The Impact of Macroeconomic Factors on Common Equity Returns, an Examination of Canadian and American Equity Markets

by

Scott Robson

An essay submitted to the Department of Economics
in partial fulfillment of the requirements for
the degree of Master of Arts

Queen's University
Kingston, Ontario, Canada

August 2009

Acknowledgements

I would like to thank the faculty and staff of the Queen's Economics Department for an excellent year. In particular I'd like to thank my supervisor, Charles Beach, for his excellent advice and extremely timely responses to a somewhat tardy paper on my part.

I would also like to thank my fellow students within the Masters program for their insight, shared experiences and commiseration. While I'd say that everyone played some role in my development as a better student, I'd particularly like to thank Adam Cooper, Patrick Day, Curtis (Yinho) Chow, Terry (Chong) Lio and Anthony Wray for being instrumental in my success as a student here.

Last but not least, I'd like to thank my immediate family and roommates for being sounding boards for ideas. Mum and Dad, thank you for listening so intently to subject matter that I'm certain you didn't find particularly enthralling. My roommates, Andrew Palombella and Raimond Gordienko, thank you for looking over my work from an outside perspective and providing valuable insight.

Contents

List of Tables

List of Figures

1 Introduction

Equity markets play an important role in the effective allocation of capital within an economy. Properly functioning capital markets are especially important to the functioning of developed economies. Levine (1997) shows that countries with more developed banking systems and active stock markets exhibit higher growth in the long term than less financially developed nations. Healthy stock markets are an important factor in spurring economic growth for a nation. Therefore, ensuring that markets remain active and vibrant is an important consideration for governments.

The fundamental concern of investors in equity markets remains returns on investment. By providing capital to entrepreneurs, investors effectively contribute to the efficient allocation of capital. This leads to the accumulation of capital within an economy, a factor which facilitates healthy economic growth. In order to be willing to invest, investors must have the expectation of receiving a return which is commensurate with the risk they are taking in investing. Effectively operating financial markets provide an effective means of mitigating some of the risk involved with this process by providing a regulated venue for this interaction to take place

While functioning financial markets have an impact on the healthy economic growth of a nation, the converse is also true. Macroeconomic factors within an economy have an influence on financial markets, a relationship explored in some detail within the last half century (Nelson, 1976; Huybens and Smith, 1999). The impact of macro factors upon financial instruments such as bond yields has been explored (Ang and Piazzesi, 2003), as how domestic and foreign markets impact output and goods markets (Fry, Hocking, and Martin, 2008), but the impact of macroeconomic factors upon equity returns is not deeply explored, especially from a Canadian context.

This paper sets out to explore the relationship between macroeconomic factors such as GDP, employment, the price level and energy prices upon stock market returns in Canada and the United States. Using data on returns from the Toronto Stock Exchange for Canada and the Standard and Poor's 500 for the United States, these relationships are analyzed, and the results from both countries contrasted to see how they differ. This is done using a simple vector auto-regressive (VAR) framework, with a series of recursive contemporaneous restrictions imposed on the framework.

Results indicate that both Canadian and US returns are affected significantly by shocks to macroeconomic factors, however the respective magnitude of these impacts differs between countries. Canadian returns are most deeply affected by shocks to the Canada-United States exchange rate and GDP shocks, while American returns exhibit a more heightened response to the price level, employment and the international price of oil.

The layout of this paper is as follows. Section 2 examines the relevant literature examining the relationship between macroeconomic factors and financial markets. Section 3 provides the layout of the VAR model used. Section 4 describes the data used in analysis, while Section 5 presents the empirical results. Section 6 concludes.

2 Literature Review

The examination of the relationship between financial markets and macroeconomic factors has been a rich area of economic pursuit for many decades. A desire to understand the transmission of shocks between financial and real markets, effectively model them, and devise adequate economic theory to interpret these relationships has created a steady flow of economic literature. Given the importance these interactions can have on effective government policy, a great deal of continued research in this field can be expected. The exploration of the impact of macroeconomic factors on equity markets is relatively unexplored in a Canadian context, creating an opportunity for further investigation.

Prior to the late 1960's, most economists and those following financial markets were likely of the belief that returns on common stocks were directly correlated with inflation. This was an extension of Irving Fisher's hypothesis regarding expected rates of returns on common stocks (Fisher, 1930) . This hypothesis states that the expected return on common stocks ($E(R_t|I_t)$) is composed of a 'real' return (α_t) and the expected rate of inflation ($E(\rho_t|I_t)$)

$$E(R_t|I_t) = \alpha_t + E(\rho_t|I_t) \tag{1}$$

where I_t is the information available to agents at time t. The presumption was that expected returns would adjust for any change in inflation, effectively compensating investors for a change in their purchasing power.

However, by the early 1970's, it appeared there was significant contradictory evidence of financial markets not following the Fisher hypothesis, and Nelson (1976) set out to empirically test the relationship between inflation and common equity returns. Using quarterly returns on the Standard and Poor's 500 index and the US Consumer Price Index (CPI) for the period 1953-1972, Nelson regressed common equity returns on change in price levels. What he found was a negative relationship between returns on common stocks and inflation, a result which contradicted the Fisher hypothesis. The relationship was persistent, holding with regards to both lagged, current and future values of inflation. Decomposing future values of inflation into expected (trend) and unexpected (non-trend) components, Nelson found both components to have a consistently negative relationship with returns. By empirically confirming that the Fisher hypothesis did not hold, Nelson (1976) opened the door for continued research seeking to explain this seemingly contradictory association. Theoretical research since (Huybens and Smith, 1999) attributes this relationship to informational asymmetries. In order to efficiently allocate capital, the financial sector must have an idea of expected return on investment. Huybens and Smith (1999) models high average productivity investment capital production as having a long gestation period, with variable output. Inflation negatively impacts effective borrowing, resulting in investors retreating to less productive capital production which produces in the next period. Higher inflation leads to an unwillingness to lend to riskier enterprises, leading to increased investment in less innovative, but more dependable endeavours. Boyd, Levine, and Smith (2001), an empirical paper aiming to test this theoretical assertion, confirms this holds true, there being significant negative linkages between financial sector performance and inflation.

The advent of more sophisticated econometric tools over the last 30 years has allowed for the usage of powerful empirical methods to more accurately forecast economic conditions and characterize data processes. Christopher Sims was responsible for the introduction of the Vector Autoregressive (VAR) framework in 1980, a powerful tool where the current level of a variable can be explained using the current and lagged values of all the variables within the system, allowing for more detailed forecasting (Sims, 1980). This methodology also allows practitioners to analyze how shocks originating in one variable transmit through the system, as well as decompose the forecasting error variance of a factor into constituent parts. Like most statistical regressions, the VAR methodology does not differentiate between causation and correlation. In order to solve this problem requires the application of sound economic theory and logic. To identify and test the causal chain in a VAR model, some form of structural restrictions need be imposed on the interaction of variables, either short term or long term.

Using VAR methods to study the interaction between bond market yields and macroeconomic factors has become common practice in the bond pricing literature. Estrella and Mishkin (1997), and others have performed VAR analysis of yield structures and their interplay with macroeconomic variables, making excellent progress advancing the understanding of yield curve responses to macro shocks via impulse response analysis and error decomposition. However, one of the limitations of this approach is that the system is constrained to describing the behaviour of maturities included in the model, restricting broad applicability, and is also unable to take into account any latent variables which may exist.

Research modeling the term structure of bond yields using latent variable specifications had proven successful in explaining term structure movements (Dai and Singleton, 2000). The issue with this approach is that latent factors are not clearly interpretable in what they represent; while these models describe the effect these latent factors have on the yield curve, they cannot explain the economic source of shocks, thus hindering the use of these models as policy tools.

Ang and Piazzesi (2003) uses a structural VAR methodology to account for bond yield curve responses to macroeconomic factors, while talking latent variables into account. By combining both modeling approaches, the authors are able to capitalize on the advantages of both techniques. What results is a model capable of describing the entire yield curve response to macroeconomic and latent factor shocks for bonds of all maturities, with the ability to perform impulse response and forecast error variance analyses. The authors find that, for short to medium term maturity bonds, macroeconomic factors can explain up to 85% of the forecast variance of the yield curve; while for longer maturity bonds, latent factors still account for most (60%) of forecast variance in yields. They also discover that a significant portion of latent factor variability is attributable to macroeconomic factors. Improving the effectiveness of yield curve forecasting, Ang and Piazzesi (2003) advanced the economics of bond pricing utilizing a vector autoregressive methodology.

Structural VAR models have also been successfully utilized to evaluate the relationship between equity markets and macroeconomic factors. Fry, Hocking, and Martin (2008) notes Australian equity market capitalization increased a staggering 519% from 1991 to 2004 in nominal terms, while Australian nominal GDP increased 210% in the same period. This increase brought the ratio of domestic market capitalization to GDP from 47.8% in 1991 to 101.3% in 2004, a more than two-fold increase in a little over a decade. Additionally, the number of Australian adults owning stock increased from 14.7% to 55.0% in the same period, with approximately two-thirds of ownership being domestic equity and the remainder foreign. Given the significant change in the structure of Australian equity holdings in this period, Fry, Hocking, and Martin (2008) were interested in determining how these changes impacted the Australian economic response to equity shocks, both foreign (US) and domestic. To do so, a structural VAR model was constructed, with identification achieved via the imposition of a set of long-run restrictions on variable interaction, while allowing variables to freely influence one another in the short-run. The restrictions chosen were based on a number of economic theories, including the natural rate hypothesis, purchasing power parity (PPP) and monetary neutrality.

After estimating the model, Fry, Hocking, and Martin (2008) found equity shocks to have significant wealth effects from the impact on interest rates and goods prices, with foreign equity shock effects on domestic goods markets occurring almost exclusively through their impact on domestic equity. This indirect transmission mechanism provides additional evidence of a home equity bias, a phenomenon where investors hold low amounts of foreign equity relative to their domestic holdings, despite the advantages of international diversification (French and Poterba, 1991). Additionally, the US-Australian exchange rate was found to deviate from PPP levels when the economy was subjected to either portfolio or price shocks. Financial crises in the United States had the effect of causing Australian equity to be significantly undervalued by 2005, although this appears to prove transitory. In short, they found equity shocks have a significant impact on goods markets within the Australian economy, and they found continued evidence of the home equity bias puzzle.

3 Outline of Modeling Approach

3.1 Specification of Model

To identify the interaction between financial markets and macroeconomic factors, a 7-variable Vector Autoregressive (VAR) model will be introduced. The vector representation of the factors under consideration is

$$Y_t = (Fin_t, FX_t, CPI_t, R_t, GDP_t, emp_t, oil_t) \tag{2}$$

where Fin_t represents the financial market index under consideration, GDP_t is real GDP at time t, R_t is the treasury bill rate at time t (3 month for Canada,13-week for United States), emp_t is the number of employed individuals in the labour market, oil_t is the price of oil per barrel in US dollars, CPI_t is the consumer price index (CPI) and FX_t is the exchange rate between Canada and the United States. In specifying these variables, all except the financial index variable are expressed as natural logarithms. In taking the natural logarithm of variables, the first difference of the vector of variables, ΔY_t represents the growth rate in macroeconomic factors, while returns are the adjusted returns on equity. Adjusted returns on equity includes both the capital gains on a group of equities, as well as assuming distributions, such as dividends, are reinvested back into the index. This specification also addresses the fact that these time series variables, like most economic time series contain unit roots of order one, which can be seen in Table 1 . To test for the presence of unit roots within the data series, an augmented Dickey-Fuller Test is used.[1] If a data process has a unit root process, shocks to the process cause permanent effects, and the variance of the process is dependent on the current time (given enough time, variance will diverge to infinity).

To model the dynamics of this system, it is helpful to represent the factors under consideration as a multivariate, or vector, autoregression of the variables defined in Equation 2. Allowing the current value of each variable to be described as a function

[1] For an excellent text detailing VAR modeling, identification and estimation, see Enders (1995).

Table 1: Variable Unit Root Tests

Variable	Canada		United States	
	Base Variables			
	Test Statistic	P-Value	Test Statistic	P-Value
GDP	3.784	1.000	17.583	0.9988
Interest Rate	-1.896	0.334	-2.07	0.2566
Oil Price	0.496	0.9847	0.496	0.9847
Employment	-0.889	0.7916	0.131	0.9681
CPI	2.481	0.999	4.964	1.000
	First Differenced Variables			
Fin	-12.352	0.000	-12.877	0.000
GDP	-7.971	0.000	-4.944	0.000
Interest Rate	-10.476	0.000	-10.714	0.000
Oil Price	-11.211	0.000	-11.211	0.000
Employment	-13.372	0.000	-8.123	0.000
CPI	-7.369	0.000	-6.71	0.000

The 5% critical value for the Augmented Dickey Fuller test with 184 observations is -2.885.

of it's own lagged values, as well as the lagged values of all other variables in the system, VAR analysis provides a versatile solution to dynamic analysis. The formal description of the VAR is

$$(A_0 - A_1 L - A_2 L^2 - \ldots - A_p L^p) Y_t = \alpha + \epsilon_t \tag{3}$$

where $L^k Y_t = Y_{t-k}$ defines the lag operator, A_k are (7×7) matrices of autoregressive coefficients with A_0 being an identity matrix, p is the length of lag, and ϵ_t is a seven element multivariate normal random disturbance. ϵ_t has the properties of having zero mean $E[\epsilon_t] = 0$, contemporaneous covariance matrix $E[\epsilon_t^{'} \epsilon_t] = \Omega$ and no autocorrelation $E[\epsilon_t^{'} \epsilon_{t-s}] = 0$, $\forall t \neq s$. α is a set of deterministic components, the (7×1) vector of intercepts. This specification can estimate a system which allows for the utilization of impulse response functions (IRF) as a means of characterizing the direction of dynamic responses in Y_t to a one-time shock to a variable in ϵ_t. The VAR framework also allows for the performance of Forecast Error Variance Decompositions (FEVD), a methodology which characterizes the relative importance of shocks on the Y_t variables. Despite these useful features, the base VAR specification suffers the limitation that estimated coefficients are not interpretable in a particularly meaningful manner beyond their relative sign and magnitude.

