the 1920's, and 1930's. This, however, will not affect the overall outcomes, that give general insight into policies.

As figure 3.19 displays, this period is associated with a broad downturn in economic activity. There was a recession that lasted four years, from 1930 until 1933. Additionally, this recession was very severe. At its peak, the real GDP was decreasing at a rate of over 10% a year. Comparing this to the recession of 2008, which lasted 12 months with a maximum decline rate of 3.7%, the great depression was considerably more severe. After the four years of negative growth, the total economic output was 26.6% less than pre-recession levels, compared to a decrease of 2.7% in the 2008 recession. This same period is associated with a significant case of deflation where prices were declining by approximately 10% in 1932 and 1933. The sizeable deflationary event caused the real interest rates to increase dramatically as nominal interest rates were fixed at a traditional rate of 6%, eventually being moderately decreased, followed by the creation of the Bank of Canada in 1935 (Powell 2005). Thus, the real prime rate reached a maximum of 16%. Canada had fixed exchange rates before 1931, as the nation was on the gold standard. In 1931 the British abandoned the gold standard and this, along with domestic issues in Canada surrounding the gold reserve, caused the currency to depreciate by 14%. Once Canada suspended the redemption of gold in 1933 and created the Bank of Canada in 1935, the exchange rate stabilized (Powell 2005). Over the great depression, real wages fell by over 14%, and the firm's markup over the wage bill was reduced by about half. Further, the unemployment rate reached a peak in 1933, of 19.3%. Additionally, the period was also associated with Canada becoming increasingly indebted.

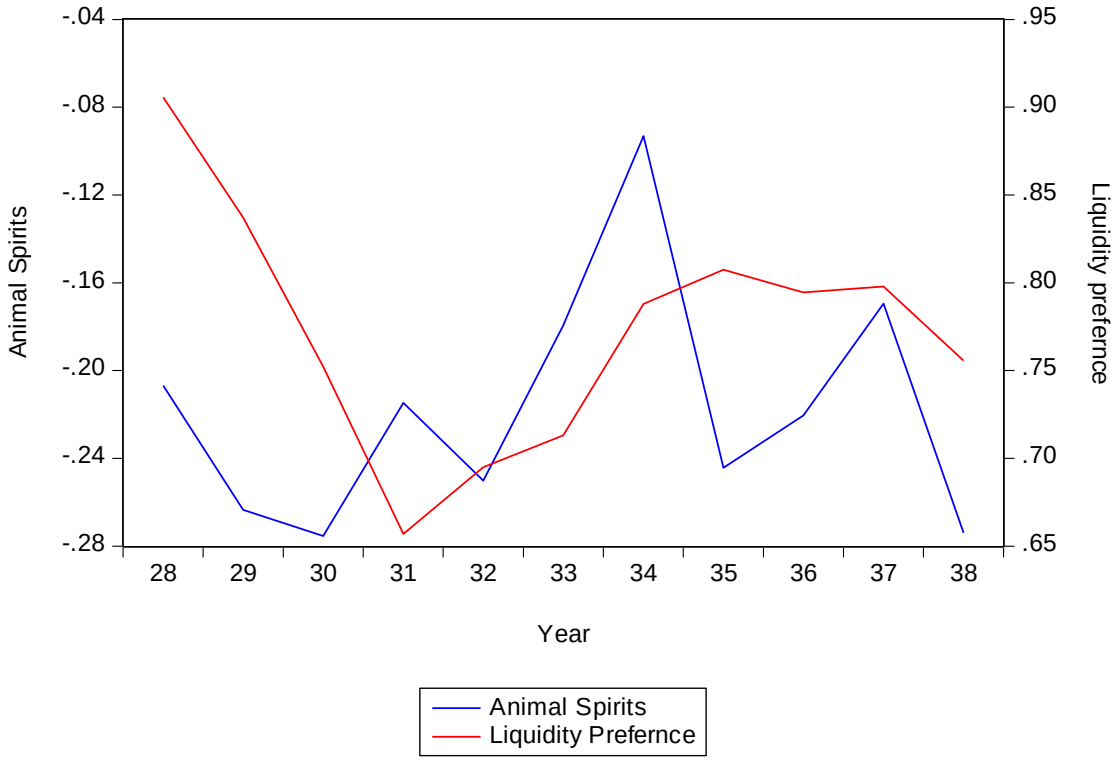
***Figure 3.19: 7 Economic Indicators Time Paths Over the Great Depression***






This allows for a simulation of the constructed exogenous variables. The simulated animal spirits and liquidity preference terms are displayed in figure 3.20.

***Figure 3.20: Estimation of Animal Spirits and Liquidity Presence Using the AMM***



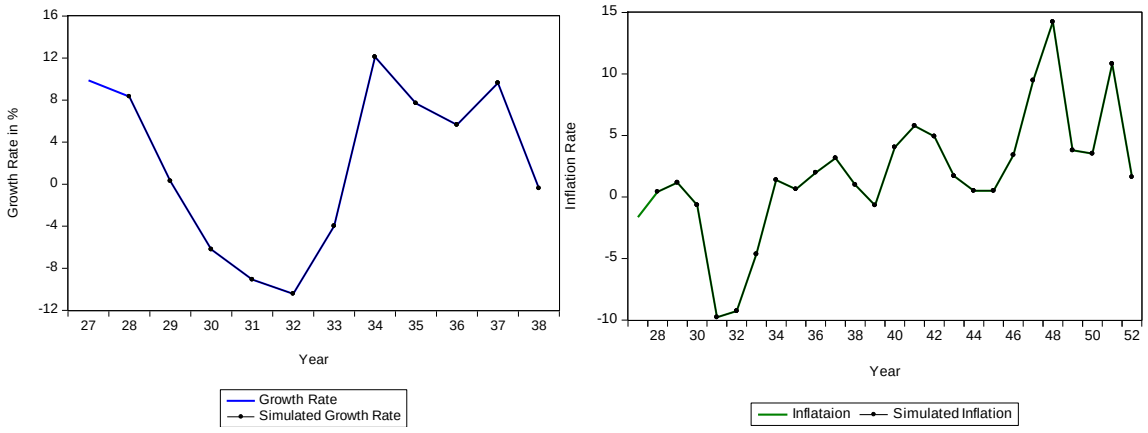

There is a substantial decline in liquidity preference in the early 1930's[6], associated with negative real returns of (27.9%), (38.6%), and (25.6%) on the TSX for the year 1930 through 1932.

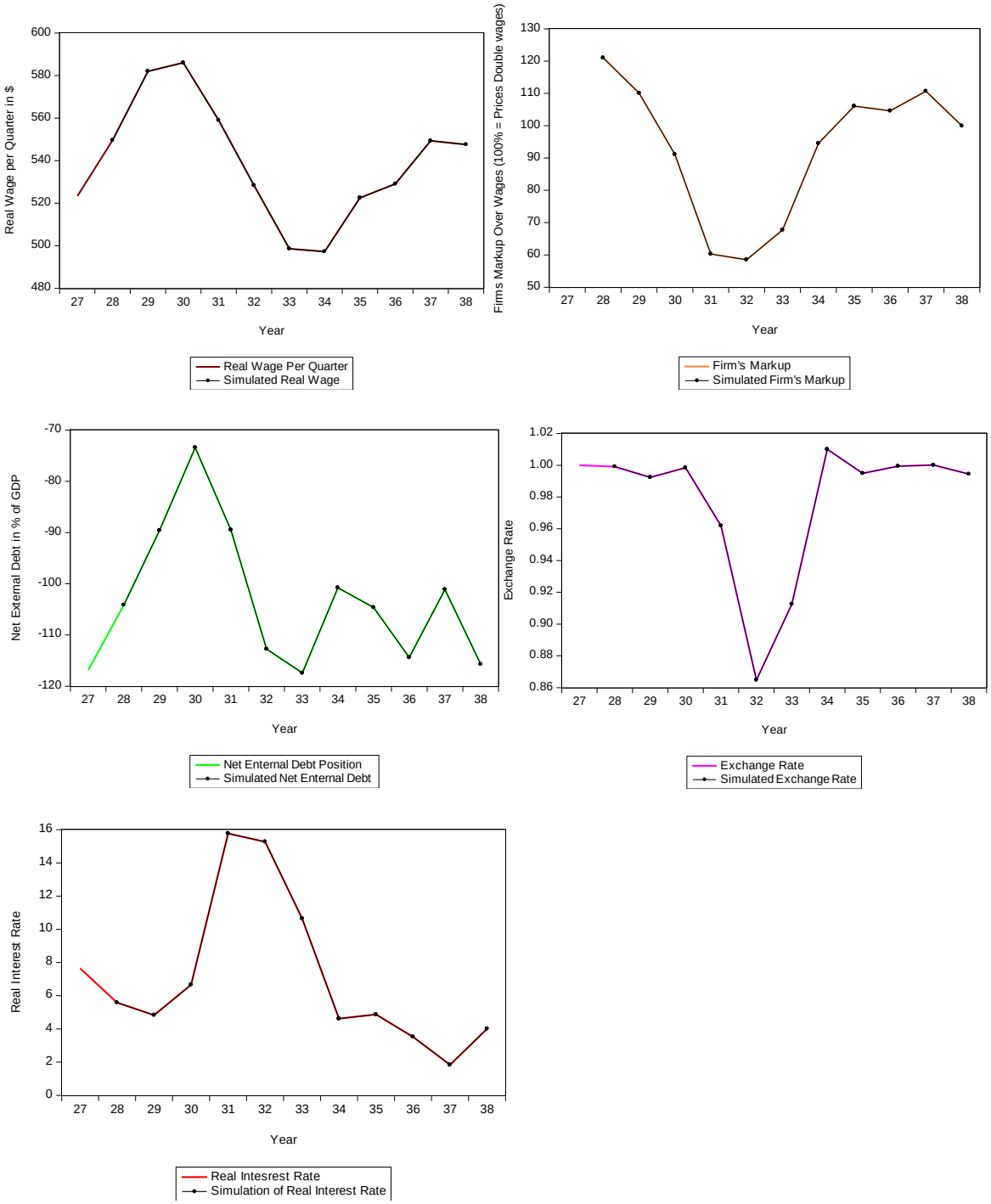
[6] A negative value for liquidity preference is defined as a "bearishness" in the financial markets. An increase in this variable would be defined as a "bullish" indicator for financial markets.

As liquidity preference began to increase, positive returns returned to the TSX for the years 1933 through 1937. 1938 had negative returns, as once again liquidity preference decreased in value. This is what one would expect to observe of the market returns, as it is consistent with how liquidity preference is correlated with markets in the current period. Animal spirits began to decrease before the depression started, and when the increase occurs, this was associated with the end of the recession in 1934. The economy again slowed in 1938 with this variable. Building permits might be a proxy on expectations for the future, and thus a proxy for confidence. In this sense building permits fell from 1929 to 1933, recovered to 1937 then again fell in 1938, following the broad pattern of animal spirits; thus, these variables do follow the broad pattern one would expect to observe in the data.

Next, the accuracy of the simulations will occur, to find how accurately the AMM can simulate these events. Figure 3.21 shows the results compared the actual data (coloured lines), to the simulations (black dotted lines). Because the simulation was calibrated to the historical data through the constructed exogenous variables, these lines perfectly overlay the actual data making the lines hard to distinguish.

