Do Oil Price Shocks Affect Household Consumption?
-Evidence from 5 OECD Countries

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Master Thesis in Economics (NEKN01)

School of Economics and Management

Spring Semester 2015

Supervised by Klas Fregert and Joakim Westerlund

Seminar period August 2015

Abstract

International oil prices have been fluctuating a lot since decades. Since oil is an important component influencing global indicators, it is also important to evaluate to what extent consumer spending is affected in the aftermath of oil price shocks. Thus the paper addresses whether international oil price change has any impact on consumer spending in the long and short run. To conduct this study, five OECD nations were chosen, classifying each into oil importing and exporting countries; Canada, Germany, Sweden, UK, and USA. Applying the empirical methodology of Vector Autoregressive Model (VAR), we find evidence that international oil price shocks have significant impact on the consumer spending in the short-run. The analysis is performed with two set of specification for oil: 'Oil price change' and 'Net oil price increase' and the main tool used for diagnosis is Forecast Error Variance Decomposition (FEVD) and Impulse Response Functions (IRF).

The results are strongly significant for Canada and USA. There are mixed inferences for Sweden, Germany and UK which leads to inconclusive decision about the impact on these countries. However, in general our empirical work supports the evidence that oil price have some predictive power in influencing consumption decision across oil-importing and oil-exporting countries.

Key words: Oil price shock, Vector Autoregressive Model, Household consumption, OECD

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Acronyms

ADF	Augmented Dickey Fuller
ASEAN	Association of Southeast Asian Nations
D(CONS_CAN)	Consumption (Canada)
D(CONS_GER)	Consumption (Germany)
D(CONS_SWE)	Consumption (Sweden)
D(CONS_UK)	Consumption (UK)
D(CONS_USA)	Consumption (USA)
D(INC_ CAN)	Income (Canada)
D(INC_ GER)	Income (Germany)
D(INC_ SWE)	Income (Sweden)
D(INC_ UK)	Income (Income)
D(INC_ USA)	Income (USA)
D(FA_ CAN)	Wealth (Canada)
D(FA_ GER)	Wealth (Germany)
D(FA_ SWE)	Wealth (Sweden)
D(FA_ UK)	Wealth (UK)
D(FA_ USA)	Wealth (USA)
D(IR_ CAN)	Interest (Canada)
D(IR_ GER)	Interest (Germany)
D(IR_ SWE)	Interest (Sweden)
D(IR_ UK)	Interest (UK)
D(IR_ USA)	Interest (USA)
D(WTI)	Oil_Price (WTI)
D(BRENT_EUROPE)	Oil_Price (BRENT)
EIA	Energy Information Administration
FEVD	Forecast Error Variance Decomposition
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
OECD	Organization for Economic Co-operation and Development
VECM	Vector Error Correcting Model
WTI	West Texas Intermediate

Acknowledgement

I would like to thank my supervisors for their valuable time and guidance throughout the writing process. Special thanks go to Professor Klas Fregert for constantly boosting up my confidence during the stressful time. Finally it is worth mentioning that I will always be grateful to Swedish Institute and Swedish Government for awarding me this excellent scholarship without which my Master Program at Lund would not have been possible.

Chapter 1: Introduction

Oil has been an important component for the global economy. The historical periods, comprising of oil price shocks due to demand or supply gaps, has been seen to affect economies of not only oil-producers but also the oil-consumers in general. Historically most of the oil price shocks arose from political conflicts or supply gaps. The history of oil price shocks dates back to the 1970s when the world experienced its first oil shock in 1973 due to reduction of export of oil by the oil-producing countries followed by political conflicts emerging between then 'OPEC' nations in 1979. Throughout these periods, oil price rose excessively higher than the existing market price causing many of the leading developed nations to suffer. Another oil crisis began in 2003 when the price of crude oil started rising and peaked at its highest value in 2008. The main reason behind this was increase in global demand for oil in response to existing supply (EIA). Very recently, the lack of global demand against the current production of oil caused the international oil price to fall since November 2014. Thus oil price shocks have always been associated with business cycles across the globe where both oil-producing and consuming countries were severely affected.

Although oil price shocks can have direct impacts on the macroeconomic indicators such as exchange rates, balance of payments, export/imports, interest rates which can allow us to measure its impact on the economic growth, but how it affects consumers is not straightforward to assess. When there is a shock in the economy, the expectations of consumers about the persistence of shock will be reflected in both their current and future consumption patterns. This, in turn, will have other economic consequences affecting decisions for wage-earners as well as industrialist. Since oil is an important component for the global economy, it is important to assess how it can affect consumers across globe as well. Since consumption constitutes a significant proportion of aggregate demand of an economy, assessment of how oil price affect consumers will also hold policy implications for Central banks and investors.

Thus, the paper aims to assess of oil price shocks can affect the consumer spending as well. Due to the increased importance of oil price globally, there has been enormous study on how oil price affects the macroeconomic activities of large oil-importing and oil-exporting nations. If there is an oil crisis, it is assumed that the effects are likely to be felt quicker in the oil-producing countries or countries heavily dependent on oil. This is because it is expected that a negative oil price shock may lead to increased job losses or changes in other macro-indicators such as interest rates and/or exchange rates. This will thus have repercussion at the consumer level. But whether the effects are similar for oil-importers too is yet to be tested. Thus, for this reason, we purposively select five OECD nations where Canada is a net exporter and Germany, Sweden, UK and USA are net importers of oil. To study the effects of oil on consumption, there has been very few proposed theory. This study, however, is based on the life-cycle model of consumption as acknowledged by Mehra and Peterson (2005). Thus applying the empirical approach of Vector Autoregressive Model (VAR), the study assess if oil price has an effect on household consumption. However, the theoretical explanation behind using a VAR model and its application is discussed in later chapters.

The paper is divided into four main sections; section 2 talks about the direct and indirect impacts of oil and previous literatures on oil price shocks. Section 3 discusses the theoretical framework and methodology following that section 4 discusses the data collection sources. Finally section 5 puts forward the empirical findings whose implications are discussed further in concluding chapter 6.

Based on the empirical findings, however, we conclude that there is strong evidence that oil price shock affects consumer spending in Canada and USA. There are mixed inferences for Germany, Sweden and UK and hence based on the test it cannot be concluded whether oil price does have significant impact on household consumption. The results, however, shed light on the fact that consumers from economies which are highly dependent on oil has larger impact in the short-run when the international oil price changes.

1.1 Research Question: Do oil price affects household consumption across oil-importing and oil-exporting nations?

1.2 Objectives:

Due to the fact that oil price has changed a lot over decades, this study aim to assess empirically if oil price has an impact on household consumption over last two decades. The annual observations used in this study mainly consist of oil price increase and hence the study will mainly incorporate two specifications of oil price shocks: ‘oil-price change’ and ‘net oil price increase’.

<u>Chapter 2: Background and Literature</u>

2.1 Consequences of oil price shock on oil exporters and importers:

The impact of oil price can be classified into two forms: Direct and Indirect effects although the impacts on oil-importers and oil-exporters in cases cannot be distinguished clearly. It is however assumed that for oil-importers, the effects of shocks arising out of oil price change may not be realized instantly.

One direct implication of oil price increase is that it will reduce the consumption of fuel. This is true for consumers of both oil-importers and oil-exporters as consumers react to increased oil prices by consuming less fuel products. Rational expectations of individuals will lead them to rely less on fuel and gasoline products and this may even cause them to cut down use of private vehicles and/or other transportations led by oil (Silverstein, 2015).

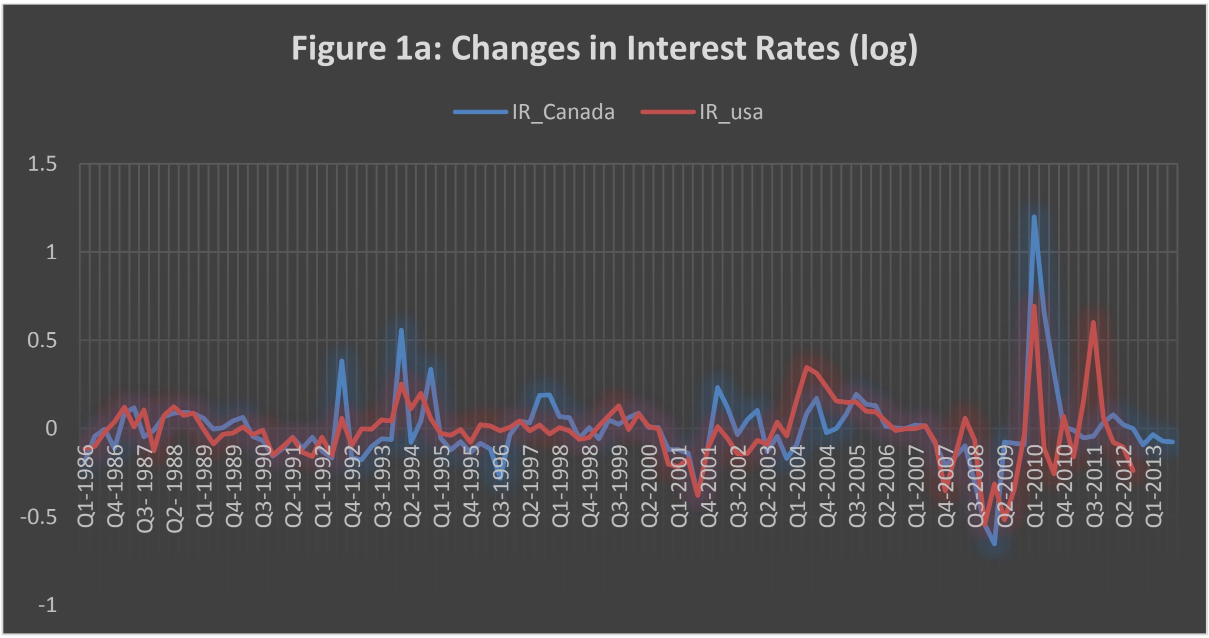
Another argument associated with energy prices is that it will lead to fall in investment (Peachey, 2015). If oil price drops substantially lower it may cause energy related investment to dip as well. This can be seen as a direct consequence because as a reaction to global increase of oil price, consumers' spend proportionately higher disposable income on current consumption and spends less on asset accumulation, such as stocks, shares or bond. As a consequence investment on housing, shares, bonds or any other form of wealth is likely to be less in the long -run, which is true for both oil-exporting and oil-importing economies. Similarly, a negative oil price shock in an economy is associated with increased unemployment as well. Countries which are net oil exporters, an increase in oil price will lead to increased employment while it will cause lay-off when there is an oil price shrink. In context of net importers of oil, the wage -earners will be affected via its impact though increased inflation which reduces the purchasing power of the mass population in general. Thus, a lot of factors contribute to the fact that the consequences of oil price shocks is likely to be realized faster for an oil exporter but slowly over time for oil importers. For instance, the consistent permanent fall in the international price of oil due to increased oil sand production in Alberta has caused unemployment to increase from 0.8% to 5.3% in Canada since 2015 (Toneguzzi, 2015).