A VAR model can be transformed into its vector moving average (VMA) representation, and by doing so, the dynamic properties of the model can be identified.

$$Y_t = \sum_{i=0}^{\infty} C_i \epsilon_{t-i} = (C_0 + C_1 L + C_2 L^2 + \ldots)\epsilon_t + = C(L)\epsilon_t \tag{4}$$

where the C_i are 7×7 matrices of moving average (MA) coefficients, which are functions of the autoregressive parameters of the VAR specification.

To characterize the VAR representation in a manner which allows for more meaningful interpretation of parameter estimates by imposing restrictions on variable interaction based on economic theory, a structural VAR (SVAR) representation is used where

$$A(L)Y_t = (A_0 - \sum_{k=1}^{\infty} A_k L^k)Y_t = \epsilon_t \tag{5}$$

where the matrix A_0 is no longer an identity matirx, but now characterizes the potential contemporaneous impact of the endogenous variables on one another. In characterizing $A(L)$ an appropriate finite lag length, p, is selected. The resultant structural VAR is

$$A_0 Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_p Y_{t-p} + \epsilon_t \tag{6}$$

To recover the structural parameters for the VAR, a reduced form VAR is first estimated from available data

$$Y_t = \Phi_1 Y_{t-1} + \ldots + \Phi_p Y_{t-p} + e_t \tag{7}$$

where $\Phi_i = A_0^{-1} A_i$, $e_t = A_0^{-1}\epsilon_t$, and the covariance matrix of e, Σ_e is of the form $\Sigma_e = A_0^{-1}\Sigma_\epsilon (A_o^{-1})'$, and structural parameters are then recovered under appropriate conditions (Enders, 1995). The reduced form VAR representation contains fewer parameters($pn^2 + n(n+1)/2$) than the structural VAR ($(n+1)n^2 + n(n+1)/2$) representation. Therefore, in order to identify the structural VAR, n^2 parameters must be restricted. These restrictions may be made upon the $\sum_{i=0}^{p} A_i$ matrices or the

Σ_ϵ matrix. The matrix A_0 represents the contemporaneous effect of a variable upon the other variables within the system. As such, the diagonal is naturally comprised of ones, providing n restrictions, requiring the imposition of an additional $n(n+1)$ restrictions to identify the system.

3.2 Restrictions on Contemporaneous Coefficients

In specifying restrictions to identify the model, financial markets are restricted from having an effect on other variables contemporaneously. Because the data used is quarterly, these restrictions are relatively short-term. The effect of the other variables within the system contemporaneously is not restricted however, being allowed to freely affect market returns contemporaneously. Also restricted is the contemporaneous effect of domestic variables on the international price of oil, preventing values of domestic macroeconomic variables from having a contemporaneous effect on the international price of oil. The effect of contemporaneous variables is also restricted on employment, under the presumption that labour markets adjust after changes in other variables. Initially, however, the price of oil is able to influenced employment, to determine if energy shocks have an immediate effect on labour demand.

Gross domestic product is restricted to having a contemporaneous effect on all variables other than employment and the price of oil, while being influenced in the current period by oil prices and employment. The Canadian-US foreign exchange rate is allowed to influence equity markets contemporaneously, while being restricted from having a contemporaneous effect on all other variables. The price level is similarly restricted, only having an effect on stock returns and the foreign exchange rate in the short run. The interest rate, while allowed to affect equity markets, the foreign exchange and the price level in the short term, is restricted from having a contemporaneous effect on GDP, employment levels and the international price of oil. This specification of contemporaneous restrictions forms a triangular system of equations, as can be seen in the contemporaneous coefficient matrix A_0 summarized in Table 2.

In predicting the contemporaneous coefficients for the return equation, it is expected that for the Canadian data series that changes in the Canada-U.S. foreign exchange rate (FX_t), the treasury bill rate (R_t), the price level (CPI_t) and the price of oil (oil_t) will have positive coefficients. The predicted coefficient for a change in GDP (GDP_t) is indeterminate. This is due to GDP potentially causing either higher growth of capital, increasing equity returns, or a decrease in required equity returns due to an increased number of investors in the equity market. The effect of employment changes (emp_t) are expected to be small with an indeterminate sign as well.

Predictions regarding contemporaneous coefficients for the United States are the same as predictions regarding Canadian values, with the exception that the coefficient for changes in the Canada-U.S. foreign exchange rate (FX_t) is expected to be insignificant to contemporaneous returns.

Remaining restrictions are imposed on the $\Sigma_{epsilon}$ matrix; a diagonal matrix is imposed, with the diagonal error variances being freely estimated. This creates a recursive system of equations.

Table 2: Contemporaneous Coefficient Matrix

	Fin	FX	CPI	Rate	GDP	emp	oil
Fin	1	a_{12}	a_{13}	a_{14}	a_{15}	a_{16}	a_{17}
FX	0	1	a_{23}	a_{24}	a_{25}	a_{26}	a_{27}
CPI	0	0	1	a_{34}	a_{35}	a_{36}	a_{37}
Rate	0	0	0	1	a_{45}	a_{46}	a_{47}
GDP	0	0	0	0	1	a_{56}	a_{57}
emp	0	0	0	0	0	1	a_{67}
oil	0	0	0	0	0	0	1

4 Data Sources for the Study

The data analyzed is quarterly, beginning from April 1962 and continuing until March 2008, for a total of 184 observations. Oil prices and the Canadian-US exchange rate are shared in the Canadian and US analyses. The remainder of data is obtained from a variety of sources unique to each country. For a precise listing of data sources, see Table 10 in the Appendix.

The price of oil (oil_t) is obtained from the International Monetary Fund's (IMF) International Financial Statistics (IFS) database. Expressed in US dollars per barrel, it is the average international spot price for that period. The Canadian-United States exchange rate is obtained from the Canadian Financial Market Research Centre (CFMRC) database. Data on the exchange rate is received via Statistics Canada. The exchange rate is expressed in both data sets as the amount of foreign currency receivable for one unit of domestic currency.

4.1 Canadian Data Series

The variable Fin_t is the CFMRC Value-Weighted Return Index and is measured in decimal terms. The CFMRC return index is based on all domestic common equities in their database for the TSX, and is fully adjusted for distributions. The Toronto Stock Exchange comprises the vast majority of shares traded in Canada, being the primary avenue for equity trading in Canada.[2] A simple measure of returns involves first differencing a market index, however this does not take account of dividend payouts or events such as stock splits. By re-adding distributions, a total return index acts as if all profits were reinvested, and the return was the first differenced index. Real output (GDP_t) is obtained from Statistics Canada via their CANSIM database. It is seasonally adjusted and calculated using an expenditure-based approach and reported in real terms, with 2002 being the base year. The Consumer Price Index

[2]Government of Canada. 1878-The Toronto Stock Exchange. accessed July 27th, 2009. $http://canadianeconomy.gc.ca/english/economy/1878Toronto_Stock_Exchange.html$

(CPI_t) is also obtained via CANSIM, with the reference year basket of goods being 2005. Employment numbers (emp_t) also are obtained from Statistics Canada, and are the total number of employed adults in the economy, with these values being seasonally adjusted. In 1976, Statistics Canada altered the method by which it tracks employment, the Labour Force Survey. This change creates a singular jump in the number of reported employees from December 1975 to January 1976. Treasury bill rates (R_t) are obtained via the IFS database. They are the weighted average yield on successful bids on three-month treasury bills. The source of these rates is the Bank of Canada, Canada's central bank.

4.2 United States Data Series

Returns (Fin_t) used for United States data is also a value-weighted return index and is measured in decimal terms. The source for this is the Centre for Research in Security Prices (CRSP). The index used is based upon the Standard and Poor's 500, taking into account the effect of dividends and stock splits upon returns. The Standard and Poor's 500 Index is comprised of 500 US incorporated companies which satisfy requirements regarding market capitalization, liquidity, and their primary area of operation. The S&P 500 constitutes over 75% of US equities. Data for real output (GDP_t) was obtained from the United States Bureau of Economic Analysis (BEA). It is seasonally adjusted via the expenditure approach and expressed in 2005 US dollars. The consumer price index (CPI_t) for the United States is obtained from the US Bureau of Labor Statistics (BLS). The reference year basket of goods for this data is 1982. As well, employment numbers (emp_t) are also obtained from the Bureau of Labor Statistics. Treasury bill rates are retrieved from the IFS database. They comprise the weighted average yield on multiple price auctions on 13-week treasury bills. IFS obtains these figures from the Federal Reserve System.

5 Empirical Results

5.1 Parameter Estimates

Using the Akaike Information Criterion (AIC) for lag length specification, the lag length (p) chosen for estimation was 2 quarters. The parameter estimates of the estimated system can be found in Tables 3 and 4. The estimates are structured according to their relative position in Equation 2 and the coefficients where free estimation was permitted as shown in Table 2.[3]

The coefficients corresponding to the contemporaneous effect on Canadian equity returns from the other variables within the system are largely as expected, with some interesting results regarding GDP and oil prices. Changes in the foreign exchange rate and treasury rate have statistically significant positive effects on equity returns (the foreign exchange rate at the 10% level, the treasury rate at the 1% level), while employment, the price level and oil prices all have a positive contemporaneous effect on the rate of return on equity, although statistically insignificant at the 10% level. While the statistical insignificance of an employment change is not surprising, a change in the price level; both broad (CPI) and more narrow (oil prices) having no significant contemporaneous effect is certainly interesting. Interestingly, a positive change in real GDP has a strong negative effect on rates of return on equity (significant at 5% level).

Contemporaneous coefficients for the United States do not differ from their Canadian counterparts in sign. However, they do differ quite broadly in terms of what effects are significant. The only contemporaneous relationship that is statistically significant at the 5% level is the price level, while the remainder of coefficient estimates are insignificant at the 10% level.

To test if the parameter estimates from the United States and Canada differ

[3] All data analysis was done using StataCorp's Stata 10IC econometrics package. For a listing of the various commands used, see Table 7 in the Appendix.

significantly, the following statistic is computed

$$(\hat{\beta}_{Can} - \hat{\beta}_{US})/\sqrt{se^2_{Can} + se^2_{US}} \tag{8}$$

Sims (1980) notes that the standard error estimates reported are often unreliable. This provides a reasonable idea of whether a significant difference exists between effects in Canada and the United States. Using this test, there is no statistically significant differences in the equity return equations between Canada and the United States (at the 5% level), although significant differences do exist in the price level, GDP and treasury bill rate contemporaneous equation estimates.

The positive contemporaneous relationship between a change in the price level and returns is significant for the United States at the 5% level, but not for Canada. This could be due to American companies being more reliant on home markets due to the condition of the S&P 500 that companies in the index be primarily based in the United States. CFMRC does not constrain its index of companies listed on the TSX to those primarily domestic; therefore, domestic price effects could be less pronounced in the short run.

The effect of treasury bill rates on returns is significant for Canada, but is insignificant for the United States. A possible explanation for this is puzzling.

The negative contemporaneous relationship between changes in GDP and returns on common equity is not statistically significant at the 5% level for the United States, although it is for Canada. While insignificant statistically, one possible explanation for this interesting result is that positive output growth leads to increased investment. This increase in demand for investment could result in a lower demanded rate of return in the short run for equity. This effect could be more pronounced in Canada, leading to a more statistically meaningful result.

Changes in the number of individuals employed exhibit a statistically insignificant positive effect in both Canada and the United States. Being strongly statistically insignificant in both cases, this result supports that changes in employment do not have an immediate effect on rates of return on equity, and that any effects from employment are indirect or have a lagged impact.

Interestingly enough, changes in the global price of oil do not seem to have a contemporaneous relationship with common equity returns. Given that the Toronto Stock Exchange contains a larger number of mining, oil and gas firms than any other exchange in the world, it is interesting to note that changes in the price of oil do not translate into changes in returns.

The estimated contemporaneous coefficients for the Canadian equity return series generated an R^2 value of 0.877, while the American returns series had an R^2 value of 0.844. This was calculated by taking the squared correlation between actual returns and the estimated returns generated by the estimated coefficients. The relatively high value indicates that the estimated model does not a bad job of explaining or accounting for much of the time series variation in the equity return series. That the Canadian result captures more of the variance of returns is unsurprising, given that the inclusion of the Canada-U.S. foreign exchange rate as a variable is far more meaningful to the small open-economy context of Canada than to the much larger United States.