***Figure 3.21: Simulations Compared to Actual Time Paths in The Great Depression***

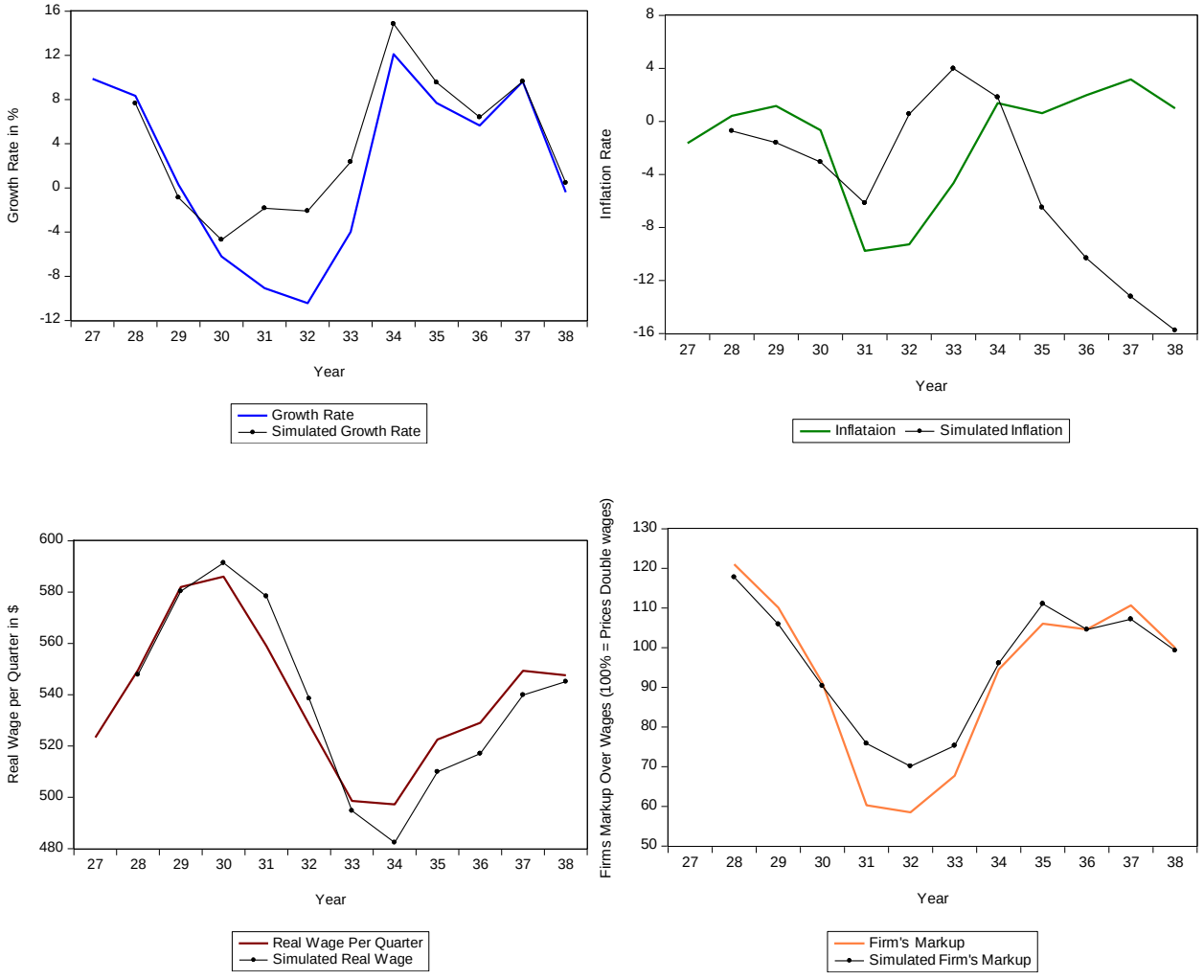


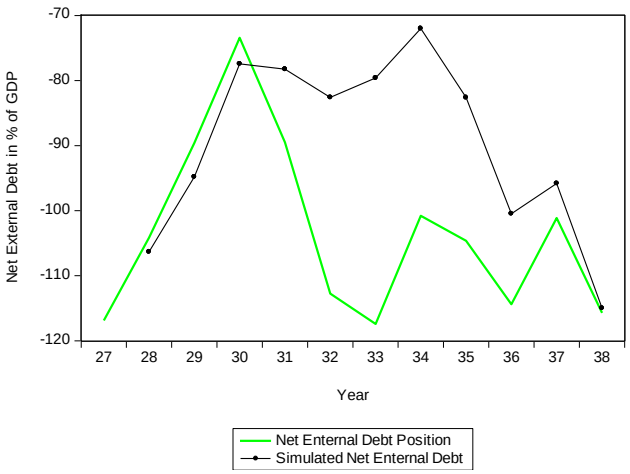


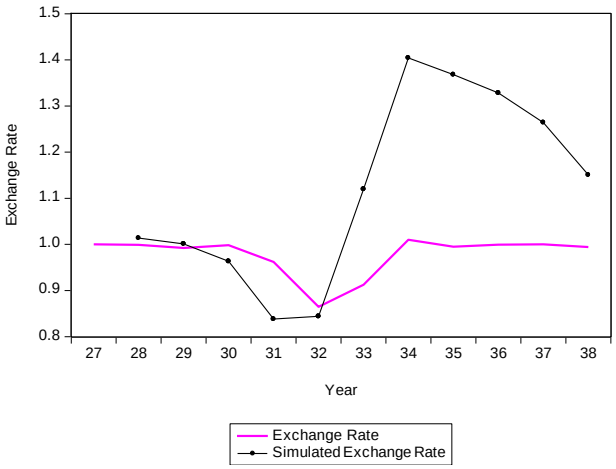

This simulation allows for one to explore the predicted effects for different policy decisions, based on the AMM. In this case, the simulation that will occur is analyzing two changes. One allowing a floating exchange rate in this entire period, and two implementing a real interest rate rule instead of fixing the nominal rate, which occurred in the actual data. Two interest rate rules will be examined. One fixing the real policy rate at the central bank, and a second a more restrictive

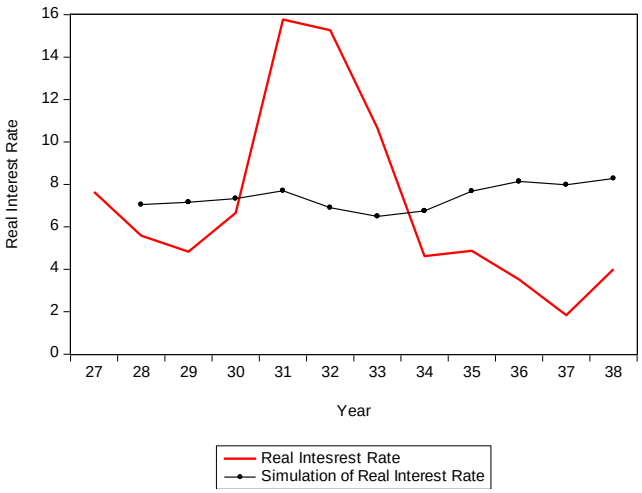
rule fixing the real prime rate at commercial banks through changes in monetary policy. It is true the central bank did not exist before 1935, but an approximation of the rate the Bank of Canada would have set can be made based on historical data. In the less restrictive rule, the policy rate at the central bank will be set at the average of the real policy rates throughout the great depression of 4.1%. Figure 3.22 displays the effect the AMM would predict of implementing that policy rule in the great depression.

***Figure 3.22: The Predicted Effects of Implantation of Both a Monetary Policy Rule Holding Constant the Real Policy Rate and Floating the Exchange Rate, During the Great Recession, with the use of AMM***