However, the indirect effects of oil price on consumption are scarcely visible or realized for an economy. When there is a positive shock in the economy, its indirect effects on consumption will be realized over the long -run through channeling effects on other variables. For instance it may increase interest rates which will reduce future disposable income and wealth accumulation. This can because, an increase in interest rate will make savings more preferred to consumption and consumers may reduce investing on bonds, shares or other forms of asset accumulation. One of the evident consequence of oil price shock is that it may increase inflation which may reduce consumption through reducing individual's purchasing power. This leads us to the consequence of indirect effects of oil price shocks.

Thus, it can be argued that an increase in oil price will 'ceteris paribus' cause aggregate price level to increase and as a reaction to this rise in inflation interest rates will also increase as a measure of tightening monetary policy of central banks. Consumers will spend less as they tend to save more. However, in reality a particular shock is not 'ceteris paribus' to other shocks and it is more realistic to expect that many economic consequences are occurring simultaneously together. As a result it is usually difficult to capture the reasons for interest rates fluctuations over decades. Thus, although the theoretical argument can be based on the fact that an increase in oil price is associated with increase in interest rates, but there can be other factors affecting simultaneously the decision of interest rate changes (Clark, 2008).

However, reflecting back in the past interest rate regime, it can be seen that the post 1970s has been the era of inflation-targeting regime for most of the industrialized countries including the ones concerned in this study. Canada has been adopting inflation-targeting policy since the formal adoption in 1991 (Bank of Canada) which was due to the economic consequences followed by high inflation in early 1980s. Figure 1a depicts that Canada has witnessed much volatility in change in interest rates compared to USA over decades reflected in the sluggish spikes for Canada. This is because since 1995, Bank of Canada decided to adopt interest policy tool as a key to control inflation which was targeted to keep stable around 2% (Bank of Canada). This led to a stable growth of economy until in 2008, the financial crisis led to inflation to fall below the target of 2%. This led the bank to reduce its policy interest rate to one-quarter of 1% (Bank of Canada) which is also reflected in Figure 4. On contrary, USA took both the traditional and non-traditional inflation targeting policy during the financial crisis. The interest changes is not only the result of changing money supply but the Federal Reserve Bank also bought asset including government and agency securities and mortgage-based securities which pushed the interest rates down thus benefiting consumers investing in securities (The Federal Reserve Bank). While Canada is among the largest five oil-exporters and USA has in last decade shifted its status into an oil-importer, much of their macroeconomic activities (such as unemployment) is deeply associated with oil price changes and hence more volatile to such shocks.

Given that crude oil still remains an important component of dependence for the industrial countries, it is yet to discover to what extent the change in oil price is associated with interest rates. Figure 1b depicts that for Sweden interest changes has been much volatile compared to UK and Germany. It was profound in the 1990s and later in 2008 during global recession. The reason could not be well established whether it is associated with oil price changes. The case of Sweden is mainly due to increasing asset prices in the late 1980s influenced by uncontrolled financial market and tax system leading to end of a fixed interest rate regime (Berg and Gröttheim, n.d.). High inflation was thus followed by consequences such as negative saving ratio and unemployment fell up approximately to 1,4%. As an aftermath to this, recession was set out in late 1990s which has led to interest rates to fluctuate much. The graphs give evidence that changes in interest rates have persisted in previous periods. However, it cannot be yet argued that different policy actions adopted by the central banks during those times has been associated with changes in consumer's spending decisions unless studied further. Thus, to what extent the fluctuation in interest rates can be explained by oil price change remains a concern of this study and its implications will be discussed further.



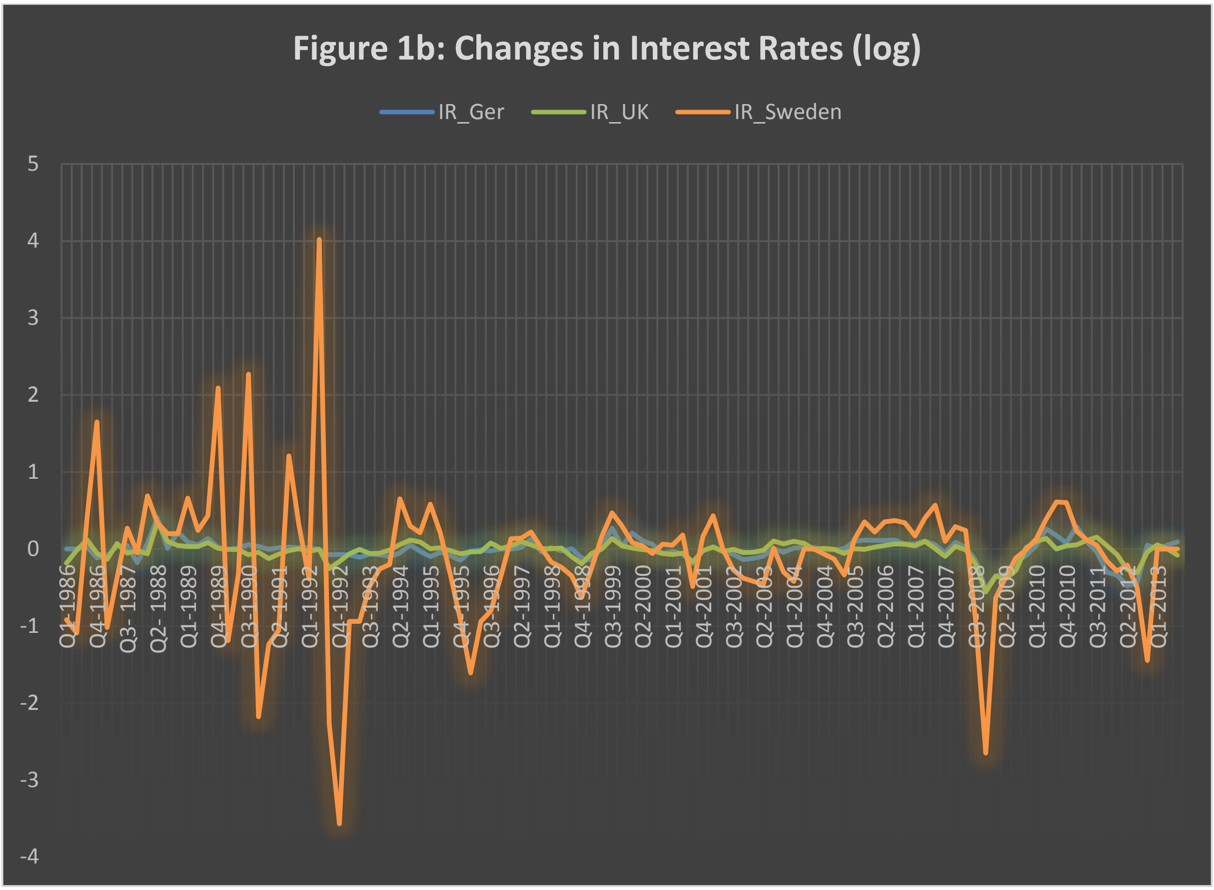


Figure 1b: Changes in Interest Rates (log)

Thus the argument could be put forward like the following: If there is an oil price change it is theoretically going to affect private consumption through monetary policy actions of lower or higher interest rates given all other things remaining constant. If there is a shock in the economy, 'ceteris paribus' it will cause consumers to adjust their expectations regarding future long term interest rates and hence consumption. An oil price change has been associated with either positive or negative shocks over last decades in the aftermath of increasing per barrel price in 2003 followed by global recession in 2007-2008. Consumption, thus, forms a major component of aggregate output under macroeconomic framework beside investment, government expenditure and net exports. This reasons well why consequences of oil price crisis should also be studied for household consumption.

2.2 Previous Literature:

A wide range of literature on oil price tends to focus on its implication on overall macroeconomic activities. This includes impacts on money market, exchange rates, or economic growth and international trades between oil-importing and oil-exporting countries reflecting their impact in the aftermath of global recession (See Rodriguez and Sanchez, 2003 and Mork et al, 1994 and Herrera et al, n.d). The study by Mork et al (1994) also studies the macroeconomic effects of increase or decrease of oil price shocks on GDP growth for some OECD countries. The results seem to have varied a lot from country to country. However, one common observation in both of the studies was that the effects of oil price change were significantly larger for the heavily oil-dependent countries.

While most of the literature emphasizes on how oil price change affects economic activities in general, there has been a handful of studies talking about its effects on household consumption. In this regard, Mehra and Peterson (2005), Blanchard and Gali (2010) and Kilian (2008) were the first to study effects of oil price on household consumption. However, each of them takes a different approach on how oil price enters the consumption function of individuals and discuss its implications differently.

For instance Mehra and Peterson (2005) adopts the famous ‘life-cycle’ model of Consumption by Modigliani and Brumberg (1954) to empirically study if oil price affects total consumption of households of USA. They study the direct impact of oil price change into the model along with other variables, wealth, income and interest rates serving as control variables and using a model of Vector Error correcting model. Based on empirical result they find evidences that oil price significantly impacts consumption in the short-run but not in the long-run. Inspired by the work of Mehra and Peterson (2005), Zhang and Broadstock (2014) expands their study using similar approach for some selected ASEAN and East Asian economies which are broadly classified as oil-importing nations. However, the difference between the two works is that, Zhang and Broadstock (2014) does not assert on interest rate changes as one of the determining factors of consumption as the former did.

Blanchard and Gali (2010) and Kilian (2008) however take a different approach. They develop a simple model where oil is assumed to be used as an input of production and the rest consumed by households. They empirically show that oil price affects consumers through increasing or decreasing the consumer price of final commodities when there is a price change. This is because, a change in price of oil will make imports expensive and hence increase the production cost of the commodities dependent on oil thus increasing the consumer price.

Mehra and Peterson (2005) was first to bring an empirical work on consumption under a standard macroeconomic context. Hence, this study is based by the empirical approach as proposed by Mehra and Peterson (2005). While the former study is performed on the economy of USA between 1960s and 2003, our study expands the work to include 5 OECD countries, notably Canada which is a net exporter of oil and Sweden, Germany and UK which is a net importer of oil. We also include USA as it has been an important economy for its oil dependence since 1960s though it's status has now changed into a net importer. While Mehra and Peterson (2005) use change in gasoline price, we use changes in crude oil price to conduct our study. Although crude oil price and gasoline price supposed to move simultaneously, the motivation behind using crude oil price is to capture the direct effects of oil price shocks on consumption.

Mehra and Peterson (2005) uses the method of GMM to estimate the two major effects: 'Positive oil price increases' and 'Net oil price increase' inspired by Mork (1989) and Hamilton (2003). In this paper, the effect of oil price is calculated for a period between 1986 and 2013 which is first calculated for the whole period and then for two major effects: an 'oil price change' and 'net oil-price increase'.