Coefficient estimates for the A_1 and A_2 lag matrices for both Canada and the United States can be found in the Appendix (Tables 11 - 14)

Table 3: Canadian Coefficient Table

Equation	Shock	Estimate	Standard Error	t-ratio	P-Value
1)Equity Returns	Foreign Exchange Rate(a_{12})	0.193	0.107	1.804	0.070
	Price Level(a_{13})	0.197	0.350	0.563	0.570
	Treasury Rate(a_14)	0.051	0.017	3.000	0.000
	GDP(a_{15})	-0.638	0.243	-2.626	0.010
	Employment(a_{16})	0.053	0.075	0.707	0.480
	Oil Prices(a_{17})	0.008	0.015	0.533	0.550
2)Foreign Exchange	Price Level(a_{23})	-0.616	0.237	-2.599	0.010
	Treasury Rate(a_{24})	-0.017	0.011	-1.545	0.130
	GDP(a_{25})	-0.164	0.167	-0.982	0.330
	Employment(a_{26})	0.053	0.052	1.019	0.230
	Oil Prices(a_{27})	0.024	0.010	2.400	0.010
3)Price Level	Treasury Rate(a_{34})	-0.008	0.003	-2.667	0.020
	GDP(a_{35})	0.097	0.052	1.865	0.060
	Employment(a_{36})	-0.024	0.016	-1.500	0.130
	Oil Prices(a_{37})†	0.003	0.003	1.000	0.270
4)Treasury Rate	GDP(a_{45})	-0.869	1.086	-0.800	0.420
	Employment(a_{46}) †	-0.030	0.337	-0.089	0.930
	Oil Prices(a_{47}) †	-0.010	0.065	-0.154	0.880
5)GDP	Employment(a_{56})	-0.054	0.023	-2.348	0.020
	Oil Prices(a_{57})†	-0.007	0.004	-1.750	0.130
6)Employment	Oil Prices(a_{67})	0.008	0.014	0.571	0.570

Log-Likelihood : 2963.615

Note: † indicates the difference between Canadian and US values are significant at the 5% level.

No contemporaneous coefficients are listed for oil prices due to the recursive nature of the restrictions (see Table 2).

Table 4: American Coefficient Table

Equation	Shock	Estimate	Standard Error	t-value	P-Value
1)Equity Returns	Foreign Exchange Rate(a_{12})	0.137	0.113	1.212	0.230
	Price Level(a_{13})	1.007	0.452	2.227	0.030
	Treasury Rate($a_1 4$)	0.022	0.019	1.157	0.250
	GDP(a_{15})	-0.393	0.289	-1.359	0.170
	Employment(a_{16})	0.408	0.592	0.689	0.490
	Oil Prices(a_{17})	0.021	0.017	1.235	0.220
2)Foreign Exchange	Price Level(a_{23})	-0.964	0.279	-3.455	0.000
	Treasury Rate(a_{24})	0.003	0.019	0.157	0.810
	GDP(a_{25})	-0.187	0.183	-1.021	0.310
	Employment(a_{26})	-0.067	0.377	-0.177	0.860
	Oil Prices(a_{27})	0.036	0.011	3.272	0.000
3)Price Level	Treasury Rate(a_{34})	0.001	0.004	0.252	0.760
	GDP(a_{35})	0.051	0.047	1.085	0.290
	Employment(a_{36})	-0.092	0.097	-0.948	0.340
	Oil Prices(a_{37})†	-0.009	0.003	-3.000	0.000
4)Treasury Rate	GDP(a_{45})	-0.719	1.08	-0.665	0.510
	Employment(a_{46}) †	-6.943	2.165	-3.206	0.000
	Oil Prices(a_{47}) †	-0.098	0.058	-1.689	0.090
5)GDP	Employment(a_{56})	-0.741	0.134	-5.529	0.000
	Oil Prices(a_{57})†	0.003	0.003	1.000	0.420
6)Employment	Oil Prices(a_{67})	-0.002	0.002	-1.000	0.400

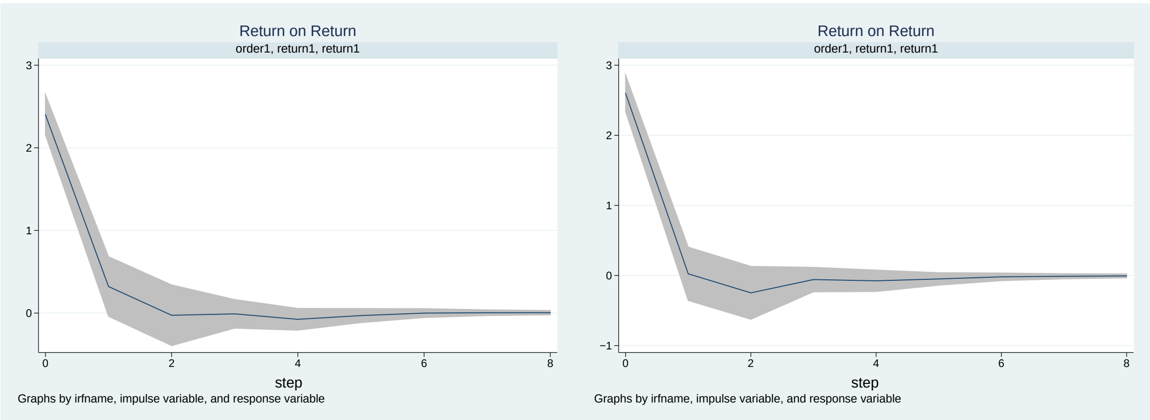
Log-likelihood: -2659.134

Note: † indicates the difference between Canadian and US values are significant at the 5% level.
No contemporaneous coefficients are listed for oil prices due to the recursive nature of the restrictions (see Table 2).

5.2 Impulse Response Functions

The effects of a shock to a variable in the system are displayed graphically as impulse response graphs. The impulse responses are plotted out to two years (8 periods). The analysis of the impulse response graphs for this system is divided into the effect of shocks on a single variable. To facilitate comparison, the relevant Canadian and US graphs are placed side-by-side. The scale on the vertical axis is percentage change in equity returns, while the horizontal scale indicates the elapsed amount of time following the shock (with each time step indicating one quarter, or three months). The shaded region in each figure indicates a 95% confidence interval. An exogenous shock to a variable is of unit magnitude.

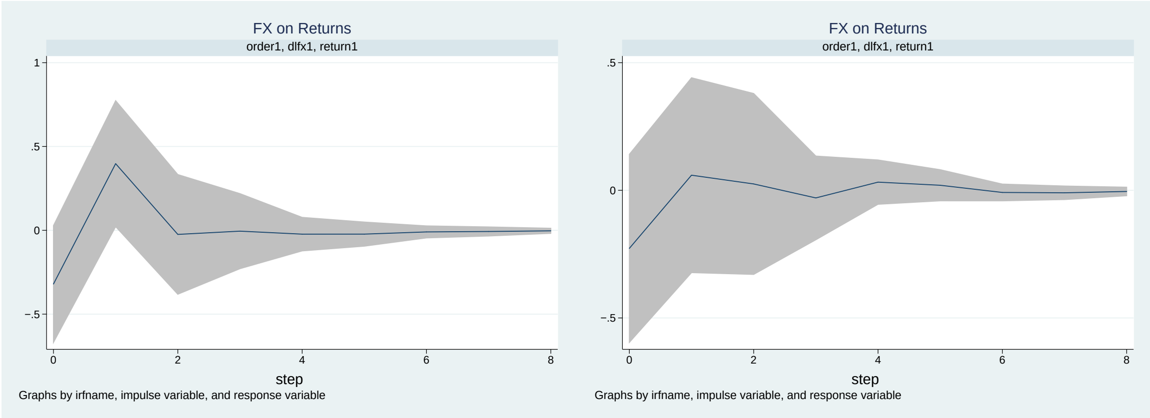
5.2.1 Shock Effects on Equity Returns



(a) Canada (b) United States

Figure 1: Return Shock on Returns

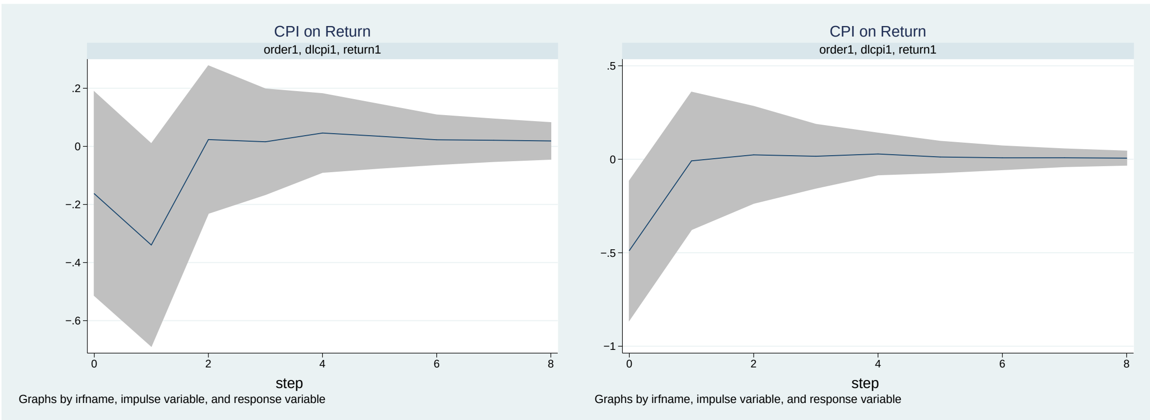
The impulse response for both the United States and Canada for a shock to equity returns (shown in Figure 1) is a magnified initial reaction, followed by a relatively quick (within 2 periods) return to equilibrium levels with very little oscillation. The initial reaction is the result of feedback from the effect of a shock on the other variables within the system. An exchange rate shock (shown in Figure 2) has a positive short term effect on Canadian returns that is absorbed relatively quickly. As would be



(a) Canada (b) United States

Figure 2: Exchange Rate Shock on Returns

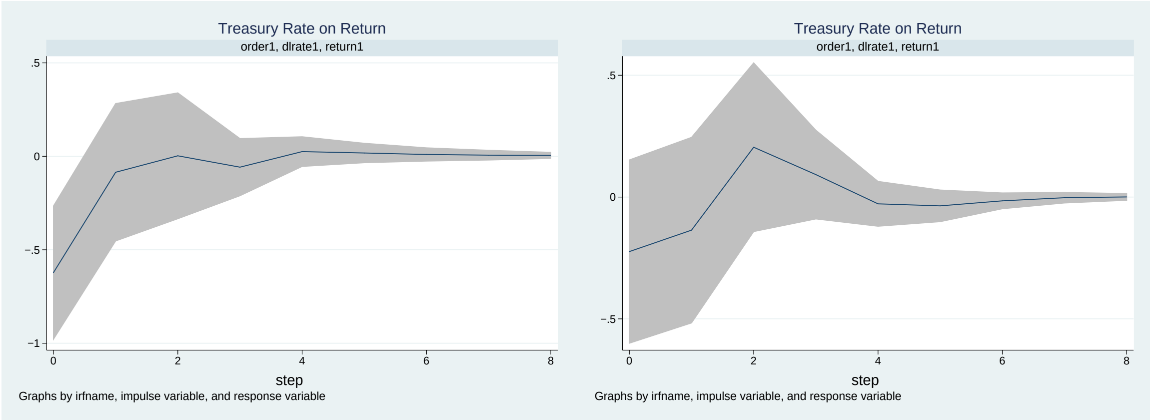
expected regarding the relative importance of the trading relationship between the two nations, there is nearly no effect of shocks to the Canadian-US exchange rate on American returns. Examining the effect of a shock to CPI for Canadian returns



(a) Canada (b) United States

Figure 3: CPI Shock on Returns

(shown in Figure 3), it is evident there is a short-term negative impact on returns. When looking at the American impulse response function, there is little to no effect of a CPI shock on returns despite there being a significant coefficient in Table 4. These results indicate that the influence of a shock in CPI on other variables creates a feedback effect on equity returns which has a negative effect approximately 3 months

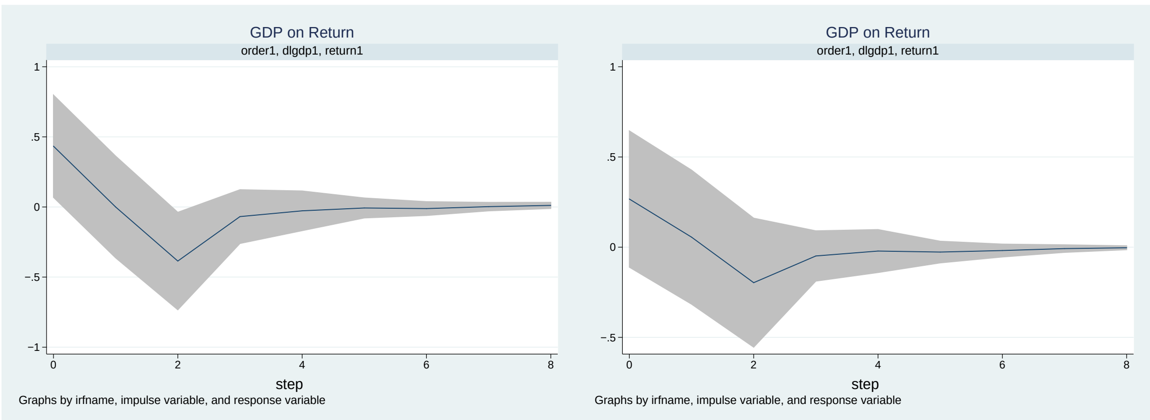


(a) Canada (b) United States

Figure 4: Treasury Rate Shock on Returns

after the shock. This negative impact supports the theory Huybens and Smith (1999) proposes, and empirical findings regarding the negative effect of inflation on equity returns that goes back as far as Nelson (1976).