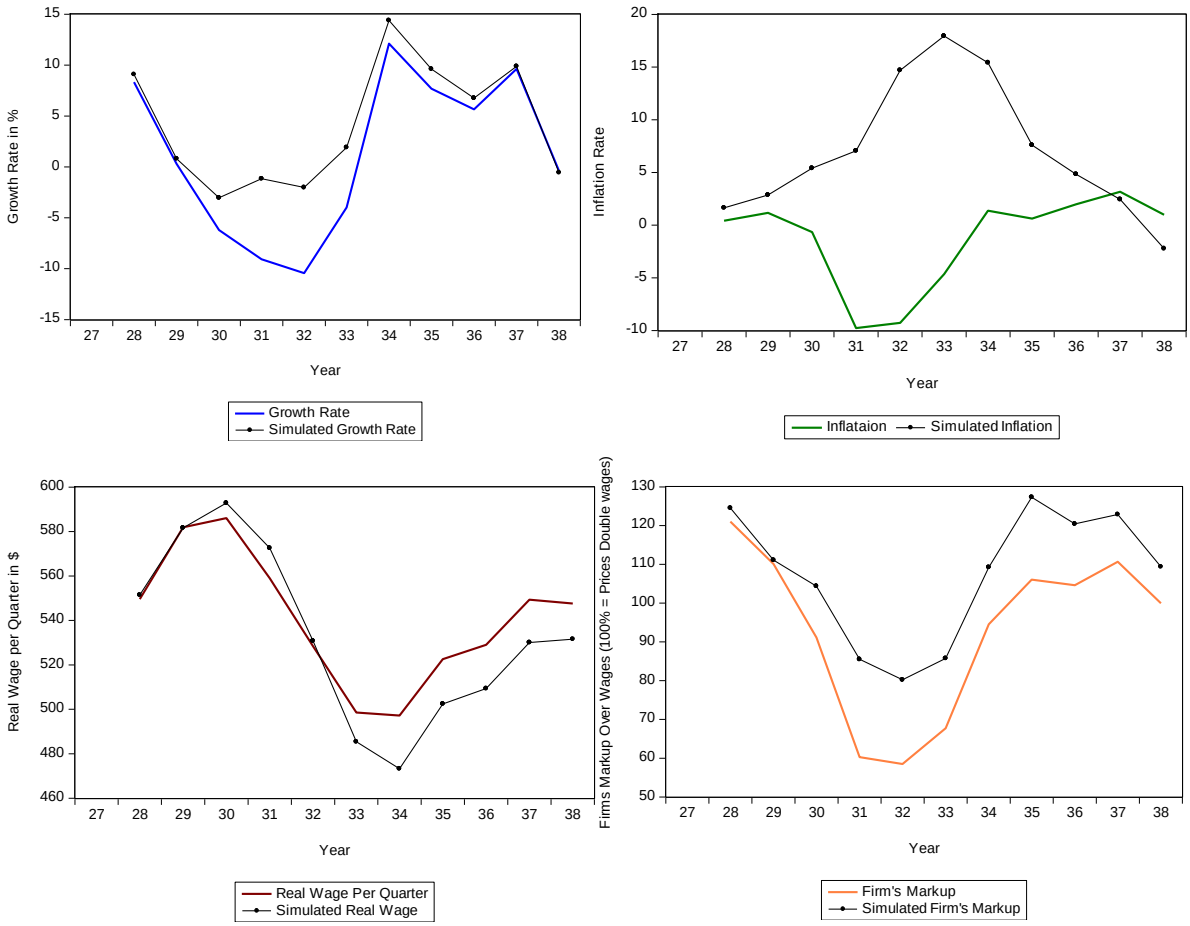



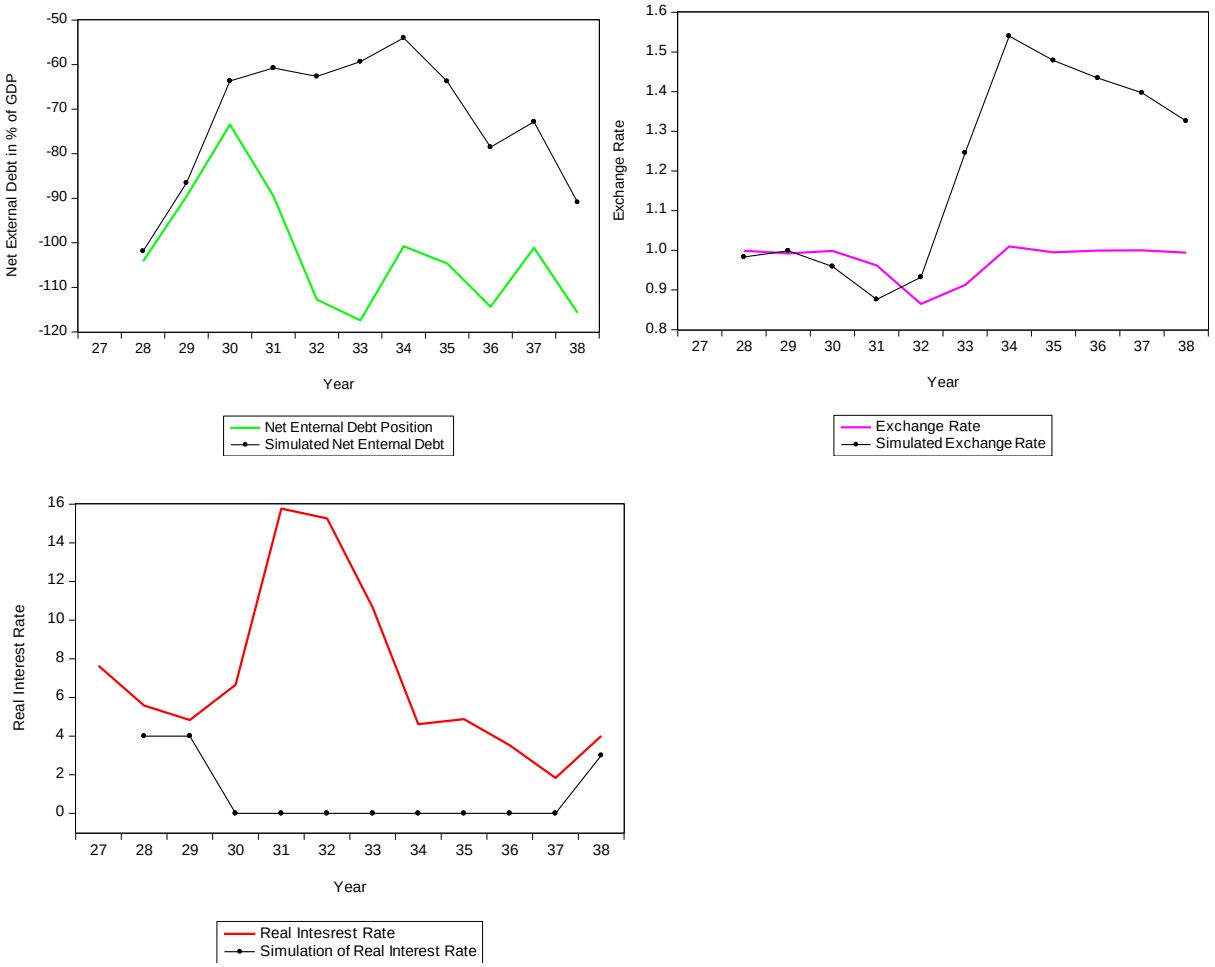

This simulation explored the predicted effect of a real policy rule. This real policy rate rule held constant the real policy rate at the average rate experienced in the data. In this simulation, eliminating the volatility in the real prime rate was found to reduce the length and depth of the recession. This policy also caused less deflation during the recession and more deflation post-recession. This is due to the interest rates in the actual event being very volatile, in comparison to more recent recessions. The average real prime rate at commercial banks was approximately 8%, causing the predicted deflation in the late 1930's. This rate would not be thought of as a policy to stimulate the economy by modern central banks standards. Thus a response more in line with current central bank policy will be examined in the second simulation. Firms were found to be better off in this simulation, while labour was found to be better off before 1933, and worse off post-1933. This is due to the appreciation that was experienced in the dollar. This means labour

was better off in foreign currency terms but, not in real domestic terms. This also caused the country to be less indebted for the majority of the simulated years.

The second simulation includes a more restrictive policy rule, where monetary policy is used to hold the real policy rate at commercial banks constant. This policy will be conducted by holding real prime interest rates at 4% prior to the recession, approximately what the real interest rate was in 1929. Reducing it to 0% in the period between 1930 and 1937, then returning it to 3% in 1938, as that is approximate rate observed in the data that year. These changes are affecting only the monetary policy, and thus there is no increased spending or taxes in this simulation. The simulations observable in figure 3.22a are the black dotted lines. The actual observed data are the solid coloured lines.

***Figure 3.22a: The Predicted Effects of Implantation of Both a Monetary Policy Rule of Holding Constant the Real Prime Rate at Commercial Banks and Floating the Exchange Rate, During the Great Recession, with the use of AMM***






Changing these policies was found to reduce both the severity and length of the recession, with the recession lasting three years, and having a maxim reduction in economic growth of 3%, compared to four years and 10%. The total loss in economic activity would be 6%, compared to 26% in the actual recession. Even with these alternative policy changes, the recession was still twice as severe as the recession in 2008[7]. This policy was also found to cause a high inflation rate, nonetheless, since this is a real interest rate rule the nominal prime interest rates would change with the inflation rate. Additionally, there was a reduction in the net external debt position in Canada causing a significant appreciation in the Canadian dollar, compared to the US dollar. This caused adverse effects on wages and positive pressure on the firm's markup.

[7] This assumes the confidence in the economy and markets was unchanged even when experiencing a less severe recession.

This expresses the predicted benefit to not having substantial changes in the real policy rate in the AMM. The AMM predicted that holding the real prime rates relatively constant, reduce both the length and severity of the recession. Finding the effects of stable monetary policy on the economy, based on the AMM, was the primary objective of this simulation. There is a significant amount of inflation in this simulation as the real rates were assumed to be reduced. If the real rates were maintained at pre-recession levels, this inflation rate would be significantly reduced at the cost of a somewhat more severe recession. The negative pressure on wages is somewhat misleading in the example, as there was a significant appreciation of the dollar. In US dollar terms, the wages in Canada would have been much higher than pre-recession levels, by 1938. Other policies could deal with this inflation or wage bill, but it would not add much value to this section, as this was examining how the real interest rate rule was predicted to affect the economy. The next simulation will examine the economic boom that occurred during WWII.

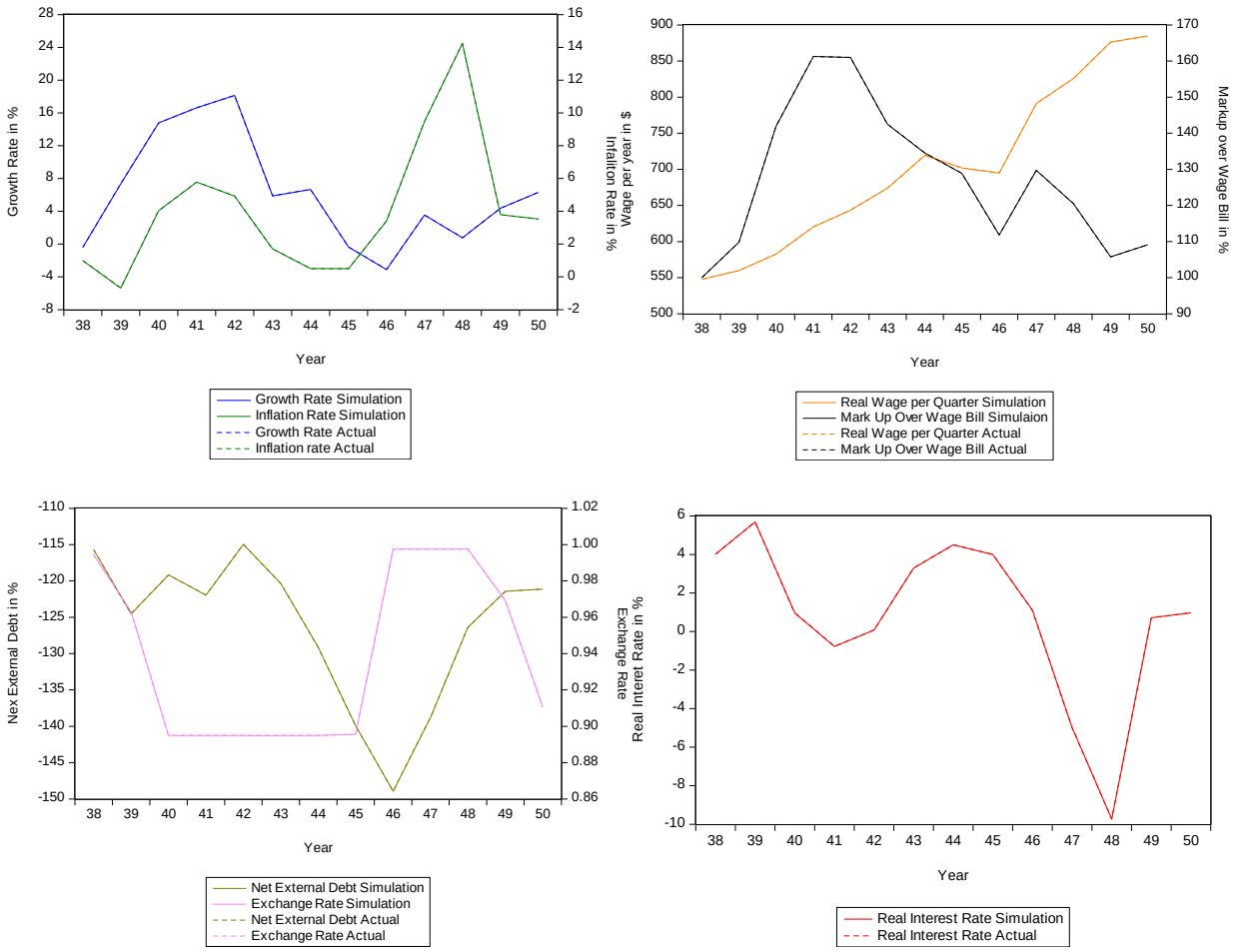
*VII.iii. World War II*

WWII is the next case study that will be examined in this section. In contrast to the Great Depression, the war forced the government to increase spending to a large extent. This is from 10.4% of GDP in 1938 to 48.1% of GDP in 1943. This far exceeded the maximum government spending in the great depression of 13.9% of GDP. Taxes also increased from 9.5% to 25.4% of GDP. Therefore, there was a deficit, ranging from 5% to 23% of GDP. In the great depression, the maximum deficit was 5.7% of GDP, and in the 2008 recession, the maximum deficit was 4.2% of GDP. Thus this amount of deficit spending far exceeded what was observed in other periods. Thus, this period is an excellent test of "Keynesian economics" where the government used deficits to fund the war, and this may have stimulated the economy. Additional to this, an examination of changes in policy can be simulated.

In figure 3.23 the outcome variables for the duration of the war and post-war years are observable. In this figure, one can observe a very high growth rate over the duration (1939-1945) of the war, followed by a recession the following year. Inflation was in a range between negative and positive 4% during the war with a very high inflation rate after the war of 24%. There were real wage gains in this period of 61%. Additionally, the unemployment rate reached a low of 1.4%. Thus, the unemployment had a substantial recovery compared to a decade earlier, where an unemployment rate of 19.3% was observed. This period also saw a significant rise in the firm's

markup over wage costs. The exchange rate was fixed in this period. During the war, the exchange rate was fixed at approximately 90 cents to the US dollar, and after the war at par. The net external debt was relatively constant during this period. The prime real interest rates were between 0%, and 6% in the war times, followed by a negative 10% real prime rate during the inflationary period.