Chapter 3

Theoretical Framework and Methodology:

The theoretical model for this study is based on the macroeconomic 'Life-cycle' model of Consumption of Modigliani and Brumberg (1954). The main assumption in the model is that in an economy, consumption is a function of income, wealth and short-run interest rate. However, each of the three variables effect consumption in different ways (See Sørensen and Whitta-Jacobsen, 2010).

As Modigliani and Brumberg (1954) acknowledges that the 'Intertemporal Budget Constraint' defines a consumer's lifetime consumption is a function of current period wealth (W_t), current period disposable income (Y_t^d) and flow of future income at (t+i) discounted at current rate of interest (r). In other words,

$$\boldsymbol{C_t + \frac{C_{t+i}}{(1+r)} = W_t + Y_t^d + \frac{Y_{t+i}^d}{(1-r)}}$$

Thus by the assumptions of 'life-cycle' theory, consumption is a function of wealth, disposable income and real interest rate:

$$\boldsymbol{C_t = f(Y_t^d\,, r_t, W_t)}$$

Thus, the ‘life-cycle’ model of consumption sets the argument that disposable income, wealth and interest rates are the main factors affecting consumption both in the long-run and short-run. But it is also needed to define how each of the variables affects consumption. The model assumes that real disposable income and net financial asset affects consumption positively, that is, an increase in disposable income will increase private consumption in the short-run. However, how real interest rate influences consumption is quite undetermined. Interest rate is assumed to affect consumption through two major ways: Income effect and Substitution Effect (See Sørensen and Whitta-Jacobsen, 2010). This implies that a rise in interest will decrease demand for wealth as people will spend less on acquisition of wealth. Similarly an increase in interest rate is likely to make savings more preferred to consumption. However to back up this theory, there has been very little empirical work that can draw a general conclusion about the effects of interest rate on consumption (Sørensen and Whitta, 2010).

When we adopt a theoretical model to study its application with real-time economic data, it requires us to include lagged variables of income, wealth and consumption in their consumption model. This helps to capture the effect of time on each of these variables. It is also reasonable to think that the effects of income and wealth may not be realized on consumption unless some particular time has elapsed.

In reality the consumer tends to smoothen consumption over lifetime; there always remains a divergence between the planned and actual consumption which needs to be identified. In this regard, Mehra and Peterson (2005) assume that a rational consumer’s actual consumption will always fluctuate around a planned consumption. This is a function of anticipated value of lifetime resources, which equals current ($\boldsymbol{Y_t}$) and expected future labor income ($\boldsymbol{Y^e_{t+k}}$) and current value of financial assets ($\boldsymbol{W_t}$) and $\boldsymbol{C^p_t}$ is planned consumption at time (t) :

$$\boldsymbol{C^p_t = a_0 + a_1 Y_t + a_2 Y^e_{t+k} + a_3 W_t} \qquad (1)$$

Thus, the differences between current and planned consumption would establish the long-run equilibrium (See Enders, 1995).

Thus, considering this issue, the final model of short-term consumption is as shown by Equation 2 where change in current consumption ($\Delta \boldsymbol{C_t}$) is a function of previous period income ($\Delta \boldsymbol{Y_{t-1}}$), previous period wealth ($\Delta \boldsymbol{W_{t-1}}$) and consumption in previous periods ($\Delta \boldsymbol{C_{t-s}}$) and the adjustment lag between actual and planned consumer spending is reflected through introducing the error correcting term in the equation $\left(\boldsymbol{C^p_{t-1}} - \boldsymbol{C_{t-1}} \right)$ as follows:

$$\Delta \boldsymbol{C_t} = \boldsymbol{\alpha_0} + \boldsymbol{\alpha_1}\left(\boldsymbol{C^p_{t-1}} - \boldsymbol{C_{t-1}} \right) + \boldsymbol{\alpha_2}\Delta \boldsymbol{Y_{t-1}} + \boldsymbol{\alpha_3}\Delta \boldsymbol{W_{t-1}} + \boldsymbol{\alpha_4} \sum_{s=1}^{k} \Delta \boldsymbol{C_{t-s}} + \boldsymbol{\mu_t} \qquad \textbf{(2)}$$

As specified in the equation (2), the error correcting term is expected to be greater than zero. This reflects that long-run equilibrium is attained as the previous period consumption ($\boldsymbol{C_{t-1}}$) draws closer to the planned consumption ($\boldsymbol{C^p_{t-1}}$).

One key problem to analyze this model econometrically is the identification of expected income in planned consumption. It is not possible to observe future anticipated wealth in reality. Thus, Mehra and Peterson (2005) makes an assumption that the growth of expected income is constant over time thus depicting that $\boldsymbol{Y^e_{t+k}} = \boldsymbol{Y_t}$. Under this assumption, the specification for planned consumption thus changes to,

$$\boldsymbol{C^p_t} = \boldsymbol{b_1 Y_t} + \boldsymbol{b_2 W_t} + \boldsymbol{\varepsilon_t} \qquad \textbf{(3)}$$

Where $\boldsymbol{\varepsilon_t}$ is a white noise process (See Enders, 1995, Zhang and Broadstock, 2014, p.7).

Substituting equation (3) in equation (1), the final model of consumption then becomes a function of Income, Wealth and Consumption as shown in equation (4)[1]

$$\Delta \boldsymbol{C_t} = \boldsymbol{\alpha_0} + \boldsymbol{\alpha_1}((\boldsymbol{a_0} + \boldsymbol{a_1 Y_t} + \boldsymbol{a_2 W_t}) - \boldsymbol{C_{t-1}}) + \boldsymbol{\alpha_2}\Delta \boldsymbol{Y_{t-1}} + \boldsymbol{\alpha_3}\Delta \boldsymbol{W_{t-1}} + \boldsymbol{\alpha_4} \sum_{s=1}^{k} \Delta \boldsymbol{C_{t-s}} + \boldsymbol{\mu_t} \qquad \textbf{(4)}$$

The key question is how can one assess oil price effects using the established model above? The impact of oil price shock on the above model is not straight-forward to assess. The main motivation behind conducting this study is that energy constitutes a high percentage of household consumption. This is because of its greater use in transportation, household use, and also in the production process of product that is consumed. Hence we directly assess the impact of oil price by adding it as an exogenous variable in the stated consumption model. In

[1],[3] It must be noted that substitution of the equation of planned consumption (eq.1) is reflected as in the error correcting term $((\boldsymbol{a_0} + \boldsymbol{a_1 Y_t} + \boldsymbol{a_2 W_t}) - \boldsymbol{C_{t-1}})$ which is then simplified into $\left((\boldsymbol{a_0} + \boldsymbol{a_1 Y_{t-1}} + \boldsymbol{a_2 W_{t-1}} + \boldsymbol{a_3 r_{t-1}} + \boldsymbol{a_4 Oil_{Price_{t-1}}}) - \boldsymbol{C_{t-1}} \right)$. We implicitly assume that if oil price and interest rates are included in the model, then by definition of a VECM, these variables will also be present in the error correcting term as long as they exhibit long-run equilibrium.

order to capture the movement of short-term interest rates as a result of oil price shock, we also include interest rate as another exogenous variable[2]

Given the model holds true, this introduces two possibilities: oil price may only have short-run causality and oil price may have both short and long run causalities. If oil price along with other variables are expected to establish long-run equilibrium, then the final model estimated would look as equation (5)[3] holds, where the 'α' coefficient represents the causalities in the short and long run.

$$\Delta C_t = \alpha_0 + \alpha_1((a_0 + a_1 Y_{t-1} + a_2 W_{t-1} + a_3 R_{t-1} + a_4 Oil\_Price_{t-1}) - C_{t-1}) + \alpha_2 \Delta Y_{t-1} + \alpha_3 \Delta W_{t-1} + \alpha_4 \sum_{s=1}^{k} \Delta C_{t-s} + \alpha_5 \sum_{s=1}^{k} \Delta Oil\ price_{t-s} + \alpha_6 \sum_{s=1}^{k} \Delta R_t + \mu_t \quad (5)$$

But it is not realistic to assume that global oil price may have strong impact on consumer's decision in the long-run unless tested empirically. Mehra and Peterson (2005) and Zhang and Broadstock (2014) have neither found any significance of long run equilibrium deriving from oil price changes. Thus, in align with previous literature; we also leave it to the empirical assessment if oil price does affects both in the short and long run. Shall there be no long-run effects, our model specification to be used will be a 'Vector Autoregressive Model (VAR)' otherwise and not a 'Vector Error Correcting Model (VECM)' and hence the error-correcting term in equation (5) will eventually drop-out.

Chapter 4 Data Type and Source

The study is conducted using 5 OECD countries of which Canada is an oil-exporting country and Germany, Sweden, UK and USA are oil-importing countries. The selection of these countries are mainly based on the availability of historical data, but the rationale behind choosing these countries is to capture whether we can find any similarities in the pattern of effects across different regions for importers and exporters.

Data has been collected on Private final consumption, Disposable Income of Household Sector, Net Acquisition of financial asset of Household Sector and Short term interest rates using Thomas Reuter Data stream software. However, the original source of data is Oxford

[2] This is a question that to what extent the monetary policy change could reflect the effects due to international oil price change. International oil price is very perception-driven and thus may not impact the monetary policy adoption of all countries in general which will be reflected in our empirical analysis further.

Economics for most of these variables while the data on consumption sources from the Federal Reserve Bank of St. Louis. This is because unlike other sources the Research unit of Federal Reserve Bank compiles data on quarterly basis which is more relevant for this study. Thus data is collected between 1986Q1-2013Q4. For Sweden, data was only available between 1986Q1-2012Q4. The collected data were at national level. Since the study involves assessing impact of oil price shock at consumer level, data were divided by total quarterly population to capture the effect at per capita level. The data across countries ranges in different unit of measurement. For instance the data of Germany, Sweden were in Euros while of UK in pound sterling. The data have all been converted to constant US dollars and exchange rate of currency from Bloomberg. To capture the effect in the short term consumption, it was important to collect data at quarterly level.

To measure the impact of oil price shock data on Spot prices of West Texas Intermediate (WTI) and Brent Europe have been collected from U.S. Energy Information Administration (EIA). The data on WTI is relevant for Canada and USA while the Brent Europe is more relevant for UK, Germany and Sweden (EIA).

4.1 Definition of Variables:

The variables used for this study are as follows:

1. Private Consumption: This is defined as the Total Private Final Expenditure measured in millions of constant US dollars.
2. Income: This is defined as the Disposable Income of Private household measured according to Income Approach. While most of the data have been collected from Oxford economics, but for USA data have been collected from OECD library and for Germany data collected from Deutsche Bundesbank. Although for a better comparison data from one source would be better, however, data was available on quarterly basis on different sources.
3. Financial Asset: This is defined as the Net Financial Wealth of Private Sector which is asset minus liabilities.
4. Short Term Interest Rates: this is defined as interest rates on loans or debt instruments (bonds, treasury bills, bank certificates) of less than a year.
5. Spot Prices of WTI and Brent: Crude oil price in dollars per barrel.