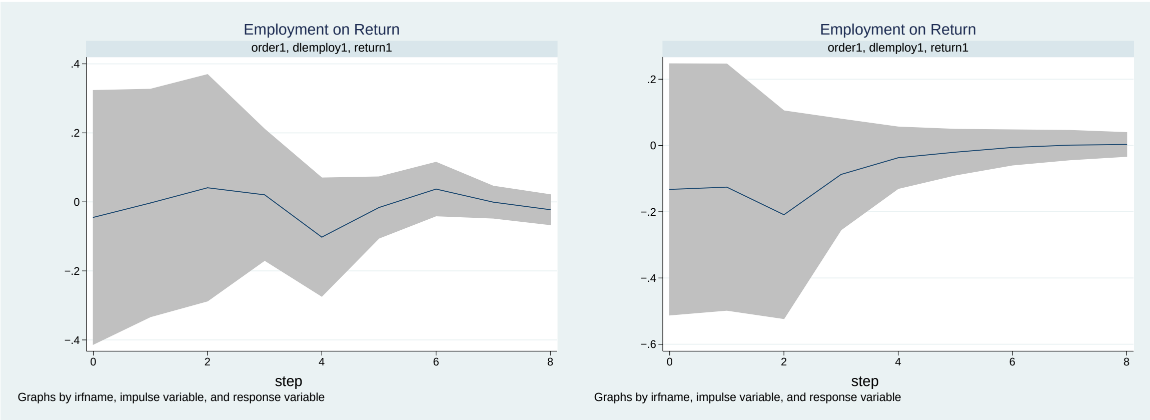
Treasury rate shocks (Figure 4) have a small negative effect on returns in the first quarter following a shock. For Canadian data, this effect dissipates relatively quickly (within 6 months), while US returns see a more pronounced negative impact in the first quarter, followed by a positive rebound which lasts for an additional six months prior to the system stabilizing. A shock to GDP (Figure 5) has return values staying



(a) Canada (b) United States

Figure 5: GDP Shock on Returns

largely unchanged in the first quarter following the shock in both Canada and the U.S. Given that the parameter estimate for the contemporaneous relationship between GDP and returns suggest a negative shock on returns, the feedback via other variables must be cancelling this out. However, by 6 months following the shock, a negative effect on returns is observed, more markedly for the U.S., which takes approximately a full year to completely dissipate. The impulse response of returns to a shock in the

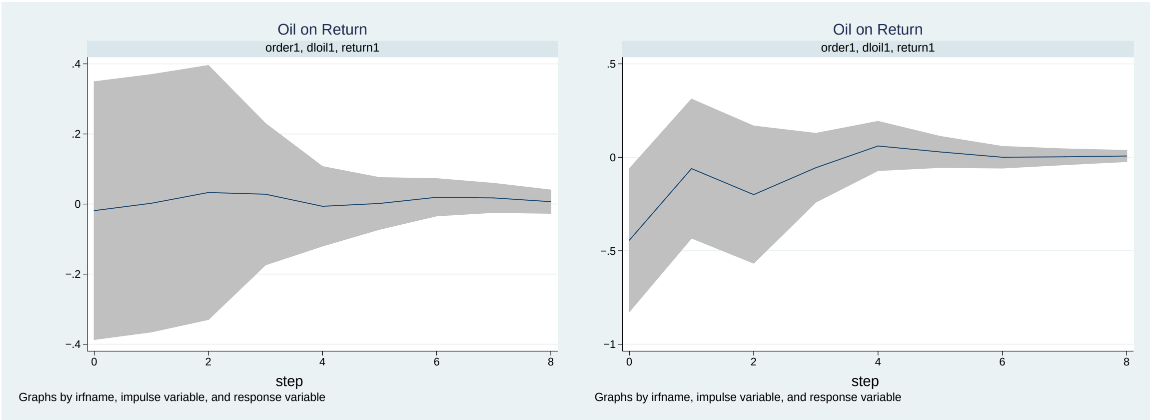


(a) Canada (b) United States

Figure 6: Employment Shock on Returns

number of individuals employed within the economy, as seen in Figure 6, suggests a very minor effect within a year of a shock. Canadian returns show a minor retardation at approximately a year after the shock, while US markets see a small negative effect at 6 months, which goes away within a year's time following the initial shock. Oil price shocks (Figure 7) show very little effect on returns in both Canada and the U.S. A very minimal positive impact on Canadian returns is seen roughly 6 months following the shock, which quickly dissipates, likely due to the large portion of oil firms on the TSX reporting a profit. US returns see a slight negative effect at the same lag, indicating that perhaps many companies comprising the US index are realizing lower profits at that juncture due to increased energy costs.

Impulse response functions for the effect of shocks on the remainder of the variables within the system are presented in the Appendix.



(a) Canada (b) United States

Figure 7: Oil Price Shock on Returns

5.2.2 Forecast Error Variance Decomposition of Equity Returns

Tables 5 and 6 outline the forecast error variance decomposition for equity returns for both Canada and the United States. Variance decomposition indicates how much each variable within the VAR system contributes to the variation of other variables (Enders, 1995). This decomposition allows for the determination of how much of an effect an exogenous shock to each variable has on other variables within the system. Values are expressed in percentage terms, for a time frame of three months to two years. In examining the FEVD it is unsurprising that the majority of change comes from shocks to returns themselves. The importance of these dissipates somewhat over time.

Table 5: FEVD for Canadian Returns

Quarter	Shock						
	Returns	FX	CPI	Treasury Rate	GDP	Employment	Oil Prices
1	89.090	1.584	0.410	5.976	2.904	0.031	0.005
2	85.608	3.802	2.068	5.747	2.741	0.029	0.005
3	83.746	3.727	2.030	5.622	4.802	0.053	0.021
4	83.632	3.722	2.031	5.662	4.862	0.059	0.032
5	83.473	3.719	2.055	5.655	4.859	0.207	0.032
6	83.447	3.724	2.072	5.657	4.857	0.210	0.032
7	83.417	3.724	2.078	5.656	4.857	0.230	0.038
8	83.407	3.724	2.084	5.656	4.857	0.230	0.042

Table 6: FEVD for American Returns

Quarter	Shock Returns	FX	CPI	Treasury Rate	GDP	Employment	Oil Prices
1	91.532	0.700	3.224	0.678	0.964	0.238	2.664
2	90.983	0.743	3.205	0.922	1.000	0.449	2.697
3	89.091	0.729	3.118	1.442	1.476	1.007	3.137
4	88.832	0.738	3.111	1.547	1.502	1.103	3.167
5	88.747	0.750	3.116	1.555	1.505	1.119	3.209
6	88.706	0.755	3.115	1.570	1.513	1.123	3.217
7	88.698	0.756	3.115	1.573	1.518	1.124	3.217
8	88.695	0.757	3.116	1.573	1.518	1.123	3.217

For Canadian returns, a notably large effect exists from the exchange rate with the United States, a result which is unsurprising given they are Canada's predominant trading partner. Domestic price levels have a less noted effect, accounting for approximately 2% of effects on returns steadily after 6 months while having a smaller short term impact. Treasury bill rates have a prominent impact on Canadian returns holding constant at levels around 5.5%. GDP fluctuations have a significant impact as well, requiring about nine months before their impact is fully realized. Changes in the employment level and international oil prices have extremely minor effects on returns on the TSX, although employment changes do have some impact over a longer time frame.

As regards returns in the United States, a different pattern of effects emerges. To be expected is the effect of the foreign exchange rate with a small, open economy such as Canada; however, changes in the price level have a consistent effect (approximately 3%) over time for the U.S.. Treasury bill rates have a minor impact, and require about 6 months to fully express. GDP and employment changes have effects requiring three quarters to fully pass through to returns, with GDP accounting for roughly 1.5% of returns variance, and employment 1.1%. Oil price variations have a much more pronounced effect on returns than in Canada. While these variations have negligible effects on return variation in Canada, they account for approximately 3.7%

of variation in returns in the United States.

The FEVDs for Canadian and US markets differ quite significantly under the model specified. While Canadian variance is most affected by changes in the exchange rate with the United States, variations in the treasury bill rate and GDP; American returns see the most variance due to price level changes, and oil price shocks. A possible explanation is profits from the relatively higher number of oil and gas companies listed on the Canadian market offsetting energy input cost increases for producers, while US market returns lack this offset for increased energy costs.

6 Conclusion

Given the importance of well operating financial markets to economic growth, a thorough understanding of how equity markets operate is essential in maintaining stable economic growth. An understanding of how these markets respond to changes in macroeconomic factors would provide policy makers with the tools necessary to understanding and positively influencing economic development. Significant research exists on linkages between bond rates and how their yields are affected by macroeconomic factors such as employment, inflation, and output (Ang and Piazzesi, 2003). As well, an international body of literature exists dealing with how real output is influenced by equity markets both domestic and foreign (Fry, Hocking, and Martin, 2008).

From a Canadian perspective, however, there has not been heretofore (to the author's awareness) an exploration into how macroeconomic factors affect equity returns, and how these relationships compare to patterns observed elsewhere.

A simple vector autoregressive, or VAR model with a recursive system of contemporaneous restrictions was constructed to examine how returns are influenced. Restricting returns from influencing macroeconomic variables in the short term, quarterly data was examined for both Canada and the United States from 1962 to early 2008.

What was found was that contemporaneous relations between equity returns and macroeconomic factors all share the same direction of impact in Canada and the United States. The relative magnitude of these effects differs however, across variables. Contemporaneously, returns are positively affected by changes in the Canada-US exchange rate, CPI, the treasury rate, employment and the international price of oil. Positive change in GDP has a curious negative relationship with returns; this could be a result of positive economic growth leading to increased total investment, temporarily reducing the required rate of return on equity. Examining the impulse response a shock on GDP has on returns seems to confirm this, with a positive GDP shock causing a temporary decrease in returns for about six months before stabilizing. Increased investment during positive growth is not an unrealistic explanation for this.

The response to macroeconomic shocks of Canadian and American returns are similar, while exhibiting some notable differences. American returns are more sensitive to changes in the price of oil than Canadian returns, experiencing a negative effect, while Canadian returns are almost unaffected. Forecast error variance decomposition confirms this, with American results showing a pronounced response to fluctuations in oil prices, with Canadian returns being almost completely unaffected.

Canadian returns showed a significant response to domestic macroeconomic factors such as GDP and the treasury bill rate, as well as a notable influence from the exchange rate, while American returns showed a smaller degree of impact from these factors. The price level had a small negative effect on returns on the TSX, while being more pronounced in American markets, consistent with previous empirical results relating higher inflation with lower returns (Nelson, 1976).

Changes in the number of employed workers within the economy exhibited a very minimal effect in Canada, whereas in the United States employment changes were a more significant factor in explaining returns.

These results show that (i) macro variables do have a significant effect on equity market returns, and (ii) there are significant differences in the way that Canadian and

American equity markets respond to macroeconomic shocks. The obvious implication of this for policy makers is that relevant national conditions need to be taken into account to formulate effective solutions.

References

Ang, A., and M. Piazzesi (2003): "A no-arbitrage vector autoregression of term structure dynamics with macroeconomic and latent variables," *Journal of Monetary Economics*, 50(4), 745–787.

Boyd, J. H., R. Levine, and B. D. Smith (2001): "The impact of inflation on financial sector performance," *Journal of Monetary Economics*, 47(2), 221 – 248.

Dai, Q., and K. Singleton (2000): "Specification analysis of affine term structure models," *Journal of Finance*, 55(5), 1943–1978.

Enders, W. (1995): *Applied Econometric Time Series*. John Wiley& Sons.

Estrella, A., and F. S. Mishkin (1997): "The predictive power of the term structure of interest rates in Europe and the United States: Implications for the European Central Bank," *European Economic Review*, 41(7), 1375 – 1401.

Fisher, I. (1930): *The Theory of Interest*. Macmillan, New York.

French, K. R., and J. M. Poterba (1991): "Investor Diversification and International Equity Markets," *The American Economic Review*, 81(2), 222–226.

Fry, R., J. Hocking, and V. L. Martin (2008): "The Role of Portfolio Shocks in a Structural Vector Autoregressive Model of the Australian Economy," *Economic Record*, 84(264), 17–33.

Huybens, E., and B. D. Smith (1999): "Inflation, financial markets and long-run real activity," *Journal of Monetary Economics*, 43(2), 283 – 315.

Levine, R. (1997): "Financial development and economic growth: views and agenda," *Journal of Economic Literature*, pp. 688–726.

Nelson, C. R. (1976): "Inflation and Rates of Return on Common Stocks," *The Journal of Finance*, 31(2), 471–483.

Sims, C. A. (1980): "Macroeconomics and Reality," *Econometrica*, 48(1), 1–48.