***Figure 3.23: 7 Economic Indicators Time Paths Over WWII***

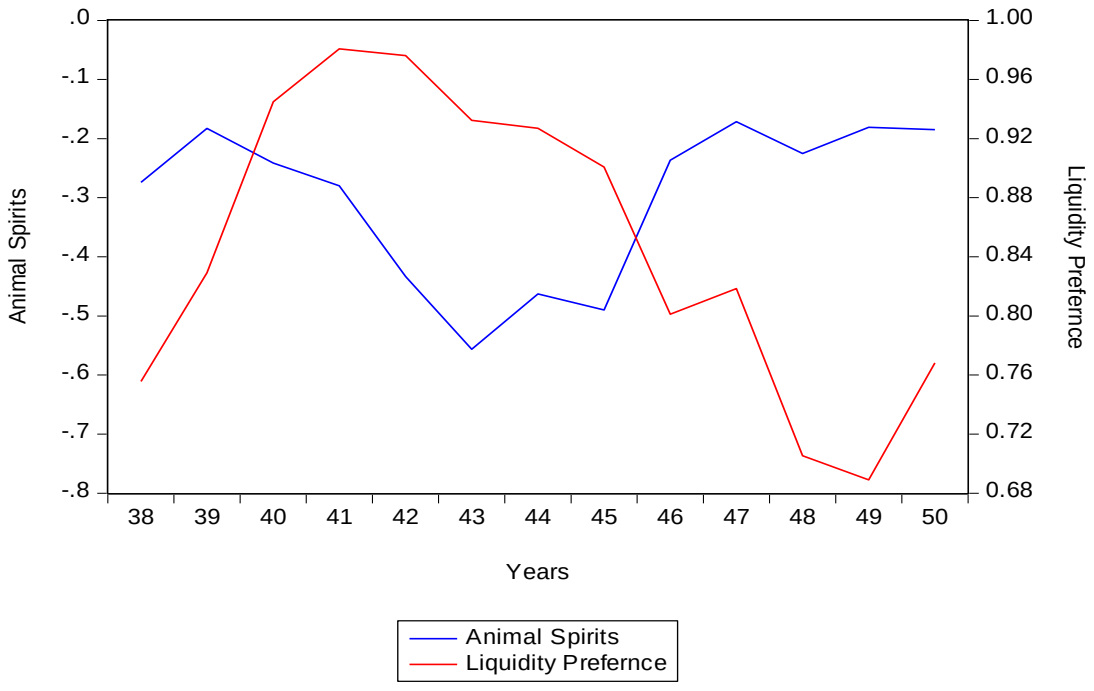



Values for the constructed exogenous variables need to be simulated. These variables are "animal spirits," and "liquidity preference." These simulations can be observed in figure 3.26. As one can observe in this figure, the animal spirits term decreased in 1942-1945. There could be several reasons for this. First, when examining business investment, much of it could be justified based on the expanding profit margins as observed in figure 3.25. Given that theoretically this variable measures investment made, not based on real economic conditions, it only accounts for investment not related to the increased profits. Second, when examining building permit data, they reached a local peak in 1940, before contracting and levelling off until 1945. Building permits then

began to expand rapidly after 1946, as animal spirits began to increase again. Finally, there was a deficit of over 20% of GDP. This may have been necessary for achieving victory in the war, but it may have been too large for the economy to fully utilize as increased employment, with the unemployment rate reaching historically low levels. In essay two when examining Okun's law, the conclusion was made that at some point as the labour market became tight, as it did in this period, the effects of stimulus would have decreasing returns. This decrease in animal spirits could be further evidence to support this claim, as the stimulus did not continue to have the same effects as it did before 1942.

When examining investment returns, there were four distinct periods on the TSX. The markets were decreasing in value from 1938-1942, with the most extensive loss coming in 1938. From 1942-1946 there were gains on the market, followed by losses in the rest of the 1940's, and a rebound in the 1950's. The liquidity preference terms seem to move before the actual markets moved. Liquidity preference reached a peak in 1941, began to decrease before the markets, and recovered in 1950 with the market. Overall both these variables acted in a way that one would expect, and thus these variables will be used in the following simulations.

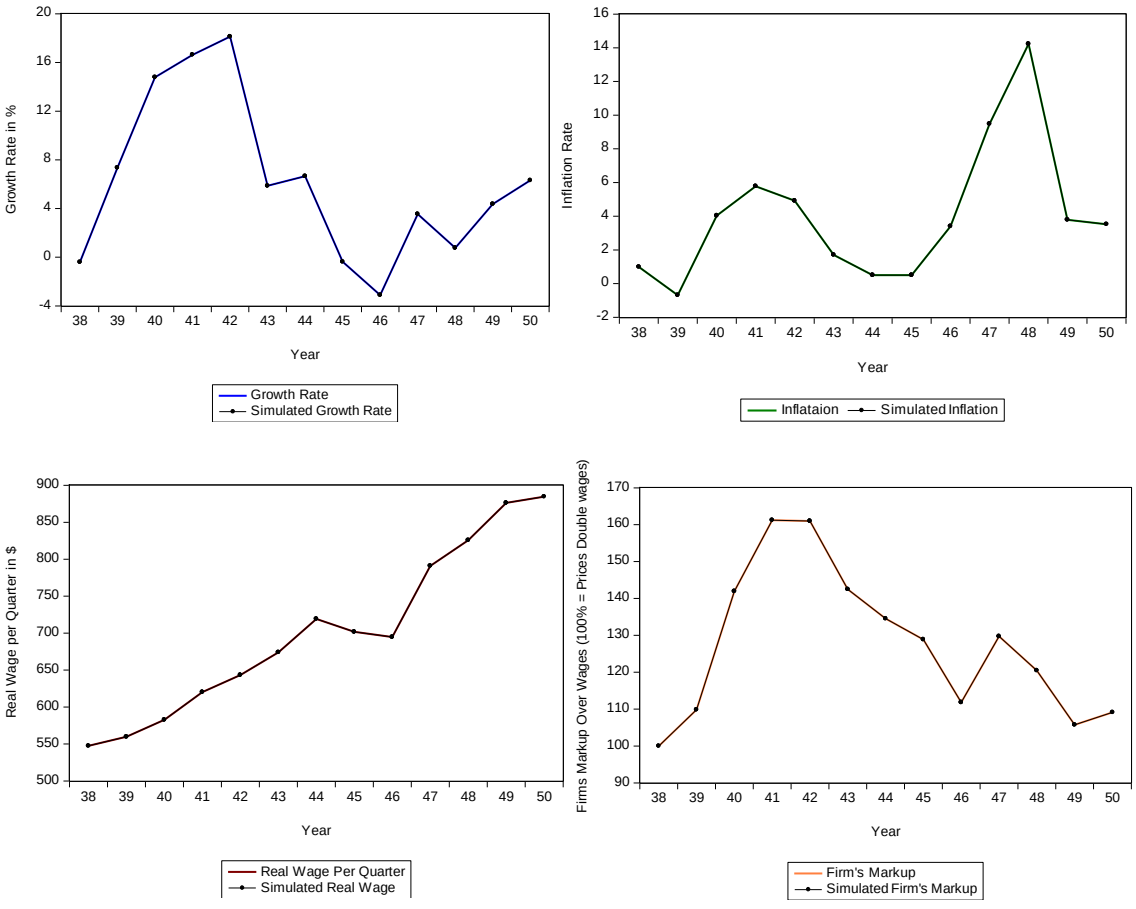
***Figure 3.24: Estimation of Animal Spirits and Liquidity Presence Using the AMM***

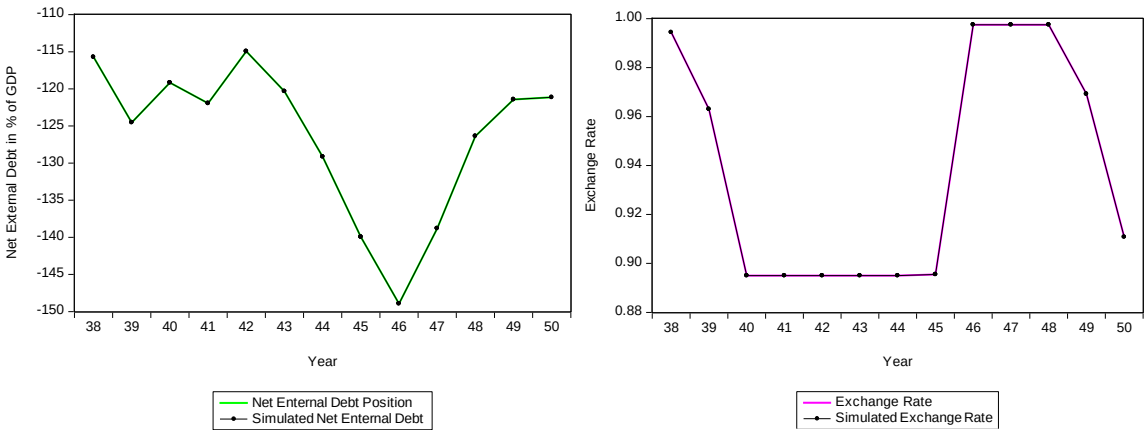


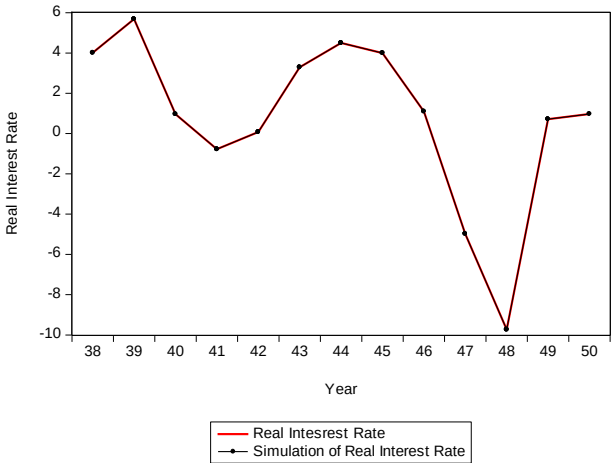
Much like the simulation of the 1930's this will only be approximate to the actual events, as not all coefficients may have been the same as at the end of the century, but this will give some insight to how policies are predicted to affect the economy in previously observed events.

In figure 3.25 one can observe the simulations for this period along with the actual outcomes. As observable below, with the simulated values for the constructed exogenous variables, the model can simulate the actual data. This will be the base case of the model, from where predicted changes will occur. Since the base case is in line with the actual observed data, this will give some insight into how the outcomes predicted by the AMM will change from the ones observed. Figure 3.25 displays the actual data (solid colour lines), and the simulation (black dotted lines). Because the simulation was calibrated to the historical data through the constructed exogenous variables, these lines perfectly overlay the actual data making the lines hard to distinguish.