Our analysis is also based on the assumption that current and expected future income are equal (see Mehra and Peterson, 2005) and hence rule out the need to identify separately another series of variables for expected future income.

Chapter 5: Empirical Results:

In order to establish if oil price has an impact on consumer spending, it is first important to study about the stationarity of the variables used. Given we estimate the model in Equation (5), it must be confirmed that the variables necessarily exhibit stationarity which, otherwise if not found so, need to be taken in first differences.

To confirm the presence of unit root, we thus perform Augmented Dicky-Fuller (ADF) test for testing unit root for each variables both at levels and in differences and the test results are reported in Table 1. The presence of unit root is investigated with ADF test by running regression using the following equational form where x represents relevant variables in our model:

$$\Delta \boldsymbol{x_t} = \boldsymbol{a_0} + \boldsymbol{\gamma x_{t-1}} + \boldsymbol{a_1 t} + \sum \boldsymbol{\beta_i} \Delta \boldsymbol{x_{t-1}} + \boldsymbol{\varepsilon_t}$$

Thus, ADF test allows one to examine presence of unit root process with ‘trend’ and ‘intercept’ regressors which are purely deterministic while $\boldsymbol{x_{t-1}}$ is a unit root process under null hypothesis (See Enders, 1995, p. 239). The computed ADF test statistics at levels are found to be significant at 5% level while those at difference were found insignificant at 5% or 1% level, thus confirming that the variables are indeed non-stationary. The only exception was in case of the wealth series for Germany which depicts stationarity even at level.

In addition, we further observe that for some variables the test results were found stationary only with intercept. A key problem with using ADF test is that the intercept and slope of the trend are not well estimated in the presence of a unit root (See Enders, 1995, p. 239). Thus, in order to investigate this issue, we further conduct ‘Kwiatkowski-Phillips-Schmidt-Shin’ (1992) to improve the intercept of trend and intercept component of our concerned variables and the results are reported in Appendix 1.

Table 1: Augmented Dickey Fuller Test Results
ADF Null Hypothesis: There is Unit Root (γ=0)

		ADF (at level)		**ADF (at first/second difference)**	
		t-stat	p-values	t-stat	p-values
Canada	C_t	-1.379845	0.5896	-3.577856	0.0078
	Y_t	-2.790909	0.2039	-4.170956	0.0069
	W_t	-0.230991	0.9916	-3.817670	0.0193
	r_t	-1.242114	0.6541	-4.293776	0.0047
Germany	C_t	-2.790685	0.0630	-3.620617	0.0327
	Y_t	-2.501512	0.3269	-3.515616	0.0428
	$\boldsymbol{W_t}$	**-5.769046**	**0.0000**	**-5.189286**	**0.0002**
	r_t	-1.305658	0.6251	-4.136944	0.0076
Sweden	C_t	0.218128	0.9726	-3.129540	0.0275
	Y_t	-1.296965	0.6289	-4.746189	0.0011
	W_t	-0.755135	0.8271	-3.341213	0.0155
	r_t	-1.182089	0.6802	-5.179129	0.0002
UK	C_t	0.562583	0.9881	-5.656522	0.0000
	Y_t	-0.502661	0.9821	-5.969440	0.0000
	W_t	-1.389054	0.8588	-5.623393	0.0000
	r_t	-0.998354	0.7520	-4.588081	0.0018
USA	C_t	-1.858752	0.6688	-3.459087	0.0110
	Y_t	-2.038622	0.5734	-3.813194	0.0195
	W_t	-2.089742	0.5455	-3.658345	0.0297
	r_t	-1.405522	0.5772	-3.573421	0.0370
Brent_Europe	Oil price	-0.645166	0.8549	-6.364396	0.0000
WTI	Oil price	-0.960736	0.7651	-6.604031	0.0000

Note: ADF (level) t-stat are greater than Critical Values while for ADF (differences) t-stat are less than Critical Values at 5% level or 1% levels.

With KPSS, null hypothesis is that the series is stationary as reverse to ADF and the test results are found to be insignificant at 5% level for all series which again confirms the presence of unit root with trend as well as drift.

Thus, unit root test results holds that the variables individually are all I(0) at first differences. In other words, they are integrated of order one. Given the variables are individually integrated, there remains possibility that the series of variables together may be cointegrated or exhibit a common trend in the long-run although it is not a necessary condition to be hold true always (See Enders,1995, p. 360). As already discussed that the decision regarding which model specification to be applied depends whether there exist cointegration between the variables, this needed to be tested further.

With the presence of cointegration, the correct model specification to be used will then become a Vector Error Correcting Model (VECM) and not a Vector Autoregressive Model (VAR). However, in this regard previous literatures (See Mehra and Peterson,2005 ; Zhang and Broadstock, 2014) have found no significant evidence of long run equilibrium although, the empirical work by Zhang and Broadstock (2014) shed light that there exist cointegration between Consumption, Income and Wealth series which is also what one might expect theoretically. Thus, before proceeding further, we investigate whether consumption, income, wealth together with oil and interest rates are cointegrated or not.

A test proposed by Engle and Granger (1987) can be used in regard to test for the presence of cointegration. The test is a two-step process where in the first step the set of variables concerned in the model is regressed and the resulting residual is then tested to see if it exhibits stationarity or long-run equilibrium (See Enders,1995, p. 359). The null hypothesis is that there exists no cointegration between the individual variables as the series of variables exhibit unit root process. Based on the result in Table 2, we accept the hypothesis of no cointegration. The null hypothesis is accepted since the test-statistic is found greater than the critical values (-4.9897) as proposed by Phillips and Oularis (1990) at 1% level. This validates that oil price together with other variables do not share a common trend in the long run and hence have no long-run effects. This means that the discussed 'Error Correcting Term' consisting of wealth, income, interest and oil price together do not represent any deviation from equilibrium .

At this point, one can find the results contradictory with the discussed theory in previous chapter.

Having no cointegration eliminates the existence of long-run effects but there can still be presence of short run effects of oil price shocks. An exogenous shock in oil price may not have effect on consumer's spending decision equally in all countries. Empirical work of Zhang and Broadstock (2014) leaves inconclusive result whether all the countries in their study depicts short-run causality or not.

Table 2: Residual Based Engle-Granger Test of Cointegration Results
Null Hypothesis: No Cointegration or Residual Series has a Unit Root process

		t-stat
Canada	ε_t	-3.338448*
Germany	ε_t	-3.712659*
Sweden	ε_t	-2.833211*

UK	ε_t	-2.866132*
USA	ε_t	-3.179087*

Note: the * represents t-stat greater than Critical Values at 1% intervals

Before reporting VAR estimation, it is necessary to determine what number of lags to include in the model. We select the number of lags for each country based on the following criterion for lag selection: FPE, AIC, SC as reported in Table 3. Each of these criteria suggested different numbers of lags. Number of lags suggested by FPE and AIC was either 5 or 6 in most cases as opposed to SC which suggested 1 lag.

For the purpose of our analysis it makes sense to choose large numbers of lags. This is because of two reasons. First, it is worth mentioning that with VAR, the standard errors are likely to be biased due to possibility of autocorrelated error terms. Thus, taking large number of lags will reduce the effects of autocorrelation of errors and the results will be less persistent. But also it must be noted that, statistically taking large number of lags would result to greater loss of observations through degrees of freedom and the regression estimates might be biased.

Secondly, taking large number of lags also makes sense on theoretical ground. Each lag represents a quarter, and given that there is a shock in the economy, its effect will be realized over the time which may take few lags. Also given that the Central banks decide to adopt a monetary policy due to the shock it may take some time to affect the macroeconomic variables. And all these seem to take large number of lags. However, we choose a reasonable number of lags as suggested by the tests which does not also let us compromise with the number of observations used. Thus the chosen number of lags is: 6 for Canada, 5 for Sweden, 6 for Germany, 5 for UK and 6 for USA. We will refer number of lags as ‘p’ for further reference in subsequent VAR analysis.

Table 3: Lag selection criteria

	Lag	FPE	AIC	SC
Canada	1	1.30e-16	-22.39087	-21.62807*
	2	1.05e-16	-22.60512	-21.20664
	3	5.83e-17	-23.20370	-21.16956
	4	5.42e-17	-23.29318	-20.62336
	5	2.51e-17	-24.08729	-20.78180
	6	1.98e-17*	-24.36288*	-20.42172
Germany	1	1.30e-16	-22.39087	-21.62807*

	2	1.05e-16	-22.60512	-21.20664
	3	5.83e-17	-23.20370	-21.16956
	4	5.42e-17	-23.29318	-20.62336
	5	2.51e-17	-24.08729	-20.78180
	6	1.98e-17*	-24.36288*	-20.42172
Sweden	1	3.13e-14	-16.90566	-16.12410
	2	1.01e-14	-18.04284	-16.60999*
	3	9.07e-15	-18.15866	-16.07453
	4	4.62e-15	-18.85088	-16.11545
	5	2.98e-15*	-19.32014*	-15.93341
UK	1	7.53e-15	-18.33159	-17.56879*
	2	5.57e-15	-18.63562	-17.23714
	3	5.45e-15	-18.66529	-16.63114
	4	5.45e-15	-18.68264	-16.01282
	5	4.21e-15*	-18.96543*	-15.65994
USA	1	4.43e-16	-21.16442	-20.40162*
	2	2.61e-16	-21.69662	-20.29814
	3	2.32e-16	-21.82277	-19.78862
	4	2.03e-16	-21.97268	-19.30286
	5	1.19e-16	-22.53494	-19.22945
	6	1.16e-16*	-22.60020*	-18.65904

Note: the * indicates numbers of lags suggested by the particular test

Other than the minimal loss of observations, the decision regarding lag selection should also reflect if the estimated VAR (p)[4] model is stable and consistent with no serial correlation. Given the five set of variables for each country, the VAR (p) model comprises of 5 equations, one for each variables. But our analysis only requires us to report the effects of oil price on consumption and hence we will only report results from that equation. Thus our analyzed equation in the VAR (p) model is of the following form:

$$\Delta C_t = a_0 + a_1 \sum_{s=1}^{p} \Delta Y_{t-p} + a_2 \sum_{s=1}^{p} \Delta W_{t-p} + a_3 \sum_{s=1}^{p} \Delta C_{t-p} + a_4 \sum_{s=1}^{p} \Delta Oil\ price_{t-p} + a_5 \sum_{s=1}^{k} \Delta R_t + \varepsilon_t$$
(6)

The regression estimates of the computed VAR (p) model will only be able to infer about any possible effects of oil price, if the model, in general, portray stability and no serial correlation.