Appendix

Table 7: Summary of STATA Commands Used

Function	STATA Command
Augmented Dickey Fuller Test for Unit Root Processes	dfuller ([variable to test])
Lag Length Specification Test	varsoc([variables])
Structural VAR estimation	svar [variables], aeq([contemporaneous restrictions matrix]) beq([error covariance matrix])
Impulse Response Function Generation	irf create order1, step(8) set(data1, replace)
Impulse Response Graph Generation	irf graph sirf, impulse([impulse variable]) response([response variable])
Forecast Error Variance Decomposition	irf table fevd sirf

Table 8: Matrix of Contemporaneous Covariance Estimates between Canadian Variables

	Returns	FX	CPI	Treasury Rate	GDP	Employment	Oil
Returns	1						
FX	-0.1073	1					
CPI	-0.0832	0.1471	1				
Treasury Rate	-0.254	0.0978	0.1875	1			
GDP	0.1395	0.0533	-0.1467	0.2146	1		
Employment	-0.0794	-0.0481	0.1898	0.1142	0.1031	1	
Oil	0.0069	-0.1829	0.1365	0.0817	0.1045	-0.0046	1

Table 9: Matrix of Contemporaneous Covariance Estimates between American Variables

	Returns	FX	CPI	Treasury Rate	GDP	Employment	Oil
Returns	1						
FX	-0.0895	1					
CPI	-0.1797	0.0804	1				
Treasury Rate	-0.1431	-0.0191	0.1358	1			
GDP	0.0276	0.0917	-0.227	0.281	1		
Employment	-0.1046	0.0751	0.0081	0.4334	0.4922	1	
Oil	-0.1487	-0.1844	0.3541	0.1344	-0.0542	0.0758	1

Table 10: Data Sources

Data	Description	Source
Canadian Return Data	CFMRC Value-Weighted Return Index (expressed in decimal form) is a total return index (tracks both the capital gains of a group of stocks over time, and assumes that any cash distributions, such as dividends, are reinvested back into the index) based on all stocks within the CFMRC database traded on the TSX	Canadian Financial Markets Research Centre (CFMRC) Summary Information Database via CHASS(Computing in the Humanities and Social Sciences) at University of Toronto(accessed monthly; transformed into quarterly values via mean averaging)
Canadian GDP	Gross Domestic Product, expenditure-based; Canada; Chained (2002) dollars; Seasonally adjusted at annual rates; Gross Domestic Product (GDP) at market prices (dollars - millions)	CANSIM Table 380-0002 accessed via Statistics Canada E-Stat
Canadian Consumer Price Index (CPI)	Canadian consumer price index, where reference basket of goods is 2005, with 2002=100	CANSIM Table 326-0020 accessed via Statistics Canada E-Stat
Canadian Employment	Number of employed workers in Canada, seasonally adjusted (Note: Statistics Canada significantly changed the manner in which they measured employment within Canada beginning in 1976, causing a singular jump in employment from 4th quarter 1975 to 1st quarter 1976)	CANSIM Table 281-0020 prior to 1976; CANSIM Table 282-0087 onwards
Foreign Exchange Rate	Exchange rate between Canadian and United States dollars	accessed via CFMRC database; compiled based on CANSIM I Series B100014

Canadian Treasury Bill Rate	Weighted average on yields on successful bids for 3-month treasury bills	accessed via International Monetary Fund's International Financial Statistics(IFS) database IFS Code 15660C..ZF(based on data submitted to IMF from Bank of Canada)
Oil Price	International average price of crude petroleum expressed in United States dollars	accessed via International Monetary Fund's International Financial Statistics(IFS) database IFS Code 00176AAZZF
United States Return Data	CRSP Value-Weighted Return Index (expressed in decimal form) is a total return index (tracks both the capital gains of a group of stocks over time, and assumes that any cash distributions, such as dividends, are reinvested back into the index) based on all stocks contained within the Standard and Poor's 500 Index	accessed monthly from CRSP database available thru CHASS(transformed into quarterly values via mean averaging)
United States Gross Domestic Product	Real Gross Domestic Product, Chained Dollars [Billions of chained (2005) dollars] Seasonally adjusted at annual rates	accessed from US Bureau of Economic Statistics, National Income and Products Account(NIPA) Table 1.1.6
United States Consumer Price Index	consumer price index for United States where reference basket of goods is 1982-1984	accessed via US Bureau of Labor Statistics-Series CUUR0000SA0
United States Treasury Bill Rate	weighted average yield on multiple price auctions of 13-week treasury bills; from October 1998 onwards stop-yields from uniform price auctions	accessed via International Monetary Fund's International Financial Statistics(IFS) database IFS Code 11160C..ZF(based on data submitted to IMF from US Treasury Department)

Table 11: Canadian A_1 Coefficient Matrix

	Return	FX	CPI	Treasury Rate	GDP	Employ	Oil
Return	0.134(0.076)	0.266(0.115)	-0.781(0.342)	0.000(0.018)	-0.182(.254)	0.037(0.068)	0.009(0.015)
FX	-0.109(0.052)	0.328(0.078)	-0.111(0.232)	-0.013(0.012)	0.072(0.172)	-0.075(0.046)	-0.019(0.010)
CPI	0.009(0.016)	0.067(0.024)	0.521(0.071)	-0.002(0.004)	0.139(0.053)	-0.030(0.014)	0.009(0.003)
Treasury Rate	0.135(0.327)	-0.641(0.492)	2.121(1.466)	0.214(0.076)	4.299(1.085)	-0.187(0.293)	0.079(0.064)
GDP	0.036(0.023)	0.051(0.034)	-0.055(0.101)	0.007(0.005)	0.204(0.075)	0.009(0.020)	0.001(0.004)
Employ	0.033(0.072)	-0.092(0.109)	0.618(0.325)	0.007(0.017)	0.209(0.240)	-0.081(0.065)	0.004(0.014)
Oil	0.297(0.373)	0.078(0.561)	-1.244(1.671)	0.040(0.087)	0.408(1.237)	0.223(0.334)	0.323(0.074)

Table 12: Canadian A_2 Coefficient Matrix

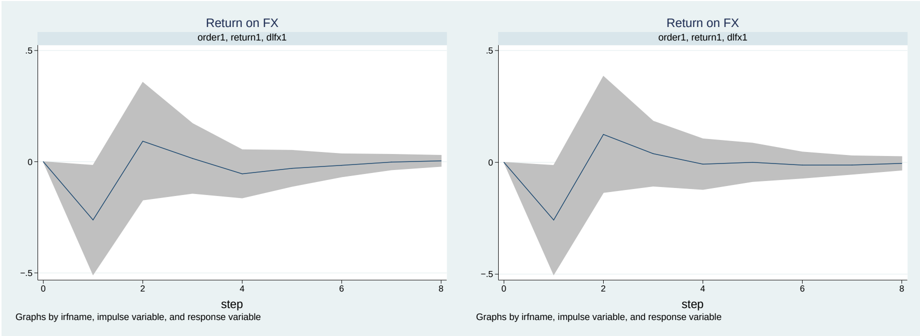
	Return	FX	CPI	Treasury Rate	GDP	Employ	Oil
Return	0.010(0.078)	-0.075(0.115)	0.571(0.336)	0.002(0.017)	-0.371(0.264)	0.037(0.069)	0.013(0.016)
FX	0.097(0.053)	-0.016(0.078)	0.253(0.228)	-0.011(0.011)	0.025(0.179)	0.016(0.047)	0.006(0.011)
CPI	0.013(0.016)	-0.070(0.024)	0.307(0.070)	0.001(0.004)	-0.035(0.055)	-0.049(0.014)	0.000(0.003)
Treasury Rate	0.959(0.333)	0.915(0.492)	-0.287(1.440)	-0.083(0.072)	1.253(1.129)	-0.249(0.297)	-0.022(0.067)
GDP	0.057(0.023)	0.023(0.034)	-0.107(0.100)	-0.003(0.005)	0.008(0.078)	0.037(0.021)	0.000(0.005)
Employ	-0.034(0.074)	0.001(0.109)	0.005(0.319)	-0.007(0.016)	0.739(0.250)	-0.477(0.066)	-0.023(0.015)
Oil	0.547(0.380)	-0.664(0.561)	2.584(1.641)	0.091(0.082)	-0.693(1.287)	-0.324(0.338)	-0.188(0.076)

Table 13: American A_1 Coefficient Matrix

	Return	FX	CPI	Treasury Rate	GDP	Employ	Oil
Return	0.009(0.075)	0.037(0.118)	-0.045(0.459)	-0.014(0.020)	-0.213(0.294)	-0.458(0.565)	-0.001(0.017)
FX	-0.099(0.048)	0.337(0.075)	-0.320(0.292)	0.000(0.013)	-0.107(0.187)	0.288(0.388)	-0.017(0.011)
CPI	-0.005(0.013)	0.023(0.020)	0.564(0.078)	0.002(0.003)	-0.037(0.050)	0.353(0.104)	0.005(0.003)
Treasury Rate	0.833(0.281)	0.416(0.445)	-1.102(1.727)	0.413(0.075)	1.895(1.103)	2.419(2.290)	0.118(0.066)
GDP	0.059(0.019)	0.033(0.031)	-0.191(0.119)	0.003(0.005)	0.022(0.076)	0.403(0.158)	0.000(0.005)
Employ	0.022(0.010)	0.024(0.015)	-0.122(0.059)	0.002(0.003)	0.125(0.038)	0.302(0.079)	0.003(0.002)
Oil	-0.151(0.335)	0.046(0.530)	-1.093(2.059)	-0.075(0.089)	0.449(1.316)	0.989(2.731)	0.337(0.078)

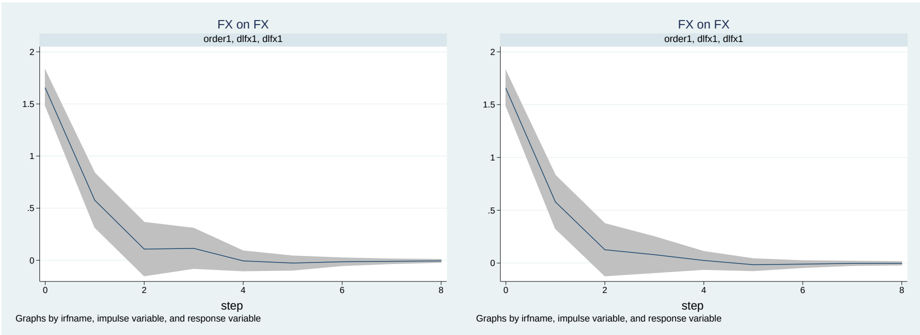
Table 14: American A_2 Coefficient Matrix

	Return	FX	CPI	Treasury Rate	GDP	Employ	Oil
Return	-0.078(0.078)	0.001(0.114)	-0.057(0.448)	0.025(0.020)	-0.213(0.294)	-0.458(0.565)	-0.017(0.017)
FX	0.078(0.050)	-0.022(0.072)	0.391(0.285)	-0.010(0.013)	0.198(0.187)	-0.225(0.360)	0.005(0.011)
CPI	0.019(0.013)	-0.050(0.019)	0.209(0.076)	-0.002(0.003)	-0.095(0.050)	0.057(0.097)	-0.003(0.003)
Treasury Rate	0.606(0.292)	0.354(0.427)	1.938(1.684)	-0.096(0.074)	0.511(1.106)	0.367(2.124)	0.022(0.065)
GDP	0.073(0.020)	0.000(0.029)	-0.089(0.116)	-0.002(0.005)	0.106(0.076)	-0.068(0.146)	0.000(0.004)
Employ	0.031(0.010)	-0.005(0.015)	0.101(0.058)	0.001(0.003)	0.076(0.038)	-0.011(0.073)	0.001(0.002)
Oil	0.454(0.349)	-0.762(0.510)	2.477(2.008)	0.139(0.088)	-1.927(1.319)	3.458(2.533)	-0.212(0.077)