***Figure 3.25: Simulations Compared to Actual Time Paths in WWII***





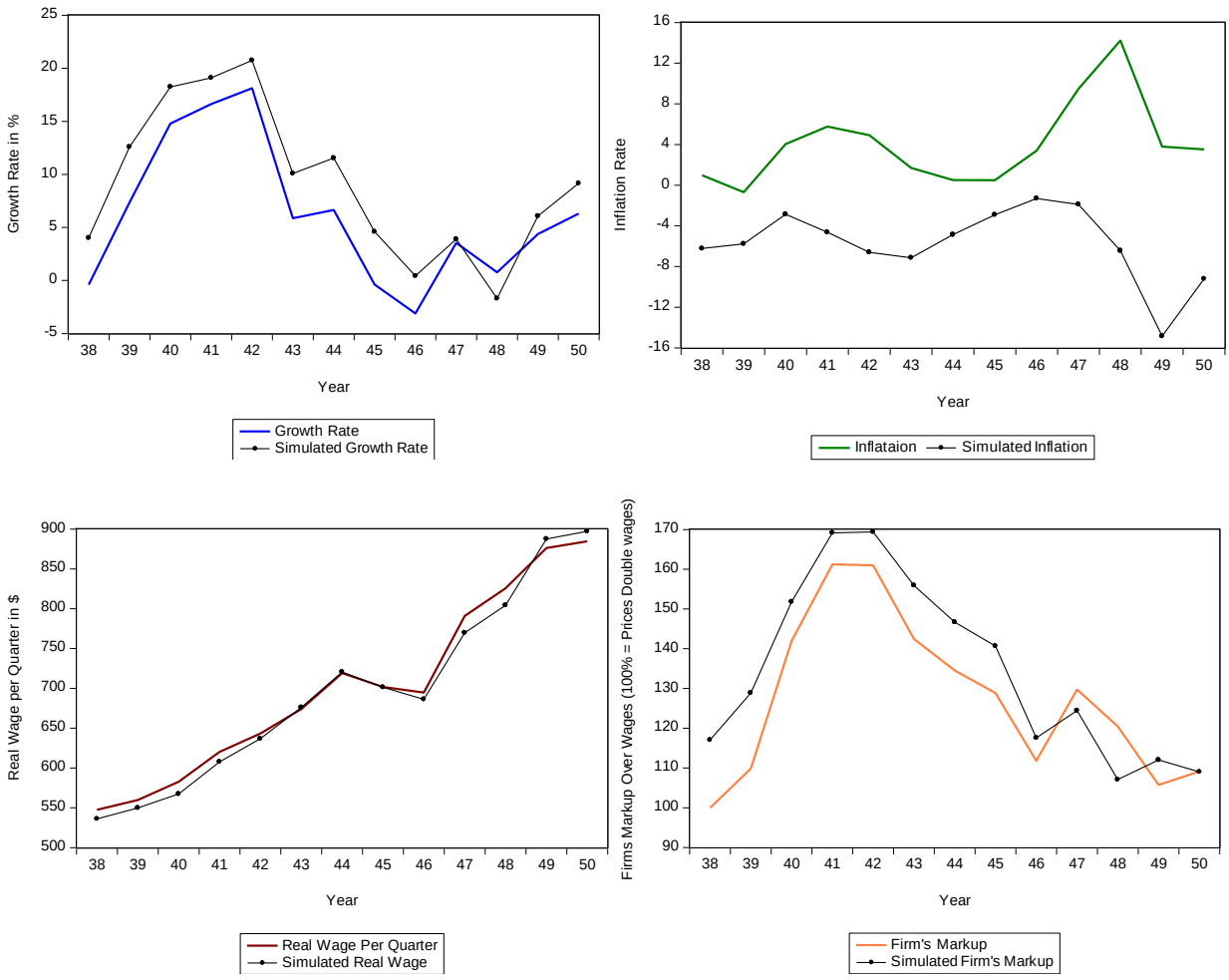



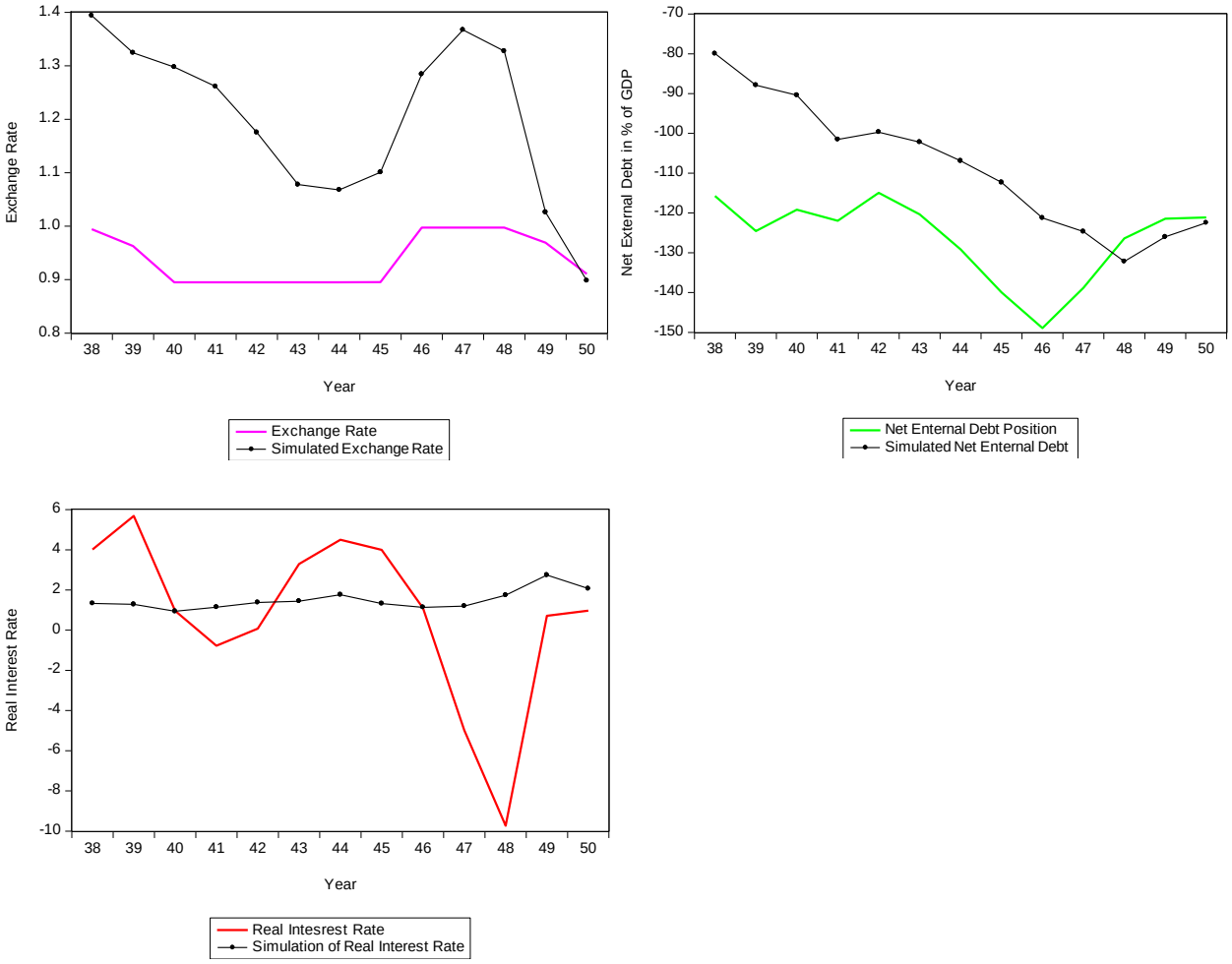

The simulation that will occur in this period will examine the effects of stable real interest rates, and its predicted effects on the overall economic factors. Thus, two real interest rate rules will be implemented. Along with this a system of flexible exchange rates will be implemented, to be more consistent with the free market. The focus of this analysis is to examine what effects the AMM would predict these policies would achieve over an expansionary period, and what effects this policy would have on the recession that immediately followed the end of WWII. The previous two case studies predicted there would be a benefit to reducing the volatility of the real interest rates. This analysis will observe the predicted effects of this policy on "boom" times, where the overall economy was achieving high growth rates.

The first real policy rule will hold the policy rate constant at the central bank. This is a less restrictive rule that would suggest the central bank should change the policy rate with the overall inflation rate. In this case, the average real policy rate was used in this simulation. From 1939-

1950 the average real policy rate was -2.5%. Thus, this rate was set to be the policy rate for the entirety of this period to examine the effects of a stable policy rate rule. This can be observed in figure 3.26 where the actual observed data is in the coloured lines, and the simulation is on the black dotted line.

***Figure 3.26: The Predicted Effects of Implantation of Both a Monetary Policy Rule Holding the Policy Rate at the Central Bank Constant and Floating Exchange Rate, During WWII, with the use of AMM***