Table 4 reports the results of LM Autocorrelation test. With LM test the null hypothesis is that there is no serial correlation and the p-values are found significant at 5% level which strongly

[4] Here 'p' represents number of lags in the respective model

suggests that there is no serial correlation. It must be noted that for simplicity we report only the LM-stat for the particular number of lag used in each model. However, the LM statistics computed up to 6 lags is presented in Appendix 2 and it depicts that for all countries most of the lags are found to be significant with 'no serial correlation'. This strongly suggests that our VAR (p) estimates are indeed consistent with having no serial correlation.

Table 4: Autocorrelation LM Test ( ) number of lags
Null hypothesis: No serial correlation

	LM-Stat	p-value
Canada (6)	25.57260	0.4307
Germany (6)	28.88702	0.2687
Sweden (5)	18.37599	0.8260
UK (5)	32.30306	0.1494
USA (6)	27.55706	0.3286

It is also important that the VAR model itself is stable otherwise the estimates and other test that follows will be redundant. To study if our estimated VAR (p) model is stable, we construct the AR root table which is presented in Appendix 3.

The AR tables present the inverse roots of AR polynomials when our model of consumption is modelled as an AR (q) process (See Enders, 1995). The underlying assumption is that if all the polynomials are less than one and lies within the circle, we confirm that the residual series is stable and so is our VAR model estimated. Thus, the stability test from AR table shows that none of the values of modulus are greater than one although some are very close to one. But again it must be noted that with five variables and large number of lags, there remains a question on stability of the model. With large lags and many variables, it is unlikely that the model will be found strongly stable. Given our sample size and the AR root tables, we conclude that all the residual series from the estimated VAR (p) models are relatively stable for the chosen number of lags.

Having established the conditions for stability and autocorrelations for our computed VAR (p), we would go into deeper inference of the estimated coefficients and how they signify oil price effects. For simplicity only coefficients of oil price are reported. We first begin with comparing the coefficients and its significance level. Few observations are put forward from the results in Table 5: It can be seen that for all the countries, the coefficients of Oil_price are not found significant for all lags. This could be because with too many lags and too many variables it cannot be well inferred to what extent each of these variables causes others. Thus, with too many lags involved for a series of integrated variables, our VAR(p) model may limit the interpretation for all lags.

Another observation is that the signs of coefficients are negative in most cases while positive in few. This draws attention whether oil price effects consumption symmetrically or not. For some of the coefficients of oil price which are found significant, the sign of the coefficient does not infer a meaningful causal direction. For instance it can be seen that the coefficient of the first lag of oil_price is positive for Canada. Thus although it is significant, we cannot make a meaningful inference about the causal direction from the individual lagged values.

It is expected that a rise in oil price should be associated with a decline in consumption for most economies, the implication of which we have discussed in Chapter 2. However, whether the effects are symmetric or asymmetric across periods of shocks cannot be identified from the coefficients. However, each of the models is found insignificant at 1% level when the p-values of f-statistic are compared and this suggest that our model are fitted well.

Table 5: VAR (p) Estimates for Consumption		
	Consumption	t-stat (p-values)
Canada		
Oil_price(-1)	0.010052*	3.097835 (0.0028)
Oil_price(-2)	-0.001255	-0.366218 (0.7152)
Oil_price(-3)	0.000650	0.183658 (0.8548)
Oil_price(-4)	-0.003423	-1.083326 (0.2822)
Oil_price(-5)	-0.009420*	-3.127927 (0.0025)
Oil_price(-6)	0.001087	0.360599 (0.7194)
R-squared	0.719693	
Adj. R-squared	0.632096	
F-statistic	8.216037*	
Prob(F-statistic)	0.000000	
Germany	Consumption	t-stat (p-values)
Oil_price(-1)	0.011759	1.565316 (0.1226)
Oil_price(-2)	0.012455	1.346626 (0.1830)
Oil_price(-3)	-0.008685	-1.010109 (0.3164)
Oil_price(-4)	0.002036	0.237720 (0.8129)
Oil_price(-5)	0.005140	0.579755 (0.5642)
Oil_price(-6)	-0.011682	-1.491574 (0.1409)
R-squared	0.709177	
Adj. R-squared	0.591276	
F-statistic	6.015019*	
Prob(F-statistic)	0.000000	
Sweden	Consumption	t-stat (p-values)
Oil_price(-1)	0.015500*	3.755364 (0.0003)
Oil_price(-2)	-0.006265	-1.088370 (0.2798)
Oil_price(-3)	0.000908	0.148754 (0.8821)
Oil_price(-4)	-0.005250	-0.874331 (0.3847)
Oil_price(-5)	-0.004803	-1.082980 (0.2822)
R-squared	0.295703	

Adj. R-squared	0.064027	
F-statistic	16.45193*	
Prob(F-statistic)	0.000000	
United Kingdom	Consumption	t-stat (p-values)
Oil_price(-1)	0.010657	0.724270 (0.4714)
Oil_price(-2)	0.014540	0.929908 (0.3557)
Oil_price(-3)	-0.029513	-1.916401 (0.0595)
Oil_price(-4)	0.002983	0.187797 (0.8516)
Oil_price(-5)	-0.010855	-0.741808 (0.4608)
R-squared	0.518625	
Adj. R-squared	0.270859	
F-statistic	2.093202*	
Prob(F-statistic)	0.004617	
USA	Consumption	t-stat (p-values)
Oil_price(-1)	0.007181*	2.672700 (0.0093)
Oil_price(-2)	-0.002554	-0.914018 (0.3637)
Oil_price(-3)	-0.001750	-0.605555 (0.5467)
Oil_price(-4)	-0.003415	-1.288354 (0.2016)
Oil_price(-5)	-0.009604*	-3.614545 (0.0005)
Oil_price(-6)	0.000821	0.293181 (0.7702)
R-squared	0.802662	
Adj. R-squared	0.722660	
F-statistic	10.03302*	
Prob(F-statistic)	0.000000	

Note: Level of significance is represented as follows: * for 1% level

The assessment of oil price shock on consumption must hold stronger implications and the coefficients of the variable gives little clue as to what extent each lagged value of oil price do affect consumption at that particular period. In this regard, we conduct Wald test for testing the hypothesis if the coefficients jointly together.

For a system of equations in the VAR (p) model, this test would allow us to predict if the lagged values of oil price jointly can affect the movement in consumption series (See Enders, 1995, p.318). Thus, it is assumed that if the lags of oil price have some forecasting power, the coefficients of variables jointly will not be zero. In that case it is said that oil price would 'Granger Cause' consumption (See Enders, 1995).

The null hypothesis is that the coefficient of oil price jointly is zero. In other words, oil price coefficients jointly do not affect consumption. Thus, not rejecting null hypothesis would mean that oil price seems to not affect consumption (including other variables) and hence cannot establish short run equilibrium.

Table 6 reports the test results and it can be seen that for all countries, f-statistic statistics are found insignificant at 5% level except for UK and Germany. The joint test for coefficients is an indication that oil price may have impact on consumption in the short-run for Canada, USA and Sweden while not for Germany and UK. A key question that our study tries to address is to what extent the oil price shock affects consumption of oil-importers and oil-exporters. It should be noted that oil-exporting countries are more dependent on oil as a matter of fact that they are also producing oil. Thus, the movement of oil price series is expected to have stronger inference on consumption for oil-exporters than on oil importers. Again, it is a very sound in theoretical sense and needs further analysis to agree/disagree with the argument.

Table 6: Wald Test Results
Null: All oil price coefficients are jointly zero meaning oil does not granger cause consumption

	F-stat (df)	Prob.
Canada	3.492883* (6, 74)	0.0043
Sweden	4.979313* (5, 76)	0.0005
Germany	1.804830 (8, 62)	0.0931
UK	1.168877 (7, 68)	0.3322
USA	4.477150*	0.0006

	(6, 74)

Note: * indicates insignificance at 1% interval

Although there is some evidence that oil price coefficients may jointly have some causal inference on consumption, but it cannot be concluded based on the Wald test. This calls for further investigation and next we compute 'Forecast Error Variance Decomposition' (FEVD) as shown in Table 7. In this context use of a FEVD will reflect if the time series path of consumption is explained by its own shocks and shocks in wealth, income, and interest and oil price (See Enders, 1995, p.314). In other words, we can see if the oil price series has contribution in the forecast error of the consumption model.

We compute the FEVD with the Cholesky ordering of VAR (p) specification: ***D(Consumption) D(Wealth) D(Income) D(Interest) D(Oil_Price)*[5]**. One can expect that it may take as long as two years' time for the persistence of oil price shock to die out and hence we compute the FEVD with 10 lags (each representing a quarter). However, again for simplicity, only the result in every 2nd lag is represented. It can be seen that the variance decomposition of oil price is increasing for all the countries up to a certain lag, in most cases 4 lags, and then remains relatively unchanged. This reflects that oil price, has some forecasting power to the movements in consumption. It is an indication that the proportion by which error variance decomposition is influenced by oil price innovation which is increasing over time for as long as 4 lags (each representing a quarter). Thus FEVD supports our assumption that oil price can affect consumption. However, if we compare the results across countries, we see that only in case of UK oil price series does not seem to contribute much in predicting of the error variance. For most of the lags the percentage of contribution remains small. In case of Germany, interest rate seem to have the highest contribution in the forecast error and thus poses question whether the impact on consumption is derived mostly through oil price or interest in this case.

Table 7: Forecast Error Variance Decomposition

	Period	Δ(Consumption)	Δ(Wealth)	Δ(Income)	Δ(Interest)	Δ(Oil Price)
Canada	2	79.71825	7.788498	1.909785	2.181492	8.401971
	4	77.13583	7.606490	2.295571	3.604885	9.357225
	6	79.22409	5.885387	2.798569	4.422006	7.669947
	8	78.37106	5.851140	3.765931	4.462739	7.549129
	10	80.24066	5.127332	3.631923	4.273175	6.726908

[5] The use of this Cholesky ordering incorporates interest rates as well. Based on the results, we can thus argue if oil price together with interest rates can explain movements in wealth, income and consumption series.

Germany	2	90.24999	0.222398	0.239208	6.323950	2.964455
	4	77.66517	0.339309	0.868147	9.773579	11.35380
	6	76.16547	2.189021	2.032499	9.507116	10.10589
	8	69.78467	3.803855	3.174336	12.42740	10.80974
	10	66.04658	4.044571	5.839536	14.79048	9.278829
Sweden	2	83.46827	0.006126	1.362052	0.016062	15.14749
	4	71.01913	0.033431	10.50980	4.426954	14.01068
	6	78.39323	1.332889	7.066775	2.987003	10.22010
	8	73.05320	2.299436	11.70620	3.661260	9.279899
	10	76.44452	2.423634	9.996798	3.090391	8.044662
United Kingdom	2	97.20218	0.061533	1.949646	0.076174	0.710462
	4	83.85707	2.723009	4.610331	1.704102	7.105488
	6	86.78876	1.939309	4.994840	1.517958	4.759138
	8	83.43943	3.048253	5.752023	2.049051	5.711243
	10	85.09242	2.869035	5.039107	2.112747	4.886688
USA	2	88.49489	3.456005	1.130247	0.099514	6.819343
	4	78.14665	5.241342	7.918041	0.684258	8.009712
	6	66.58249	10.48911	5.945389	7.543142	9.439870
	8	64.62234	10.74096	6.918797	7.213411	10.50449
	10	66.72221	9.697516	6.269980	7.584030	9.726259

Note: The Cholesky Ordering Used is: D(Consumption) D(Wealth) D(Income) D(Interest) D(Oil_Price).