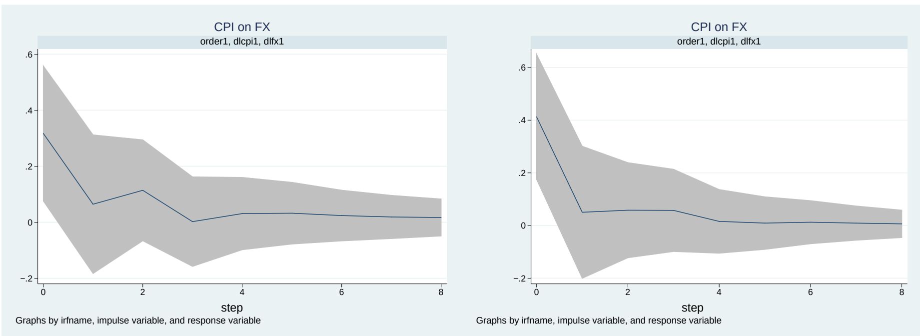
(a) Canada (b) United States

Figure 8: Return Shock on Foreign Exchange



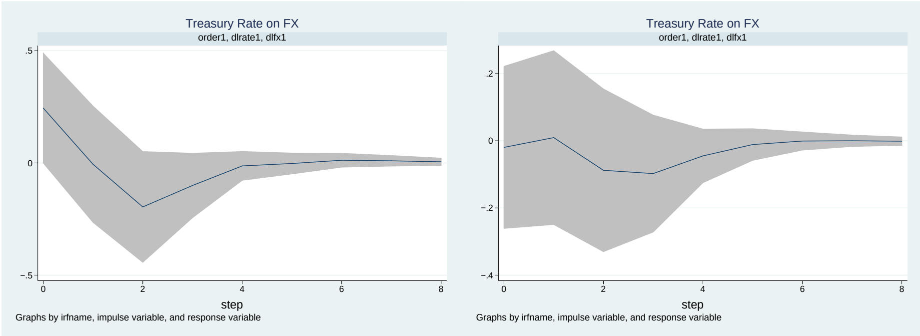
(a) Canada (b) United States

Figure 9: Foreign Exchange Shock on Foreign Exchange



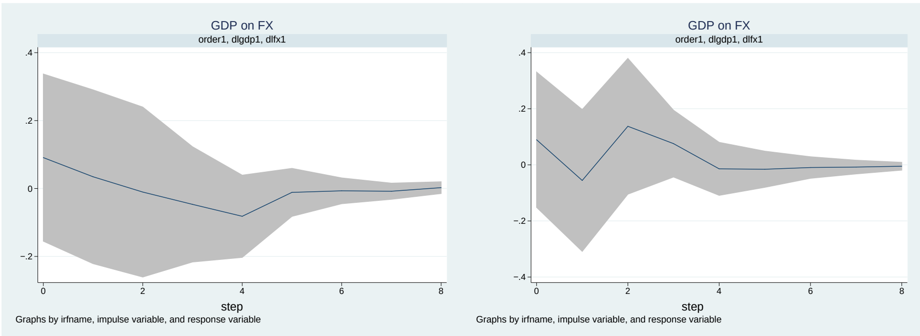
(a) Canada (b) United States

Figure 10: CPI Shock on Foreign Exchange



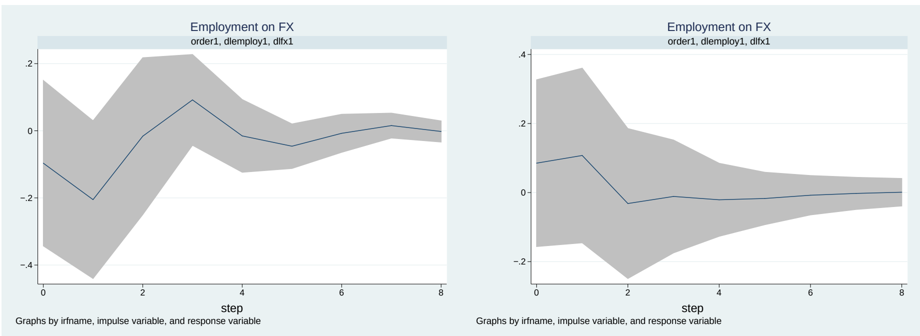
(a) Canada (b) United States

Figure 11: Treasury Rate Shock on Foreign Exchange



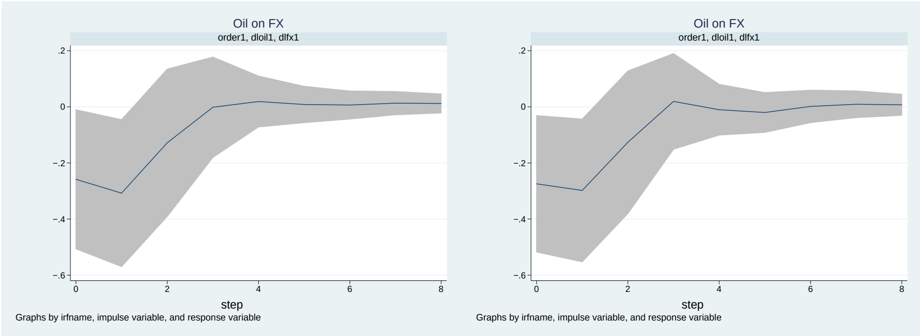
(a) Canada (b) United States

Figure 12: GDP Shock on Foreign Exchange



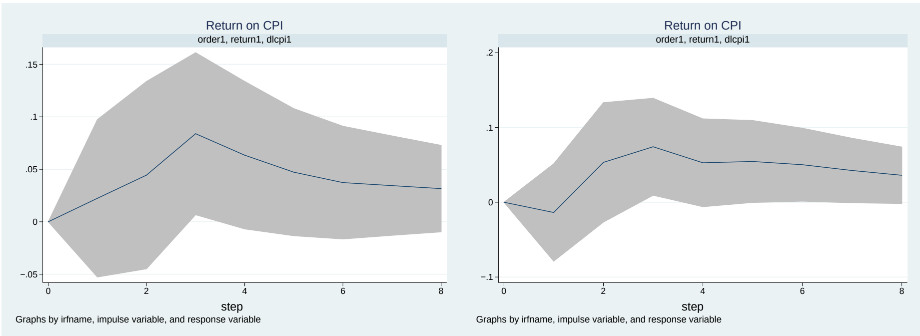
(a) Canada (b) United States

Figure 13: Employment Shock on Foreign Exchange



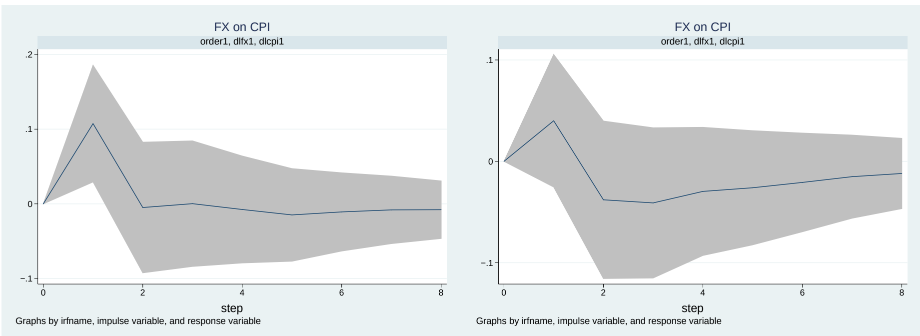
(a) Canada (b) United States

Figure 14: Oil Price Shock on Foreign Exchange



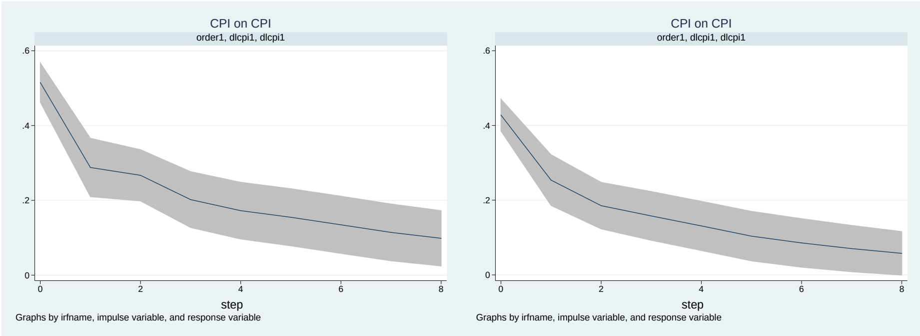
(a) Canada (b) United States

Figure 15: Return Shock on CPI



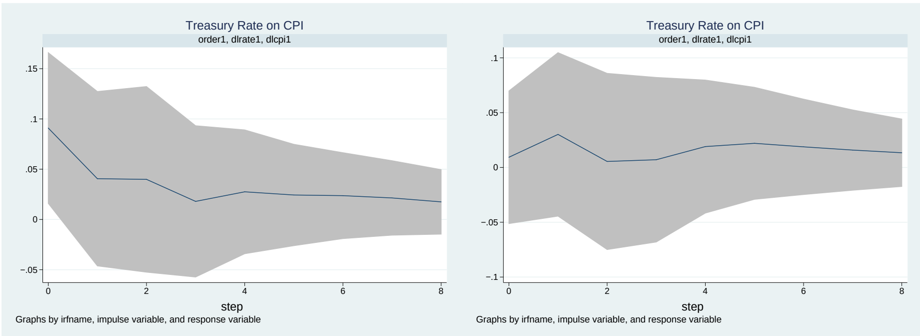
(a) Canada (b) United States

Figure 16: Foreign Exchange Shock on CPI



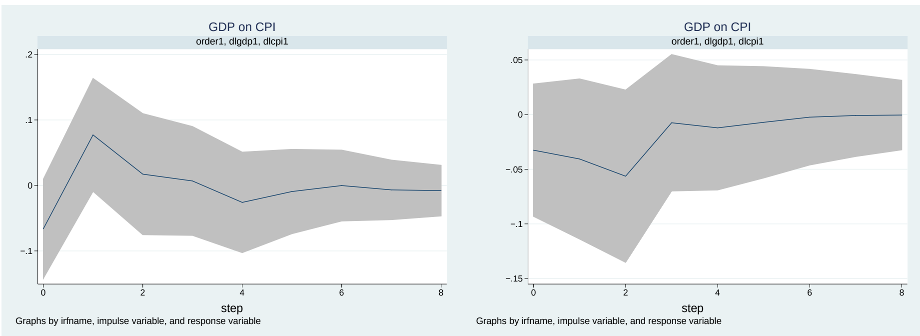
(a) Canada (b) United States

Figure 17: CPI Shock on CPI



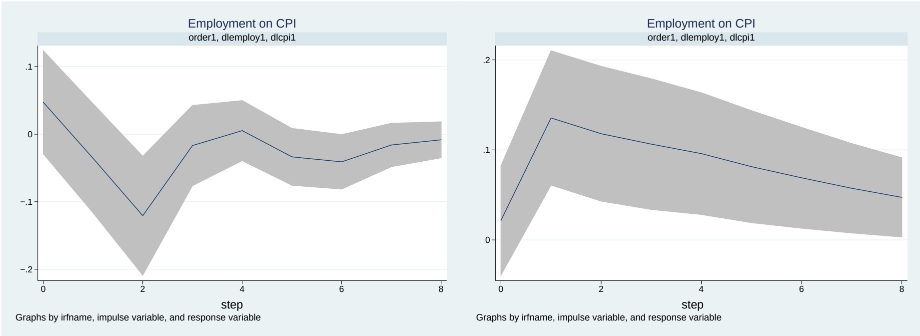
(a) Canada (b) United States

Figure 18: Treasury Rate Shock on CPI



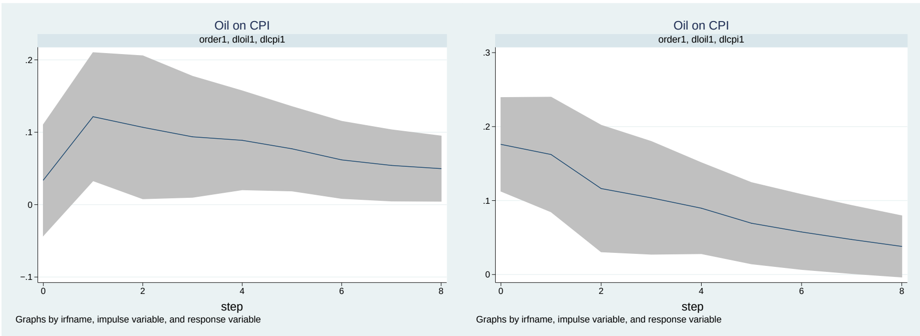
(a) Canada (b) United States

Figure 19: GDP Shock on CPI



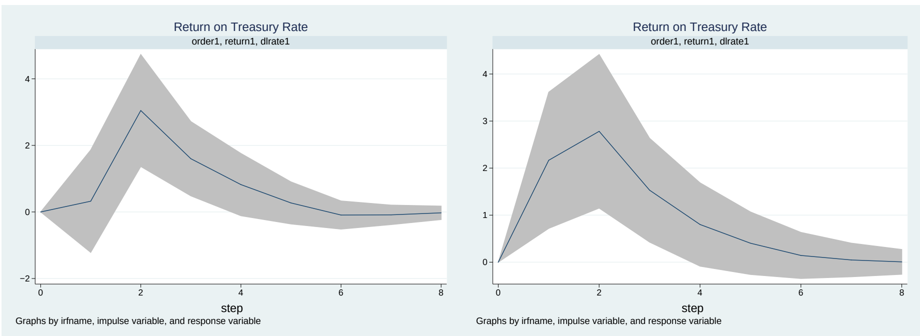
(a) Canada (b) United States

Figure 20: Employment Shock on CPI



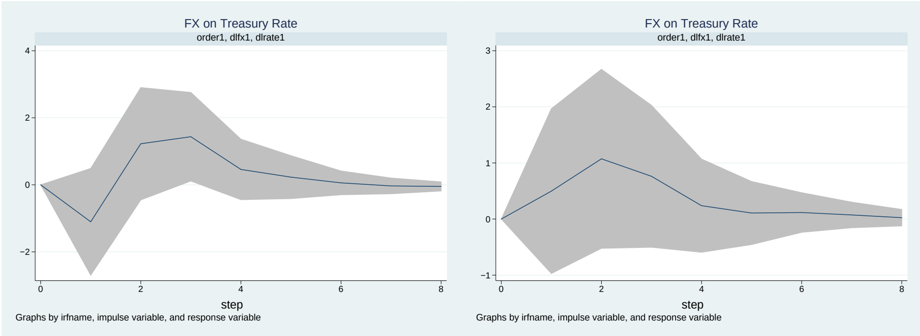
(a) Canada (b) United States