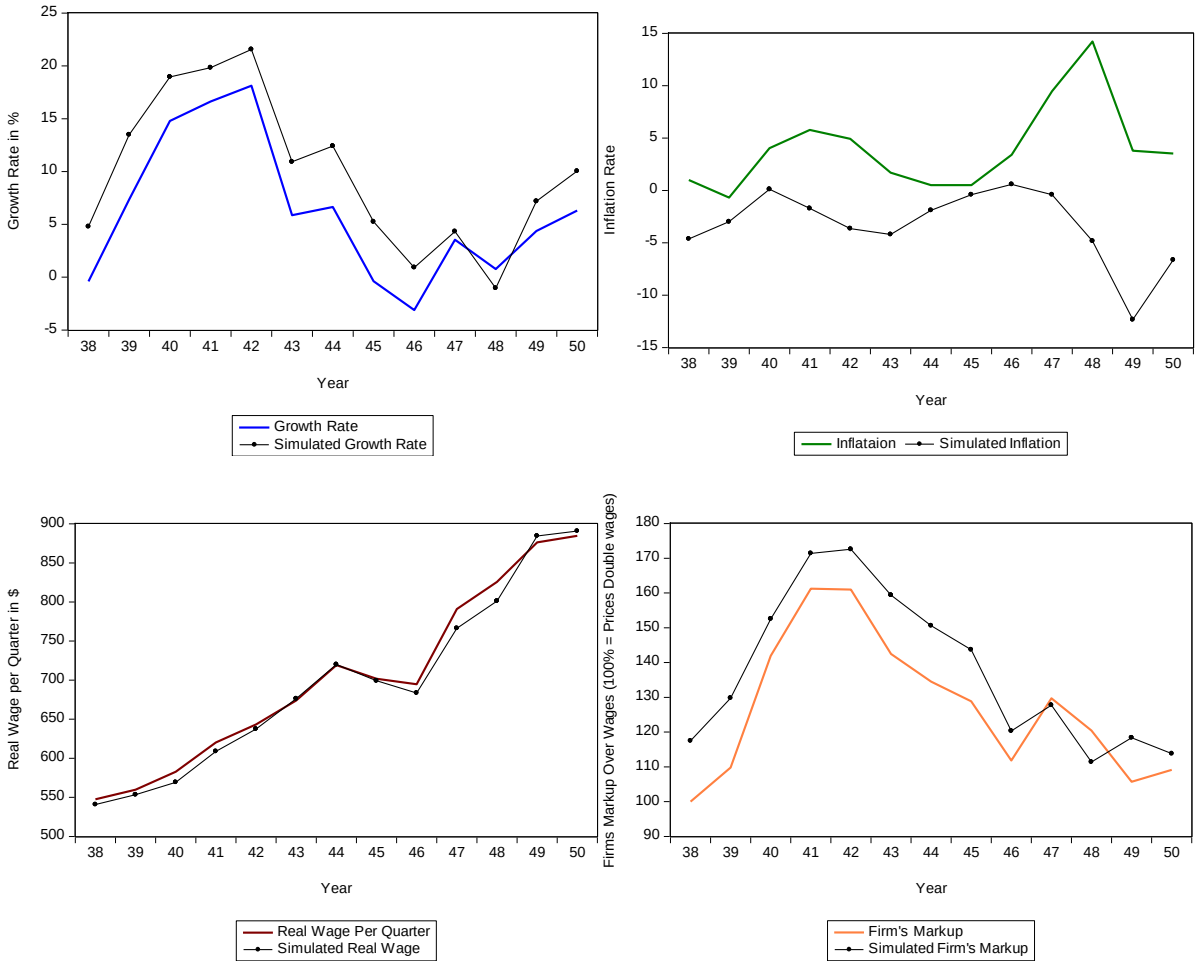


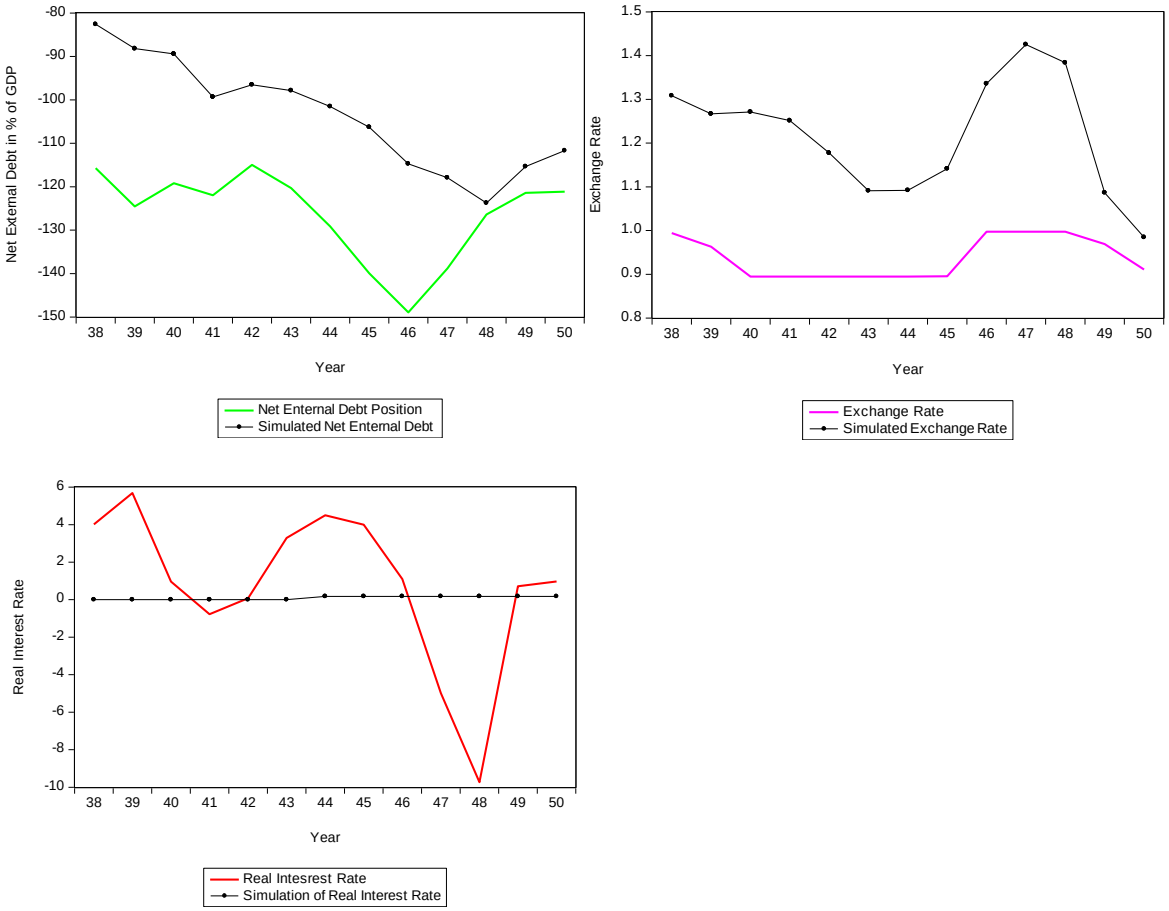

This simulation displays the predictions the AMM makes about the effects of holding the real policy rate constant and having a floating exchange rate. When examining GDP, it can be observed that throughout the boom time of WWII the GDP growth rate was predicted to be increased. In the actual data, after WWII the economy experienced a recession for two years. The stable interest rate policy was predicted to avoid the recession of 1945-1946, with a smaller one-year downturn in 1948. Overall in every year except 1948, the predicted GDP was increased by the stable interest rate policy and floating exchange rate. When examining inflation in every period, the inflation rate was lower than with volatile interest rates, observed in the economic data, as predicted by the AMM. When examining the wages and profits expected by the AMM the wage path was similar to the path experienced without the stable interest rate policy. Business profits, however, were found to be greater in all periods apart from 1947 and 1948. This mechanic of higher business profits in the model is one of the reasons that the GDP growth rates were found to be superior to the ones experienced in the real-world data. The net external debt in the economy was observed to

be less than in the real world, and the Canadian dollar was predicted to appreciate against the US dollar. This analysis showed that the AMM predicted that having stable real interest rates, has beneficial effects on almost every economic characteristic, in both boom time or recessionary times, let it be higher growth rates or lower inflation rates.

The second more restrictive real policy rule would hold constant the real prime rates at the commercial banks, through changes in monetary policy. For this analysis, a fixed real rate of interest must be chosen, and for an unbiased examination, the average real prime interest rate for this period was used. This rate was 0.17%. This will be used for the $r'$ term in equation (3.6) to find the predicted outcomes. The simulations that take this into account can be observed in Figure 3.26a with actual observed data (the colour lines) and the predicted changes of the new policies (the black dotted lines).

***Figure 3.26a: The Predicted Effects of Implantation of Both a Monetary Policy Rule and Floating Exchange Rate, During WWII, with the use of AMM***






From this simulation, it can be observed that the real prime interest rate rule only marginally changed the economic outcome variables. The growth rates, inflation rate, wages, firm's markup, exchange rate, and net indebtedness all followed the same time path as observed in the previous simulation. Although the outcome variables do not show the same results, they follow the same path, and the same findings from the analysis occur. This analysis showed that the AMM predicted that having stable real interest rates, through either policy rule, would in most cases lead to better outcomes, let it be higher growth rates or lower inflation rates.

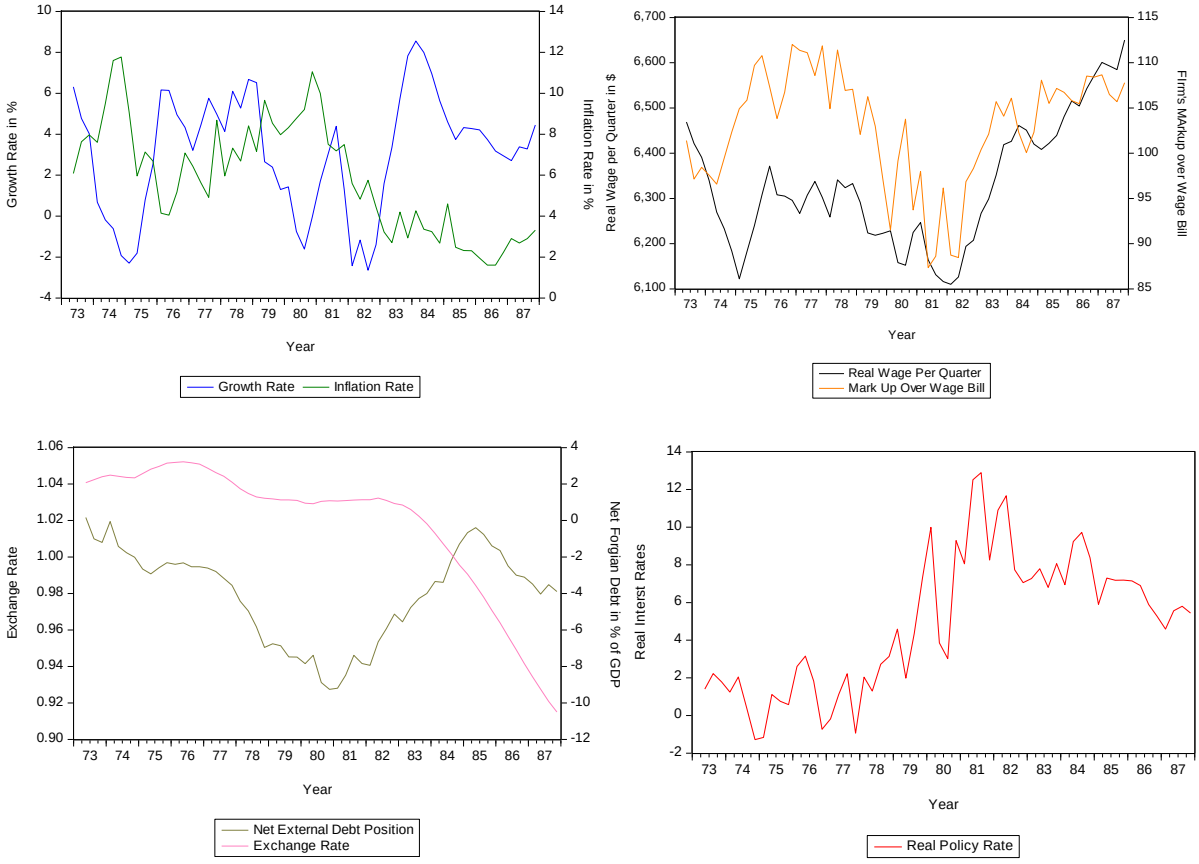
*VII.iv. Stagflation*

The final historical economic event that will be examined is the stagflation of the 1970's. During the 1970's the western economies, especially the United States, had problems with stagflation. Stagflation is a period when high inflation rates, low economic growth rates and a significant amount of unemployment is experienced. These simulations will apply the model to the United States in this period to find how the AMM would predict the economy would react to a stagflation crisis.

Figure 3.27, contains the time paths for the various outcome variables. Many events happened in this period. Most notably the oil shocks of 1974 and 1979. In 1973 and 1974 the Organization of Petroleum Exporting Countries (OPEC) enforced an oil embargo on the United States, over the United States support of Israel. West Texas Intermediate oil prices rose from $3.56 a barrel at the beginning of 1973, to $11.16 a barrel by the end of 1974, a 313% increase in the price of oil. These actions were associated with a loss of productivity and a recession in 1974. At the same time, the inflation rate increased to 12%. In response to the recession of 1974, the Federal Reserve reduced the federal fund's rate in nominal terms from 13% to 4.75%, and with the high inflation rate, this caused the real Federal Funds rates to become negative, for at least part of the year, every year until 1979. Inflation over this period ranged from 4% to 11%. This period was associated with a depreciating exchange rate and a constant net foreign debt position at around 0% of GDP. Additionally, in this period the real wages were stagnant, and the firm's markup was in a range of 100-110% of the wage bill. Unemployment reached a peak of 8.2% in 1975, decreasing to 6% by 1979.