However, more realistically, with too many variables involved (consumption, wealth, income, interest and oil price), it cannot be well inferred if the oil price variable has strong predictive power in explaining the movements of consumption series. Thus as an additional diagnosis to our analysis, we use FEVD for the following a new Cholesky ordering including wealth and income variables only: ***D(Consumption) D(Wealth) (Income) D(Oil_Price)***[6] shown in Table 8 .

The reason behind this additional diagnosis is that, inclusion of wealth and income variables may allow a better evidence of direct impacts of oil price on consumption[7]. As Modigliani and Brumberg (1945) acknowledge that wealth and income are the determining factors of consumption, it is expected that shock in oil price will affect each of the variables in

[6] Since the reported Cholesky ordering is not our actual model to be estimated rather, rather an additional diagnosis, we do not report the VAR estimates and corresponding stability tests here.

[7] It is assumed that if oil price increases, marginal propensity of consumption will increase as consumers will spend proportionately higher of their disposable income. Thus consumption as well as income will fall as a result of oil price increase.

sequence. Although it is true that an oil price shock is likely to increase interest rates in the aftermath of inflation but that is again not obvious.

Thus Table 8 summarizes the findings and we only report the one for oil price as it is more relevant. The results reflect that the variance decomposition for oil price remains high and proportionately increasing for more lags for Canada (14.2215%), Sweden (13.03012%) and USA (9.338782%). For Germany (4.718694%) and UK (0, 395308%) it remains proportionately low compared to other countries. In cases of Canada, Sweden and USA, the variance decomposition is increasing up to 6th lag and then remains stable indicating that the persistence of shock arising out of oil price starts to die after 6 quarters or remains stable. Comparing our results with that in Table 7 suggest that oil price seem to explain the forecast error variance better with interest rate variable dropped out. This is also align with the theory which suggest that it is difficult to predict the causal impact of interest rate on consumption. Also as it has been argued in Chapter 2, we cannot say what actually cause fluctuations in interest rates. The inflationary impacts leading to interest rate changes may be derived from other shocks occurring in the economy simultaneously and may not necessarily be result of international oil price change.

Table 8: Forecast Error Variance Decomposition

	Period	Δ(Oil Price)
Canada	2	14.22150
	4	14.04999
	6	12.50355
	8	12.24476
	10	12.19032
Germany	2	4.718694
	4	5.378220
	6	4.317495
	8	4.370860
	10	4.043119
Sweden	2	13.03012
	4	13.70701
	6	12.57924
	8	12.69817
	10	12.37104
United Kingdom	2	0.395308
	4	4.021663
	6	2.804692
	8	4.163302
	10	3.565051

USA	2	9.338782
	4	10.01339
	6	9.992394
	8	10.02614
	10	10.27434

Note: The Cholesky Ordering Used is: D(Consumption) D(Wealth) D(Income) D(Oil_Price)

Following the Wald test and FEVD test, we have now established that oil price do have some impacts on consumption at least for Canada, Sweden and USA while the case of Germany and UK still remains inconclusive. However, none of the former test suggests the causal direction of the shock. That is, whether a unit increases in oil price increases or decreases consumption still remains a question. Thus to further our analysis, we also plot Impulse Responses functions (IRF) as shown in Figure 2a-2e to assess impact of one unit positive shock on consumption using the Cholesky ordering: ***D(Consumption) D(Wealth) D(Income) D(Oil_Price[8]).*** For clarity, accumulated response of each graphs are presented with a cholesky one standard deviation to oil price innovations.

The first impression one get from the set of response functions is that for a unit positive shock in oil price, consumption increases over the lags. Thus a positive shock to oil price innovations lead to a positive shock in wealth, income and consumption. As well The persistence of shock increases for consumption and income for most of the countries while it dies out after 5th lag for Wealth series as shown in the graphs. One would expect that a positive shock in oil price innovations should lead to decrease in consumption as well as income and wealth.

Given our assumption that a positive shock in oil price should reduce consumption, the IRF gives unusual inference to our assumption and hence we cannot conclude anything from here. Thus it can be argued that when there is an oil price increase, it is not expected that rational consumers will reduce consumption of oil instantly. They may switch to using a cheaper energy, such a gas, but this whole process takes some time. Although the effect for consumption is realized after certain lags, it is still expected that consumer's disposable income as well as accumulation of wealth will be negatively affected. It must be recalled that other than the exogenous variables in our model, there can be many other factors affecting

[8] It should be mentioned that we plot IRF with respect to Cholesky ordering: D(Consumption) D(Wealth) D(Income) D(Interest) D(Oil_Price) as our VAR (p) model suggests. However, the responses of interest rates gives ambiguous response to oil price and hence was dropped. Instead we compute the Cholesky ordering following Table 8.

consumption simultaneously (the omitted-variables argument can hold in this regard). However, based on the response functions, it remains inconclusive whether the positive shock in oil price leads to a positive or negative causal impact on consumption.