Figure 21: Oil Price Shock on CPI



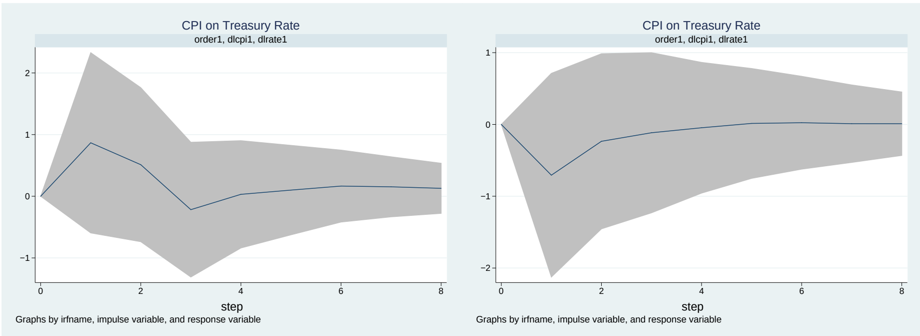
(a) Canada (b) United States

Figure 22: Return Shock on Treasury Rate



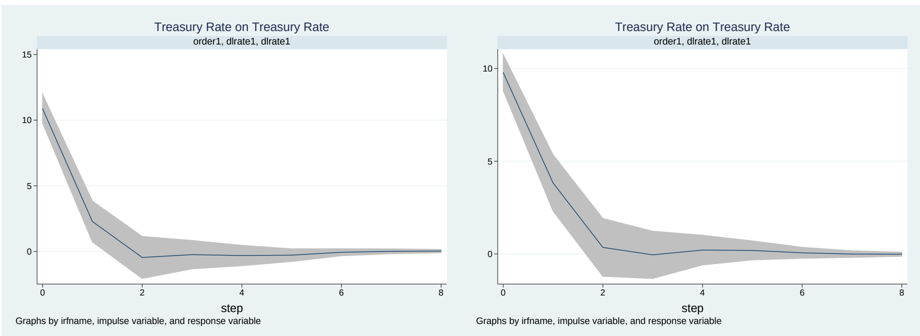
(a) Canada (b) United States

Figure 23: Foreign Exchange Shock on Treasury Rate



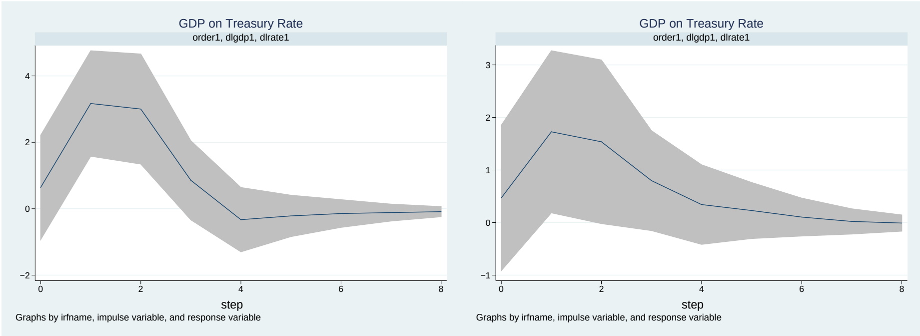
(a) Canada (b) United States

Figure 24: CPI Shock on Treasury Rate



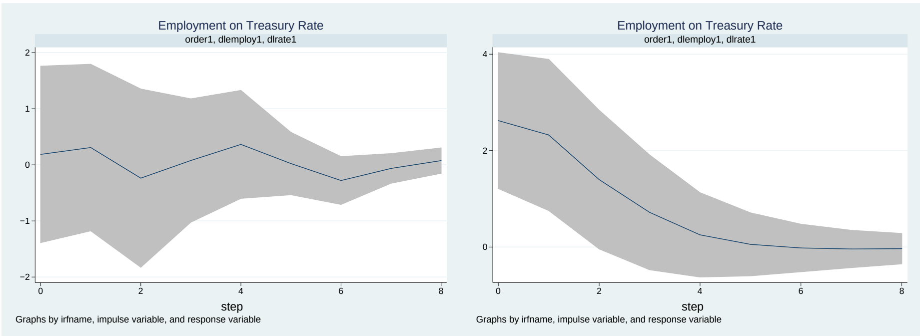
(a) Canada (b) United States

Figure 25: Treasury Rate Shock on Treasury Rate



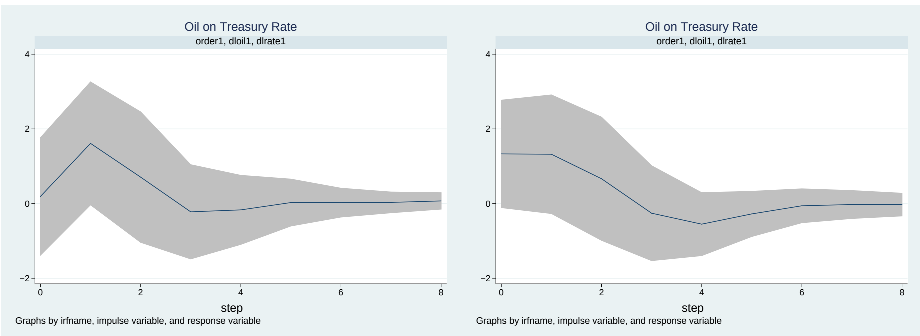
(a) Canada (b) United States

Figure 26: GDP Shock on Treasury Rate



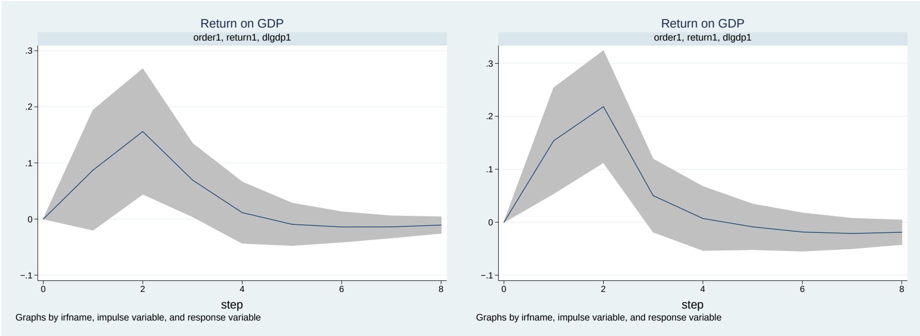
(a) Canada (b) United States

Figure 27: Employment Shock on Treasury Rate



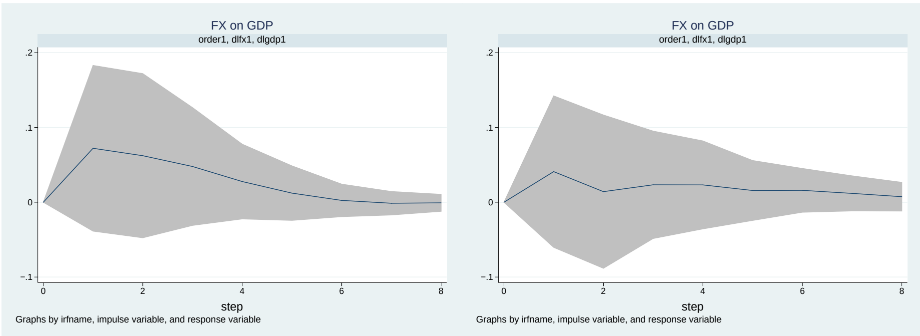
(a) Canada (b) United States

Figure 28: Oil Price Shock on Treasury Rate



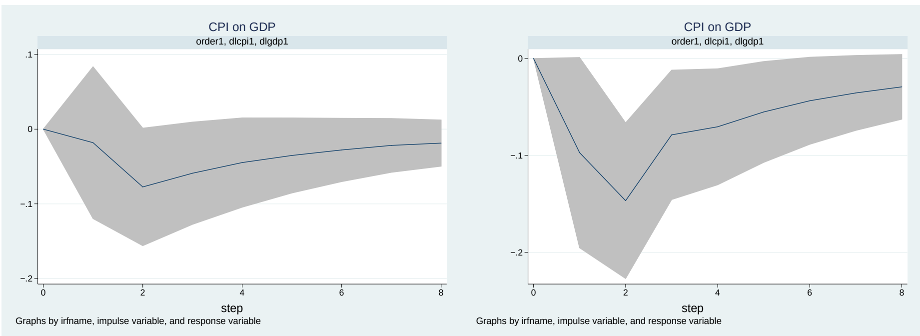
(a) Canada (b) United States

Figure 29: Return Shock on GDP



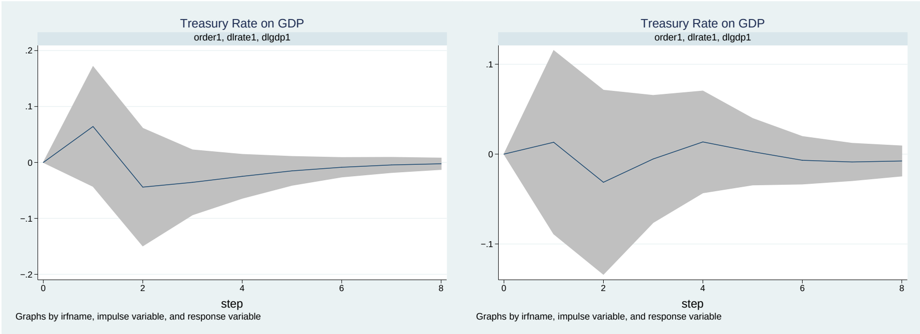
(a) Canada (b) United States

Figure 30: Foreign Exchange Shock on GDP



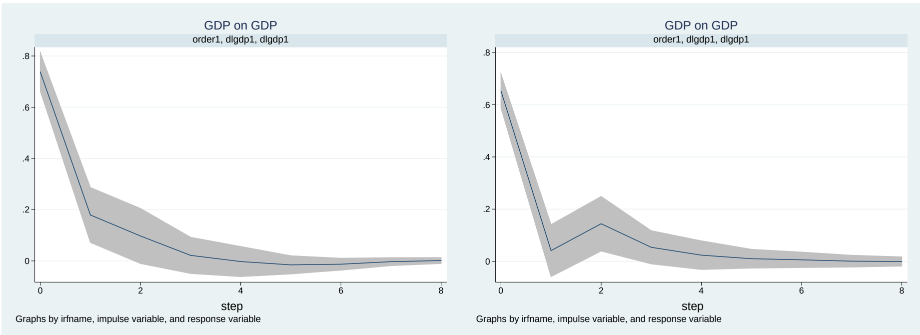
(a) Canada (b) United States

Figure 31: CPI Shock on GDP



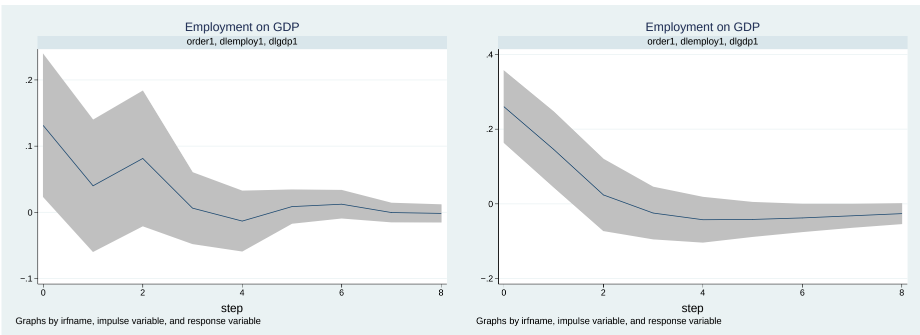
(a) Canada (b) United States

Figure 32: Treasury Rate Shock on GDP



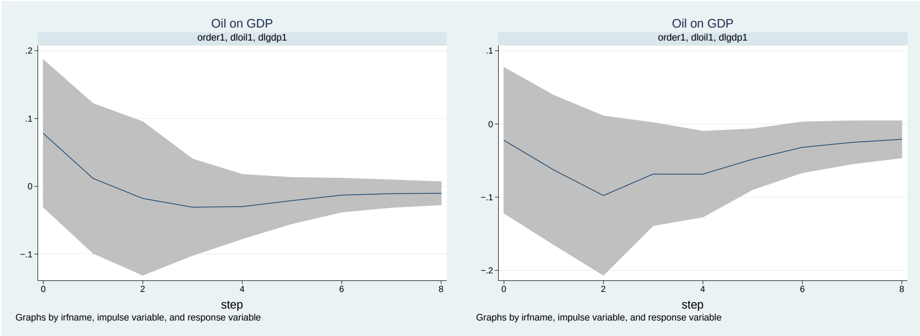
(a) Canada (b) United States

Figure 33: GDP Shock on GDP



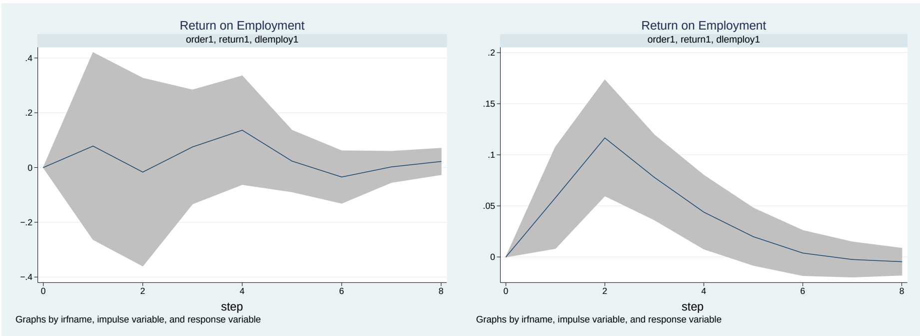
(a) Canada (b) United States

Figure 34: Employment Shock on GDP



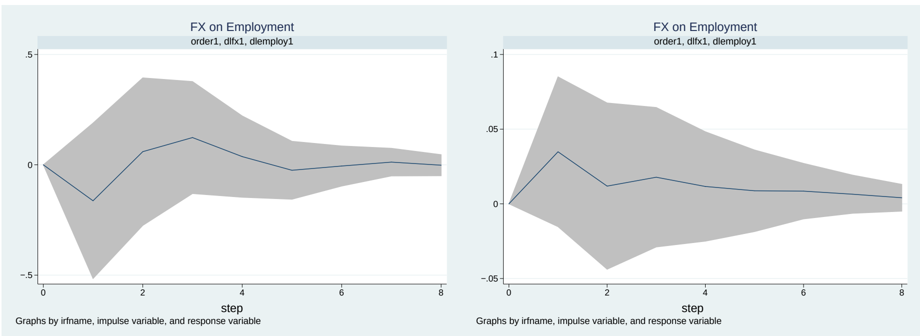
(a) Canada (b) United States