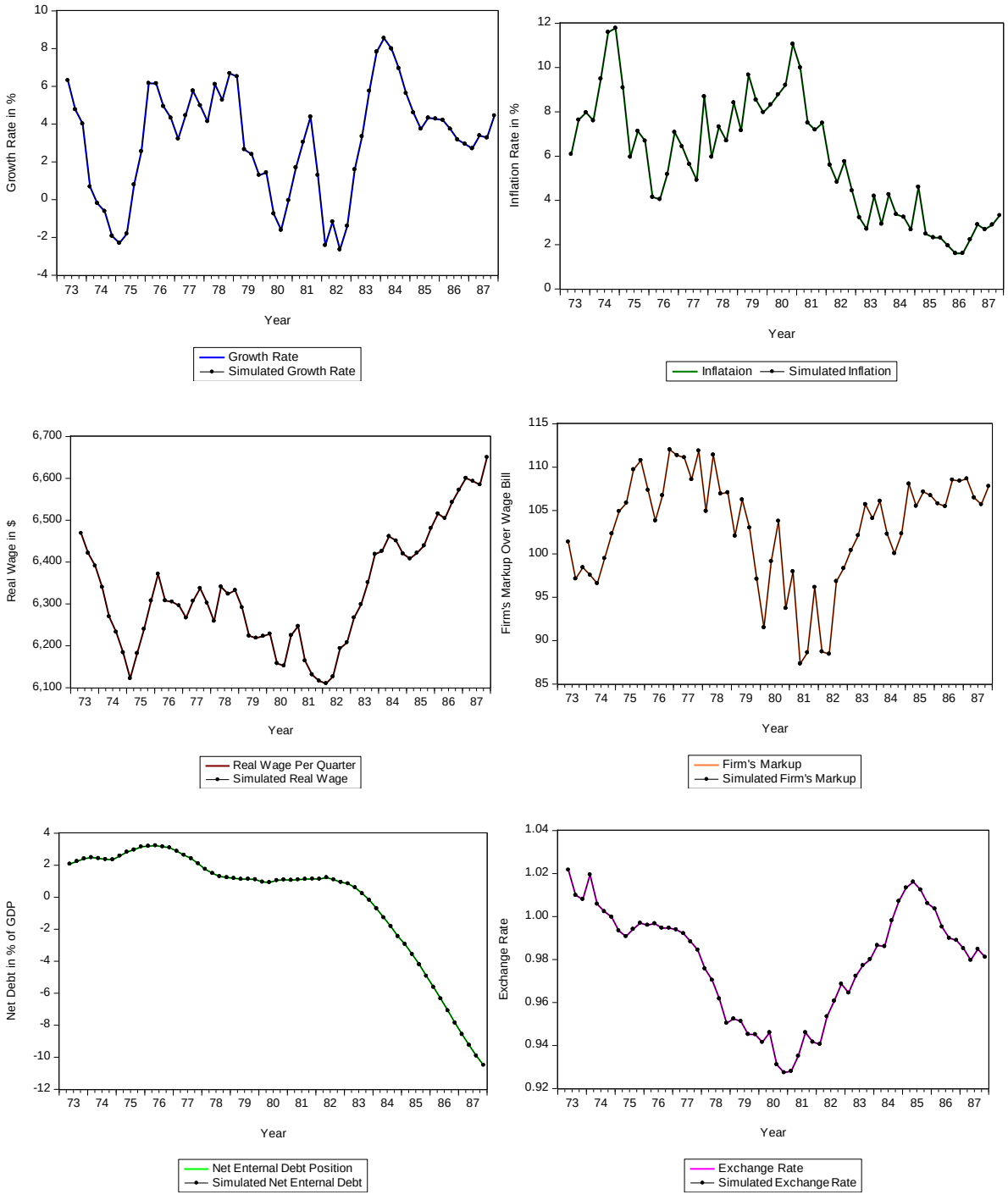
In 1979 Paul Volcker became chair of the Federal Reserve. He responded to the high inflation rates by increasing the nominal federal fund's rate to 20% by 1981. This caused the real rates to increase by 12% over the course of four years. The economy went into recession in 1980 and 1982, the firm's markup and real wages reached a decade low in 1981 and 1982 respectively, and unemployment reached a multi-decade high at 10.8%, a rate higher than any period since the great depression, including the 2008 financial crisis. These actions achieved the goal of decreasing the inflation rate. The early 1980's saw the appreciation of the dollar and the beginning of the increasing net foreign debt position in the United States. The simulation that will be examined in this section will find the predicted effects of alternative policies, using the AMM. These policies will try to achieve an end to the stagflation of 1974, with the same goal of Volcker of reducing the inflation rate, but without having a large adverse effect on the overall economy.

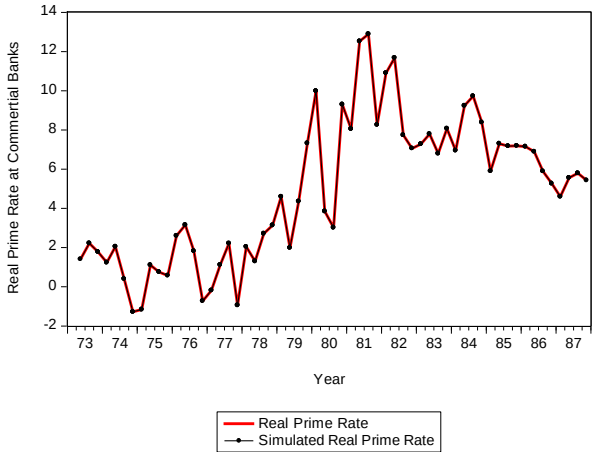
***Figure 3.27: The Seven Economic Outcome Variables in the Stagflation Crisis of the 1970's***




Empirical tests were already conducted on animal spirits and liquidity preference for this period in essay one, thus the constructed exogenous variables have already been examined. Figure 3.28 is the simulation of the event using the AMM. The coloured lines are the actual data, and the black dotted lines are the simulations. Because the simulation was calibrated to the historical data through the constructed exogenous variables, these lines perfectly overlay the actual data making the lines hard to distinguish.

***Figure 3.28: Simulations Compared to Actual Time Paths in the 1970's and 1980's***



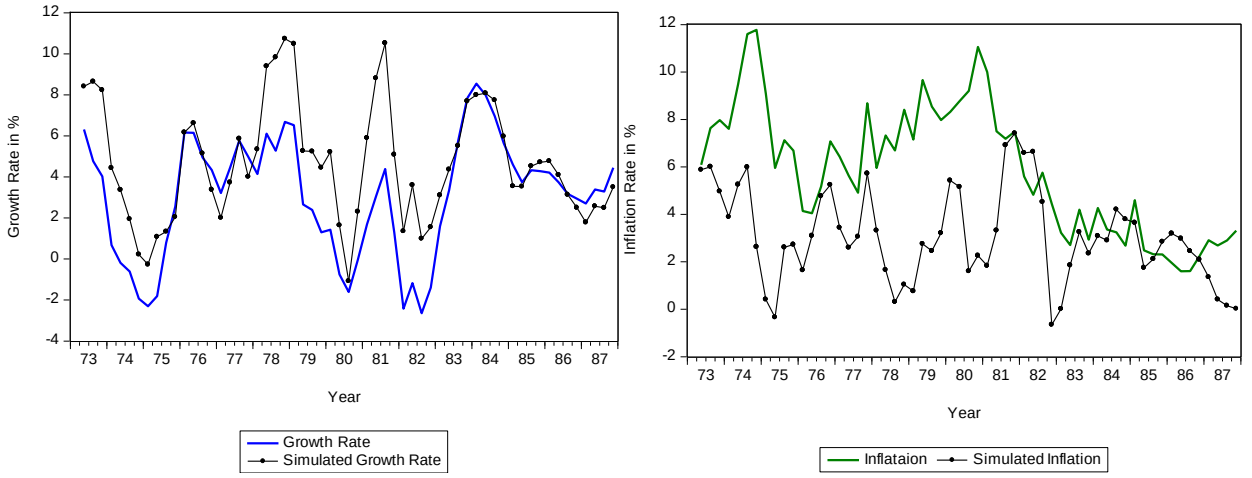


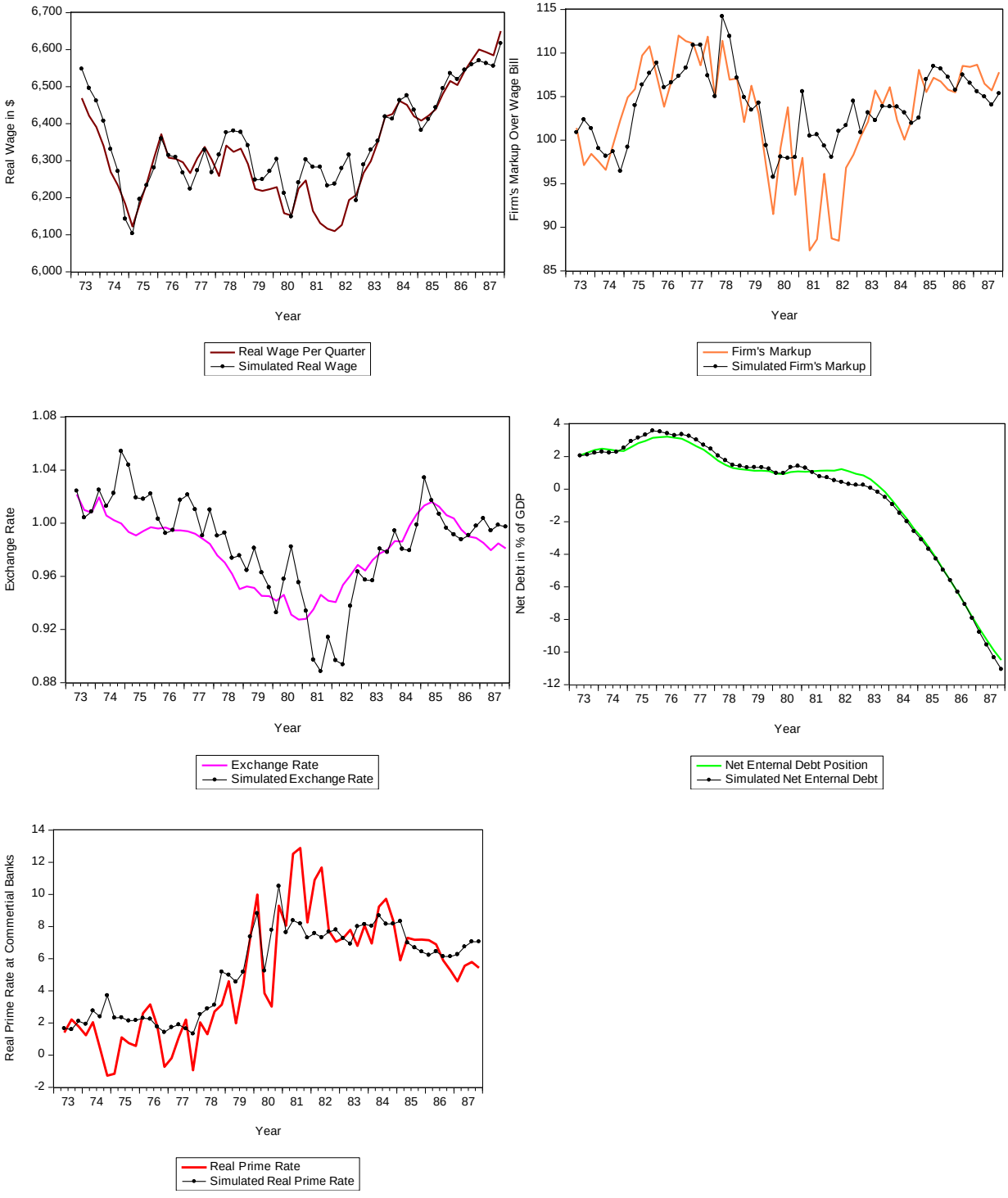

From the baseline simulation, it can be observed that the AMM can perfectly replicate the economic event. This is due to the constructed exogenous variables changing to account for any imbalance. From this baseline simulation, alternative economic policies will be examined, to find if better outcomes were possible when analyzing the event with the AMM. The alternative policies will attempt to decrease the inflation in the 1970's, while at the same time reduce the severity of the two recessions in 1974, and 1980.

There are two different events needing to be addressed, those being the inflation incident and the recessions. In the case of the inflation, the cause is not as simple as it may first appear. The oil shock would have had a positive influence on the inflation rate, but the AMM would predict two other inflationary policies were co-occurring. The first inflationary policy was the monetary policy at the Federal Reserve. The real policy rate at the central bank was kept negative in a significant portion of the period. The theoretical effect of this policy is a higher inflation rate. The second inflationary policy occurring in the 1970's was the fiscal policy. The government spending increased by 9%. An increase in spending, in the earlier simulations, was predicted to be an inflationary event. Clearly, government fiscal and monetary policy could not influence the oil shock. Thus the alternative policies that will be explored will be a focus on mitigating the effects of this shock. The second event that is occurring during this period is the recessions. The recession in 1974 saw a reduction in productivity, and the recession in 1980-1982 was associated with rising real interest rates. Thus the alternative policies being explored in these two instances will be different.