Figure 2a: Impulse Response Functions for Canada

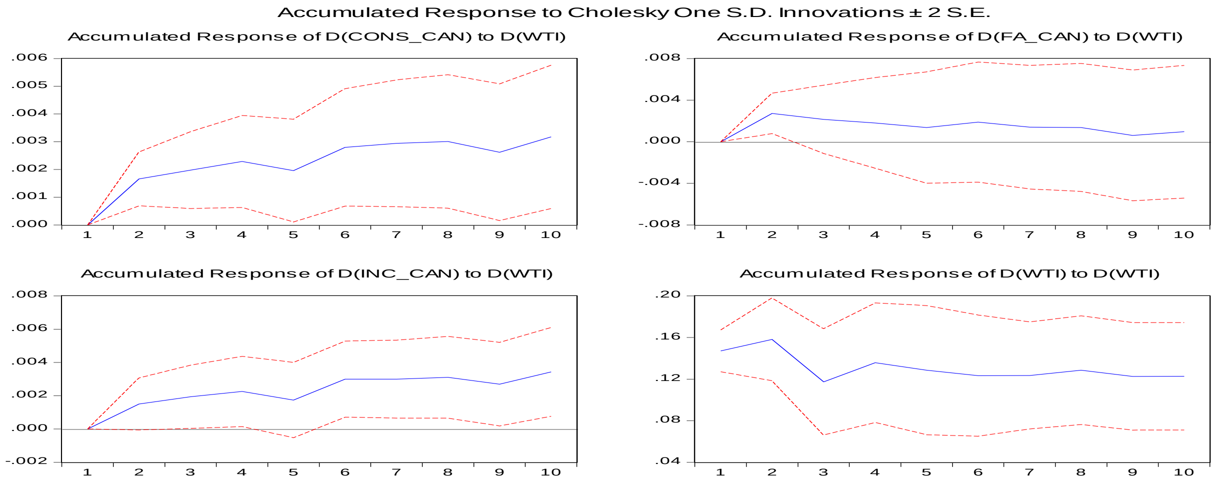


Figure 2b: Impulse Response Functions for Germany

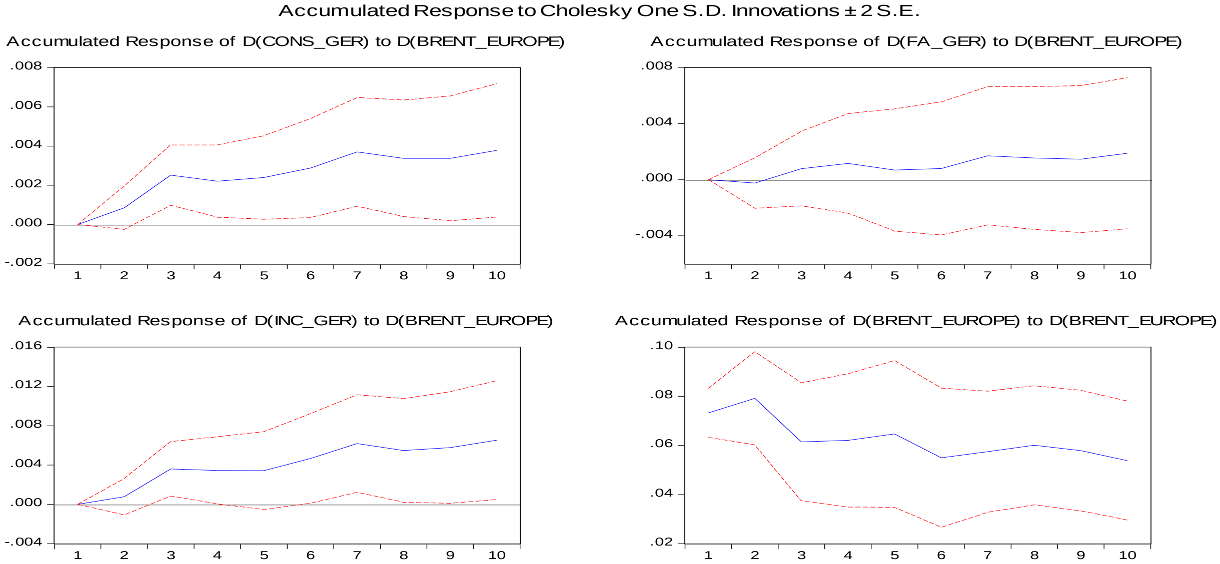


Figure 2c: Impulse Response Functions for Sweden

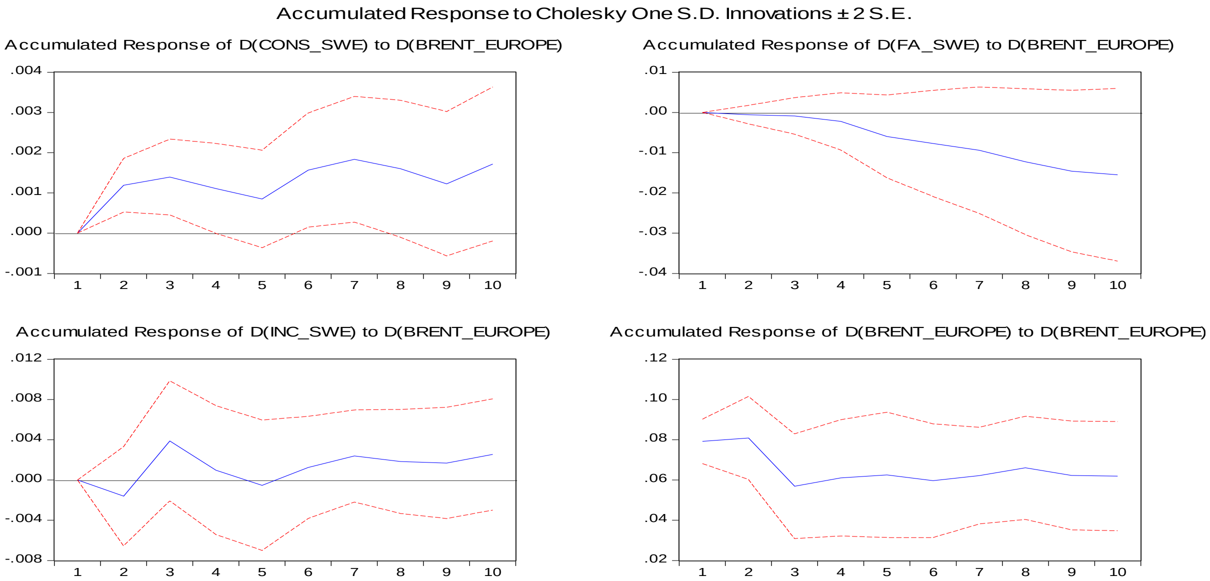


Figure 2d: Impulse Response Functions for UK

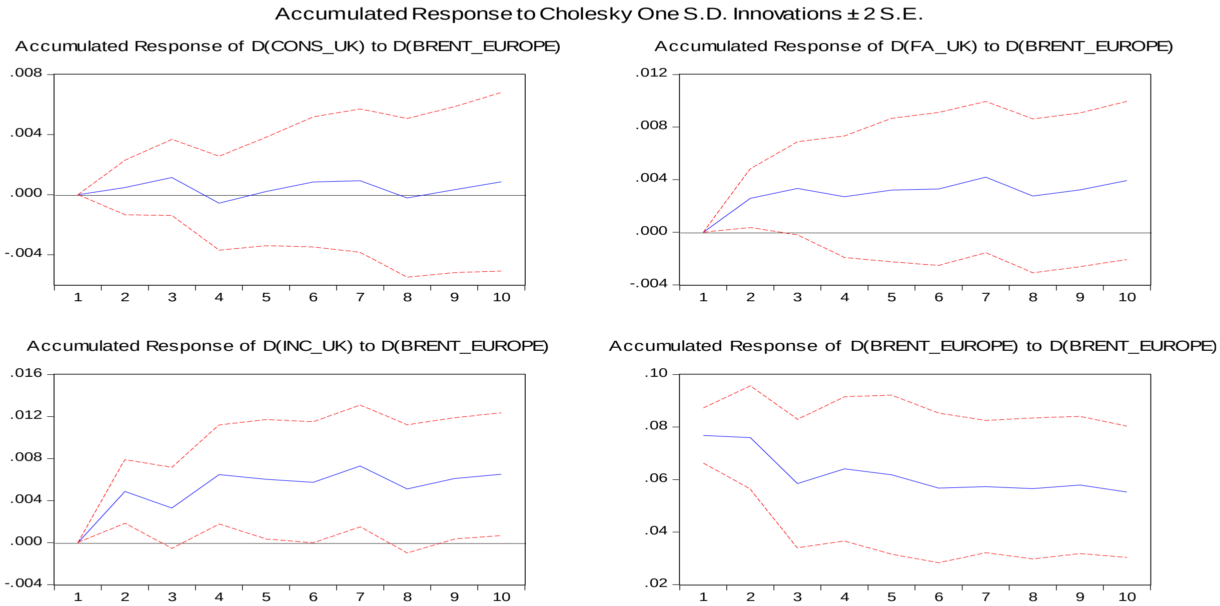
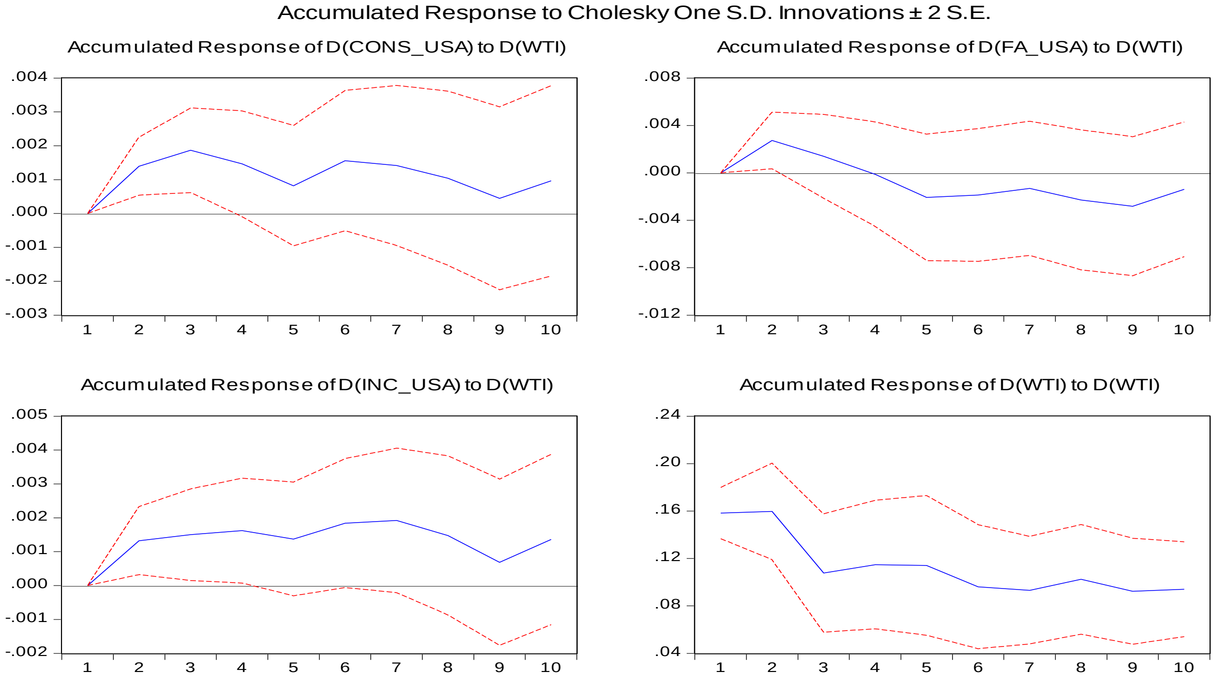


Figure 2e: Impulse Response Functions for USA



From our result so far, we find evidence that economies of Canada, USA and Sweden are more volatile to shocks emerging from oil price in the short run. The results for UK and Germany remain inconclusive as some of the test suggests evidence of shocks while rest does not imply that. It must be remembered that the implication of shocks purely depends on the dependence on oil of that particular country. So far our analysis is in align with Mehra and Peterson (2005) who have concluded that for USA there seem to be a short run causality of oil price on consumption and it was also found in our study. While Mehra and Peterson (2005) conducted the study way back using sample size between earlier periods, the application of recent sample depicts similar results. The study by Zhang and Broadstock (2014) also comes up with similar conclusions about the short run causality. Their work, however, is based on the ASEAN countries and empirically they study two kinds of effects of oil price: a net positive effect and net negative effects on consumption. However, based on their estimates too, they argue that oil price does not necessarily impact consumption for all countries.

But our analysis so far sends mixed responses about the probable effects of oil price. Thus we conduct a robustness check using a new specification where we replace the 'oil price' variable in equation (6) with 'net oil price increase' variable[9]. The reason for assessing the net oil price

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[9] Many literature has acknowledged the use of 'Net oil price increase' to study the asymmetric effects of oil price shock on macroeconomics variables (Zhang and Broadstock, 2014; Mork et al,1994, Löschel and Oberndorfer, 2015). It is defined as: Max(0, $Oil\_Price_t - \max(OiL\_Price_{t-j})$ according to these literatures.

increase is that the previous two decade between 1980s till 2010 has experienced major oil price increase in 2007. Thus, given our sample size, it can more meaningfully capture the asymmetry of shocks arising out of oil price increase.

Like before, we select the number of lags based on the lag selection criteria as before as shown in Appendix 4. We then test for stability of the model and autocorrelation and proceed with our analysis. The new equation of VAR is referred as VAR (s) where‘s’ represents the new number of lag used to compute the results. Given that the VAR (s) estimates are not much relevant in drawing inferences about oil price shocks, we do not report it in the paper but as before all regression output were found significant (See Appendix 5 for detail)

We continue our analysis with Joint-coefficient test for causality as before. The results from Table 9 show that for Canada, Sweden, Germany and USA the results of f-statistic are insignificant at 5% or 1% level. This result is similar in align to our previous Wald test results; the only exception being that this time it also indicates that for Germany oil price seems to have some effect as well.

Table 9: Wald Test Results
Null: All oil price coefficients are jointly zero meaning oil does not granger cause consumption

	F-stat (df)	Prob.
Canada	2.667842** (5, 80)	0.0278
USA	2.775722** (4, 86)	0.0320
Germany	3.969340* (4, 86)	0.0053
UK	1.314252 (4, 86)	0.2711
Sweden	4.340375* (4, 82)	0.0031

Note: the * indicates insignificance at 1% level and ** indicates insignificance at 5%

Following Wald Test, we also compute Forecast Error Variance Decomposition as shown in Table 10 with the Cholesky ordering: ***D(Consumption) D(Wealth) (Income) D(Net_Oil_Price_Increase)*** since we have ruled out that interest rate changes do not make any reasonable inference. Again, there is evidence that for all the countries (except UK) oil price seem to have proportionately increasing contribution in the forecast of error variance.

This again implies its significance in the model. In most of the cases the variance decomposition increases up to the 4th lag and then starts to decline or remains stable.

Table 10: Forecast Error Variance Decomposition

	Period	Δ(Oil Price)
Canada	2	10.61811
	4	10.36918
	6	9.682416
	8	9.473835
	10	9.829543
Germany	2	3.829202
	4	8.488244
	6	7.370894
	8	7.369183
	10	6.861712
Sweden	2	17.27644
	4	16.67801
	6	12.26141
	8	11.58476
	10	10.53963
United Kingdom	2	0.504615
	4	5.101954
	6	3.669131
	8	4.689637
	10	4.111290
USA	2	8.780552
	4	9.617489
	6	9.580284
	8	9.974704
	10	9.394949

Note: The Cholesky Ordering Used is: D(Consumption) D(Wealth) D(Income) D(Net_Oil_Price_Increase).