Figure 35: Oil Price Shock on GDP



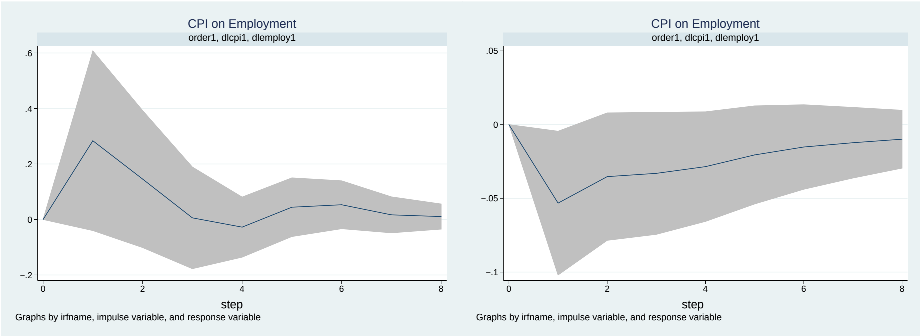
(a) Canada (b) United States

Figure 36: Return Shock on Employment



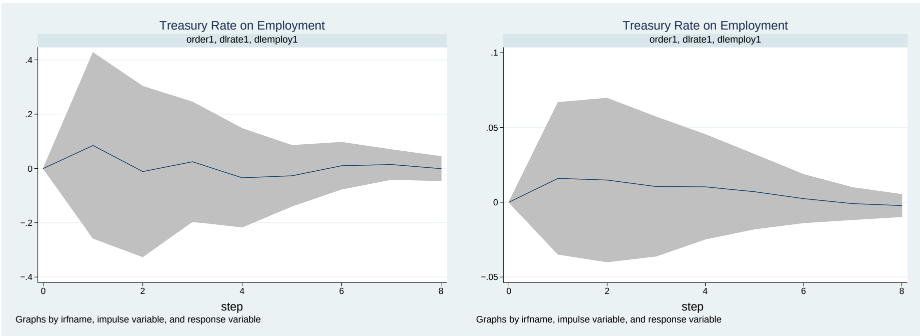
(a) Canada (b) United States

Figure 37: Foreign Exchange Shock on Employment



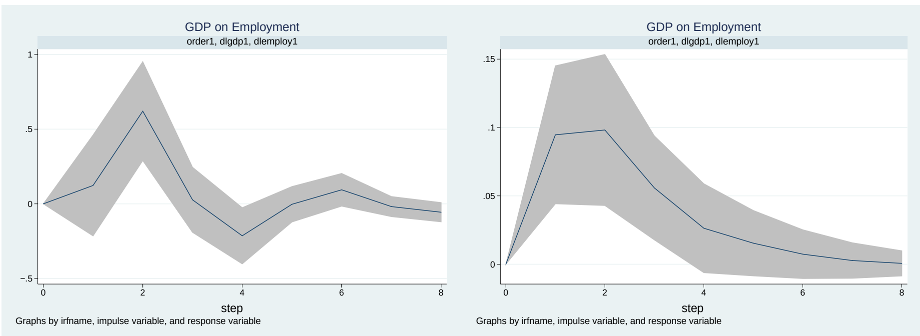
(a) Canada (b) United States

Figure 38: CPI Shock on Employment



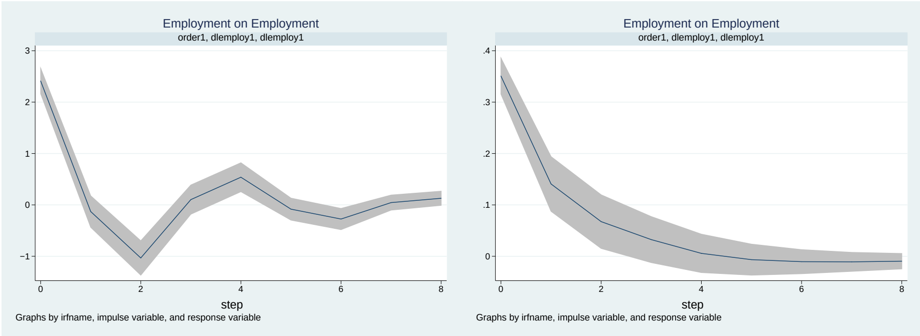
(a) Canada (b) United States

Figure 39: Treasury Rate Shock on Employment



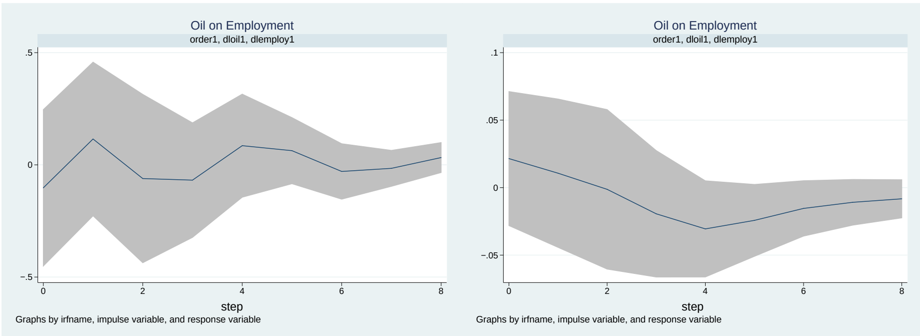
(a) Canada (b) United States

Figure 40: GDP Shock on Employment



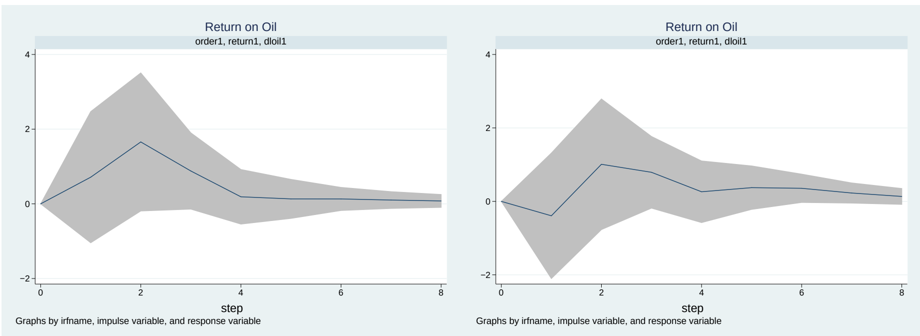
(a) Canada (b) United States

Figure 41: Employment Shock on Employment



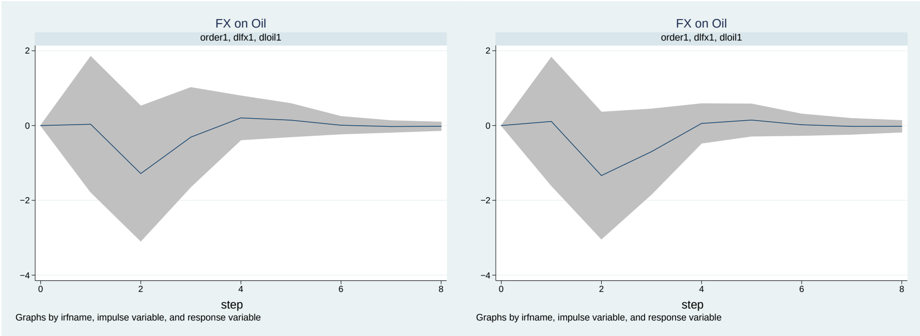
(a) Canada (b) United States

Figure 42: Oil Price Shock on Employment



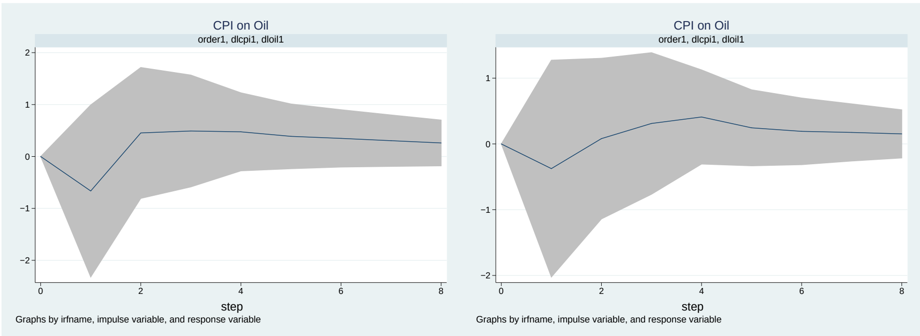
(a) Canada (b) United States

Figure 43: Return Shock on Oil Prices



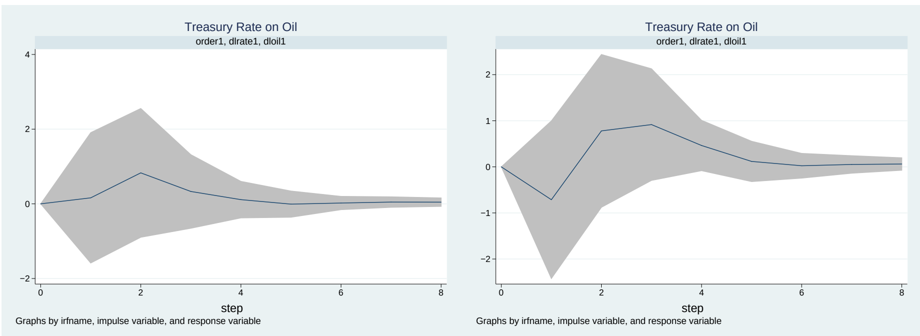
(a) Canada (b) United States

Figure 44: Foreign Exchange Shock on Oil Prices



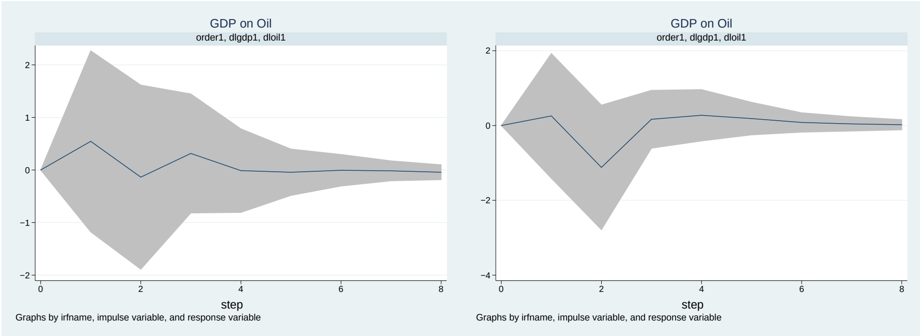
(a) Canada (b) United States

Figure 45: CPI Shock on Oil Prices



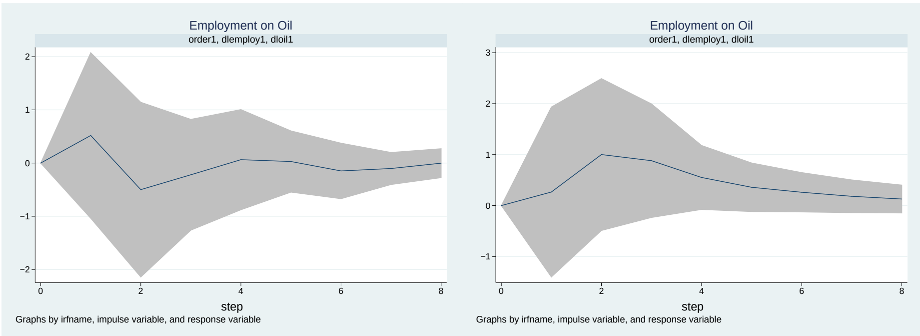
(a) Canada (b) United States

Figure 46: Treasury Rate Shock on Oil Prices



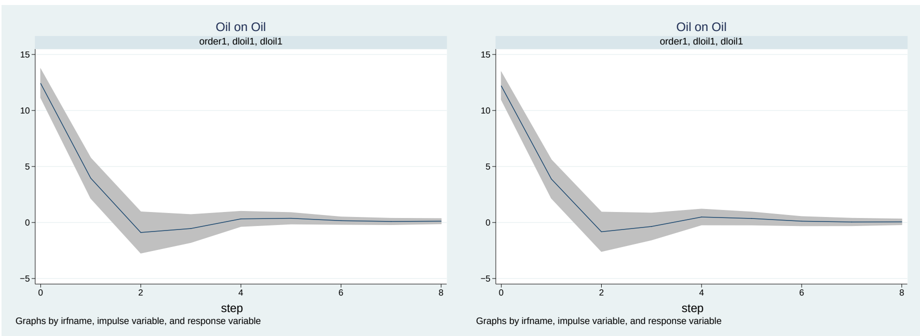
(a) Canada (b) United States

Figure 47: GDP Shock on Oil Prices



(a) Canada (b) United States

Figure 48: Employment Shock on Oil Prices



(a) Canada (b) United States

Figure 49: Oil Price Shock on Oil Prices