The alternative policies that will be examined will affect both fiscal and monetary policies. The alternative fiscal policies conducted were as followed. First spending was fixed at 1973 levels before 1975 and between 1978 and 1982. During these periods the deficit was held constant, and the reduced spending was coupled with a reduction in the taxes thus government indebtedness was held constant. This action reduced some of the inflation in the period of 1975 and between 1978 and 1982. The second policy change was a single year stimulus in 1975 of 2% of GDP. This was predicted to alleviate the recession of 1975. In all other years no, fiscal changes occurred. The second change was to monetary policy. The action was conducted to limit the volatility in the real policy rate while reducing the volatility and maximum of the inflation rate. The alternative monetary policy examined was as followed. Prior to 1975, the real policy rate was held at 2%, between 1975-1978 the real policy rate was lower to 0%. Between 1978-1979 the real policy rate was increased to 1%, between 1978-1979 the real policy rate was increased to 2.5%, between 1979-1983 the real policy rate was increased to 5%, between 1983-1985 the real policy rate was increased to 6.5%, and between 1985-1987 the real policy rate was lowered to 5%. This is more volatility in the real policy than in the previous economic events as some policy change was needed to counteract the projected high inflation rates. This policy did, however, reduce the actual real policy rate volatility, and as a measure, the standard deviation of the real policy rate was reduced by 30.4%, and the range of values experienced by the real policy rate was reduced by 50%. This simulation can be observed in figure 3.29.

***Figure 3.29: Simulations of the Alternative Fiscal and Monetary Policies Compared to Actual Outcome 1970's and 1980's***






From the simulation in figure 3.29, it can be observed that these policy changes enhanced the growth rate in the economy in most periods. In this simulation, the country is never entering either recession. These actions also reduced the average, range, maximum, and standard deviation of inflation. This meant that there was an avoidance of the stagflation crisis due to not reducing real

policy rates into the negative rates and avoiding the inflationary fiscal policy. The next significant effect these policies had were on the real prime rate at commercial banks. In this case, the range, maximum, and standard deviation were all reduced, but the average was increased, as this was not an "easy money" change. The average interest rates increased 0.5% in this period, but with less volatility than in the actual data. During the early 1980's was the only time wages and the firm's markup was not more than marginally affected. As the recession of the 1980's was avoided both firms and labour situations were improved. The net foreign debt position was only marginally affected, and there was more volatility in the exchange rates, but following the same general pattern. The AMM would suggest avoiding stagflation events it is better to respond with non-inflationary fiscal policy and moderate monetary policy where rates are not changed to the extreme, either positively or negatively. Keeping the policy rate increased in the 1970's avoided the inflationary event and lowering the real policy rate in the 1980's was predicted to keep the economy from going into a severe recession.

## *VIII. Conclusion*

This essay examined the eight-equation version of the AMM. In this model, an additional three equations were included, examining the exchange rates, net foreign debt position, and a monetary policy rule. In the econometric examination, no theoretical boundaries were found to be violated, and the overall estimations were found to be consistent with the predictions in the AMM.

With the validity of animal spirits and liquidity preference variables established in previous essays, further simulations were conducted to examine the effects of the expanded model of the AMM. This now incorporated both the net external debt position and exchange rate dynamics. These simulations found many of the same results as in the five-equation model of the AMM, and the monetary policy rule was found to reduce volatility in the real economy.

These predictions were tested empirically against Canadian data since 1981, to examine if one could find econometric evidence to support the economic relationships predicted by the AMM. In 91% of the economic changes, the econometrics supported the assertions of the model, with varying degrees of statistical significance. The only abnormality was found to be the directional change of the inflation rates in some economic events.

Historical economic events were examined. These events were the recession/financial crisis of 2008, the great depression, the boom of WWII and stagflation of the 1970's. The fiscal policies were predicted to moderately shorten or reduce the depth of the economic events. The AMM predicts that these policies, however, would not avoid the economic events entirely. The AMM predicts there are economic benefits of a monetary policy rule at the central bank that is targeting the real policy rule. This policy was simulated to reduce volatility in rates and make the economy more stable. When examining the great depression, one of the contributing factors was that real interest rates increased to around 16%. A real interest rate rule eliminated this problem, and the AMM predicts that the rule would have vastly shortened the duration and depth of the great depression. When examining WWII, a real interest rate rule was simulated to improve the growth rate in all periods, except one. This could give some evidence to support the creation of a real interest rate rule, at central banks, where the interest rates were maintained at a low but positive rate. This would in effect eliminate significant changes in the prevailing real interest rates at commercial banks, and the AMM predicts this would be beneficial to the economy.

## Concluding Remarks

This concludes the series of three essays on monetary economics in Canada. The primary focus of these essays was on the validity of the Alternate Monetary Model (AMM). The model was tested econometrically and through numeric methods. Adjacent issues were also addressed.

The first essay focused on an examination of the five-equation AMM and tested it empirically with Canadian macroeconomic data. The estimated variables and coefficients were tested against theoretical boundaries, and no violations or anomalies were found. Further, several "constructed exogenous variables" were created, for example, indices for "animal spirits" and "liquidity preference." Animal spirits, as the term has been used in this thesis, may be thought of as an estimate of the composite effects of consumer and business confidence and the Keynesian "propensity to save." It is broader than Keynes's original concept of animal spirits. In several instances, a decline in this variable occurred some quarters before significant economic downturns. Liquidity preference relates to confidence in the financial markets. This variable was found to move with returns in the stock market with a high degree of accuracy. Changes in this number correlated with returns in the financial markets. Using one standard deviation as the benchmark, when liquidity preference decreased, the stock market decreased the following period 75% of the time. Predicting market directions at this rate or better by random chance would only occur at a rate of 1.77%. Additionally, four of the seven most substantial losses in the stock market, losses over 10% in a three-month period, were identified. For an increase in the liquidity preference term, it identified the correct direction of the market, for the current period 92% of the time, if predicting market directions by random chance the chance of having this accuracy or better is 4.25%. Also, a study of monetary transmission mechanism was conducted. It was found that since the 1980's, there has been a steady relationship between the overnight rate at the central bank and the prime rate at commercial banks. This relationship was tested, and it was found that the commercial banks were following the rate changes at the central bank. This gives evidence in support of there being endogenous money in the Canadian financial system and that the policy rate is an efficient tool for the Bank of Canada to affect interest rates in the economy.

The second essay continued the work of the first, using the findings to conduct simulations of the economy for the five-equation version of the AMM. A variety of different policies were tested, and predictions made for the time paths of several variables such as growth rates and

inflation rates and for the income shares of different economic groups in the economy (e.g., firms, labour, and rentiers). These models were then expanded a more general form of the AMM, and the conclusions were largely consistent across models. One conclusion is that deficits could spur economic activity. This brings up the inevitable question of why, if a small deficit is beneficial to the economy, should we not run a massive deficit forever.

This question has two different subsections. The first relates to government debt sustainability. Sustainability was examined on the basis of debt dynamics relating to debt-to-GDP. Two propositions were stated (a) when the government debt was converging to a steady-state level, and (b) when it was expanding to infinity. The first proposition relies on the real interest rate on government debt being lower than the economic growth rate. In many existing models of deficits, this is assumed to be an impossibility as the models impose transversality and government no-Ponzi conditions. However, when exploring the data, it was found that in Canada growth rates were higher than real interest rates on government debt in half the periods studied. This is not to say, however, that large deficits "do not matter" as the other half of the time interest rates on government debt are above this level. In those scenarios, the second proposition stated that government debt to GDP ratio was on a path to either, infinite government debt, or infinite government assets depending on the primary deficit of the government. A second conclusion from the dynamic analysis is that a balanced budget was only needed for sustainability if the real interest rates were higher than growth rates, combined with zero economic growth. A statement about third world debt was also made. The conclusion was that debt relief may not be necessary to put a country on a balanced path regarding debt to GDP. Reducing the interest rates on government debt below the growth rate would put that country into a position of a converging debt-to-GDP ratio. Interest rates were found to be very important in determining sustainability. An examination of interest rates on government debt in Canada was also conducted. It was found that the main determinant of the interest rate on government debt was the overnight rate at the Bank of Canada and that government bonds moved to keep a relationship with these rates. To keep government debt on a converging path, a low-interest policy at the central bank will be beneficial. This is more evidence that the policy rate at the Bank of Canada is a critical policy tool as it affects the prevailing interest rate at commercial banks and both short-term and long-term rates on government bonds. In Canada, there is very little evidence that government budget deficits have any meaningful long-term effect on interest rates.

An examination of Okun's law was also conducted in essay two, exploring the relationship between unemployment and the growth rate. The results, in this case, were very much in line with what was found for other developed nations, that growth must increase more than 1% to reduce the unemployment rate by 1%. The study was further used to examine if there was a limit to economic growth. It was found that there was indeed a limit to growth based on how low unemployment rates can go. One example of this would be during WWII. There was a significant government stimulus, thus increasing the growth rate, but this may have had diminishing efficiency as the unemployment rate approached zero percent in the latter years of the war.

The third essay examined the eight-equation version of the AMM incorporating both the net external debt position and exchange rate dynamics. The analysis in this section verifies that there is a codependent relationship between the exchange rate and the net foreign debt position. Additionally, the exchange rates were found to move with the countries currency liquidity preference variable created in this analysis. Further simulations were conducted on a variety of government policies and economic events to measure the effects these events would have on the value of the currency and debt position of the nation. These changes were tested econometrically to determine if the same results could be found in the Canadian data set as predicted in the simulations. The econometrics found that these predictions were accurate for the directional changes 91% of the time, with a varying degree of statistical significance. The econometrics indicated that in the majority of instances, there was evidence to support the conclusions of the AMM at a 90% confidence interval. This evidence supported the predictions of the AMM for growth, interest rates, wages, and the firm's markup in all nine tests. The only economic variable to find any evidence to the contrary was the inflation variable, wherein four of the nine tests it was found to contradict the theoretical findings of the AMM.

The final analysis of essay three examined historical economic events. The economic events that were examined were the recession/financial crisis of 2008, the great depression, the economic boom of WWII, and the stagflation crisis of the 1970's. Overall different fiscal policies were found to shorten somewhat or reduce the depth of the economic events. The AMM predicts that these policies, however, did not give a clear indication of how to respond, to avoid the economic events entirely, without significantly expanding the deficit. What did have a significant effect on all these economic events was a fixed real interests rate policy, at the central bank. This reduction

in the volatility of the real policy rate was found to have beneficial effects on the economic outcome variables. When examining the great depression, one of the contributing factors was that real interest rates greatly increased. A real interest rate rule eliminated this problem, and as the AMM predicted would have vastly shortened the duration and depth of the great depression. When examining WWII, a fixed real interest rate rule was found to improve the growth rate in all periods except one. This could give some evidence to support the creation of a real interest rate rule at the central bank.

One of the key overarching themes through this essay is the influence the central bank may have on the economy. When examining the findings of all three essays, one can observe that the central bank's interest rate rule can affect many aspects of the economy. In essay one, it was found that the transmission between the policy rate at the central bank, and the prime rate at commercial banks currently have a robust relationship, and the commercial banks change rates based on the central bank's decisions. Any policy changes will be transmitted through to the interest rates at commercial banks, and throughout the economy at a higher degree than any other period in Canadian history. Essay two examined the relationship between the policy rate at the central banks, and interest rates on government debt. A significant relationship between interest on government debt and the policy rate at the central bank was found, with the central bank leading this relationship. Further, there were debt sustainability implications for the government, where higher interest rates on government debt made a sustainable outcome harder to achieve. Thus, if the central bank sets interest rates at a lower level, it may put the government debt in a position where it is easier to achieve sustainability. Finally, in the third essay, a policy rule was added into the model, and it indicated when the volatility was eliminated for the commercial bank's interest rates, it led to better economic outcomes when simulating the economy with the AMM. Thus, summarizing these three findings, it would indicate that commercial banks follow the lead of the central bank, the government debt position is better off with lower interest rates, and the economy experiences better economic performance with less volatility with a real policy rate at the central bank. This may indicate a benefit to having a policy rule at the central bank that maintains a fixed real policy rate, at a level low enough to maintain government debt sustainability.

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