As before we continue with plotting the Impulse response functions (IRF) for our model with specification: ***D(Consumption) D(Wealth) D(Income) D(Net_Oil_Price_increase)*** and Figure 3a-3e summarizes the findings of IRF. It can be seen that the responses of wealth, income and consumption for a unit shock in 'Net oil price increase' innovations is found negative and increasing with time. This time with the new specification, the responses for consumption are in align with the theory. For Canada, Germany and USA, the reaction starts to fade after the 4th lag but then again picks up after the 5th lag. This is also reflected that between 3rd and 4th lag the shock in 'Net oil price increase' decline is followed a decline in consumption between 4th and 5th lag for these respective countries. Thus from this, it can be observed that the persistence of shock to consumption dies out more slowly than the persistence of shock in 'Net oil price increase' innovation. Thus summarizing our findings form IRF, it can be seen that a unit positive shock in 'Net oil price increase' innovations lead to a fall in consumptions for countries: Canada, Germany and USA. The persistence of shock in consumption dies out slower than the shock in the oil price variable concerned here. Thus the effect remains negative and increasing over time. Thus for these countries, it can be concluded that a 'Net oil price increase' will have an impact on consumption in the short run and the persistence of shock dies out much slowly over the years. However, again the implication for Sweden and UK remain inconclusive as the positive oil price shock causes the consumption to increase instead. Comparing the set of IRF in 3a-3f with 2a-2f, we find that 'Net oil price increase innovation' can draw more meaningful inference on the consumption than the only 'Oil price' innovations.

Figure 3a: Impulse Response Functions for Canada

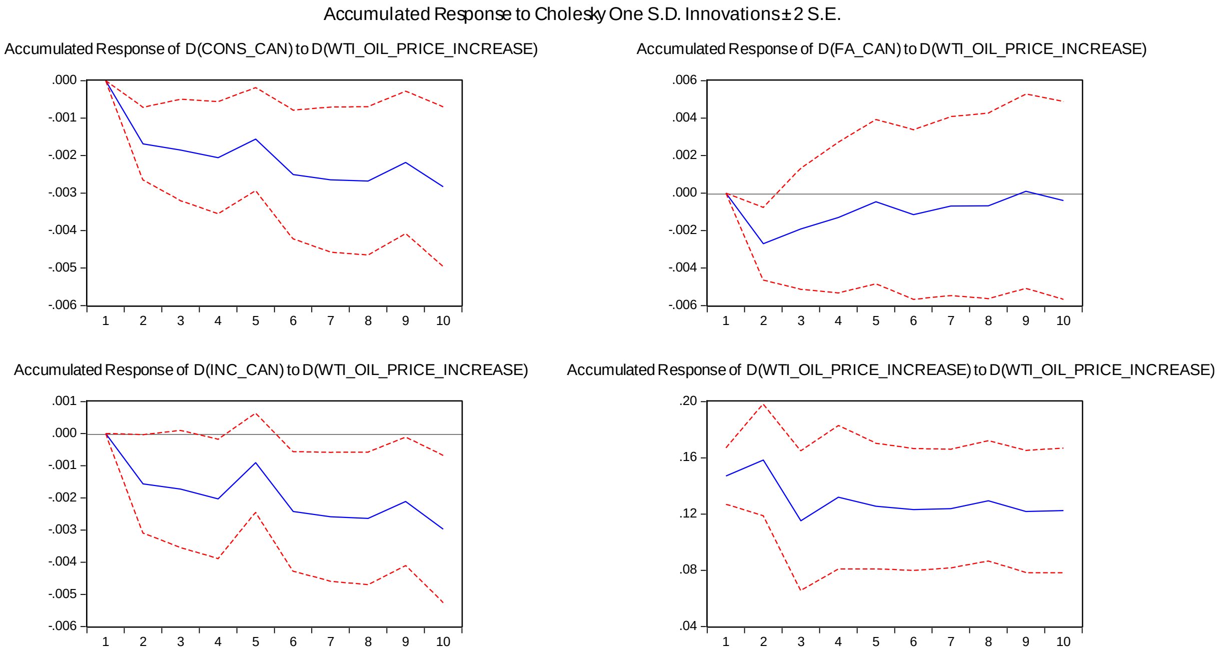


Figure 3b: Impulse Response Functions for Germany

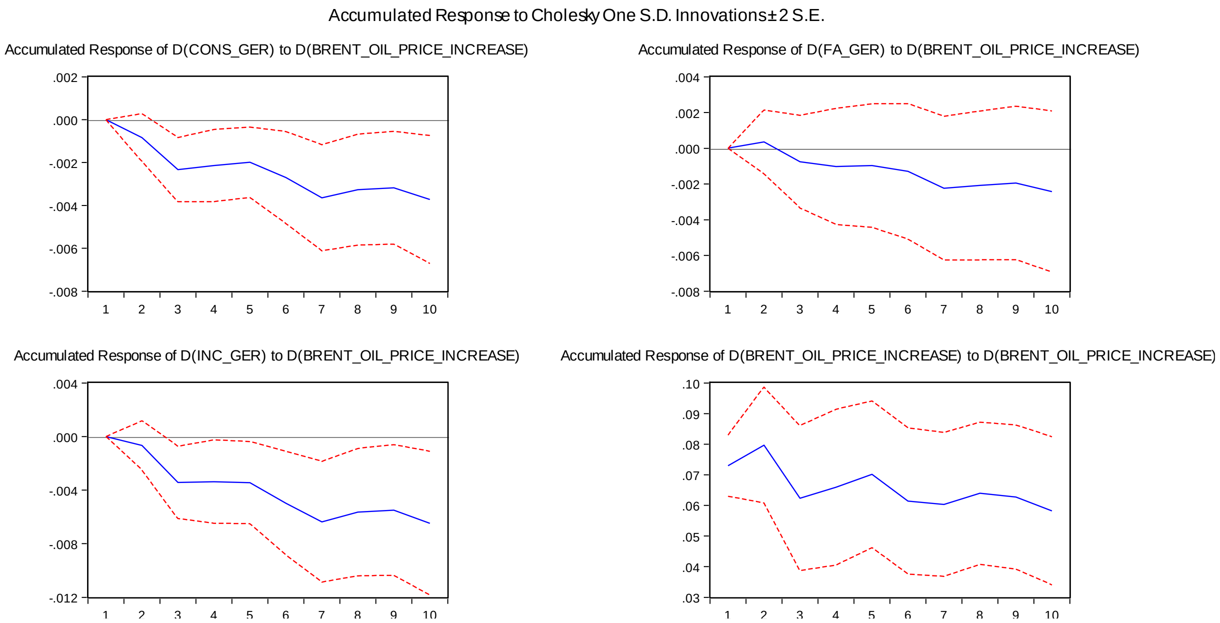


Figure 3c: Impulse Response Functions for Sweden

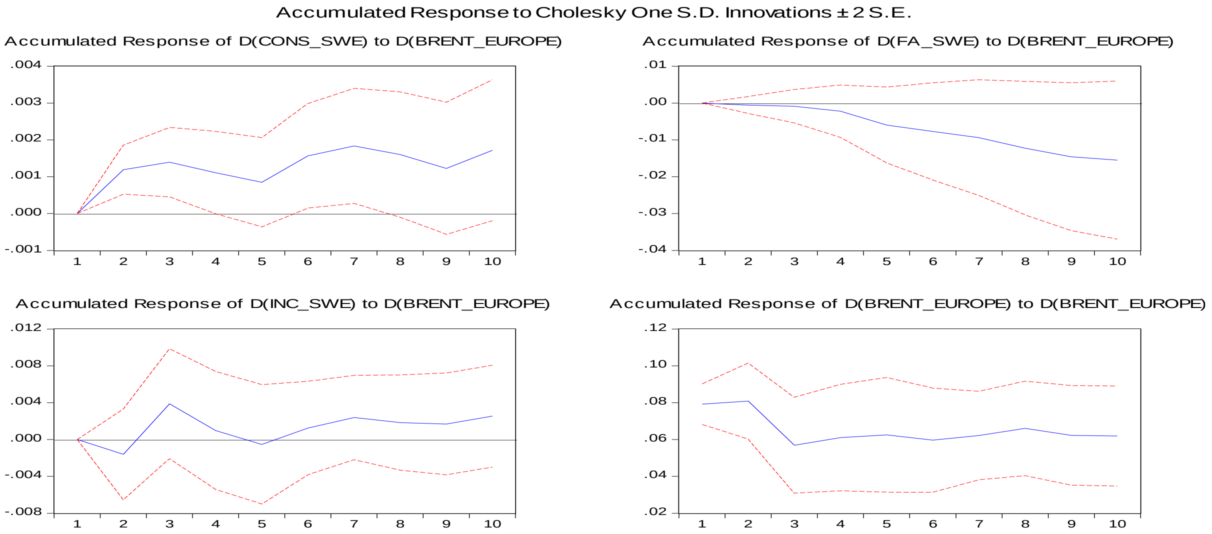


Figure 3d: Impulse Response Functions for UK

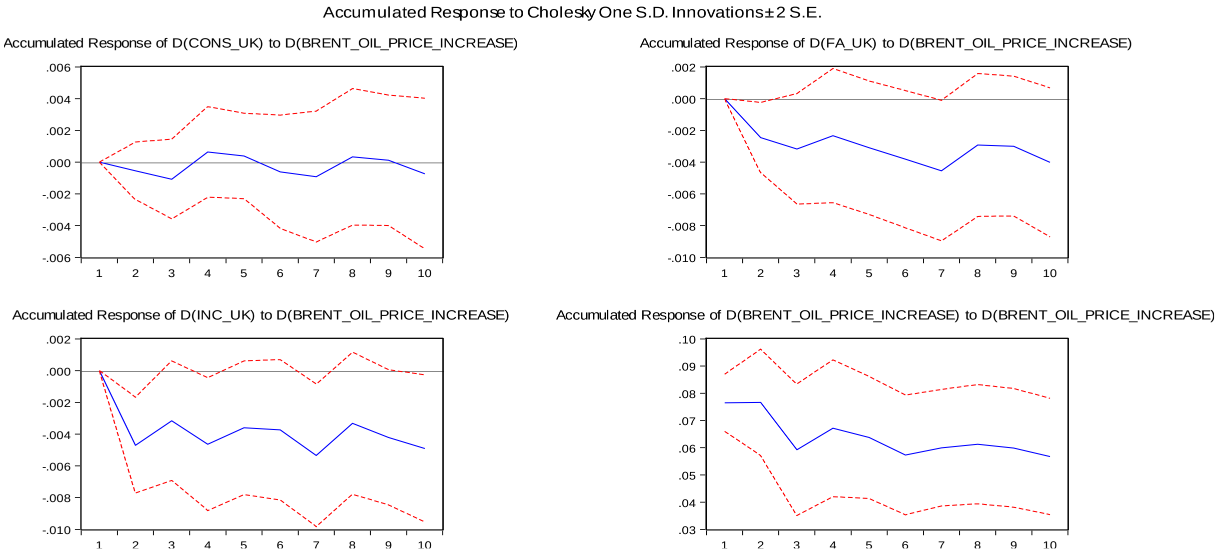
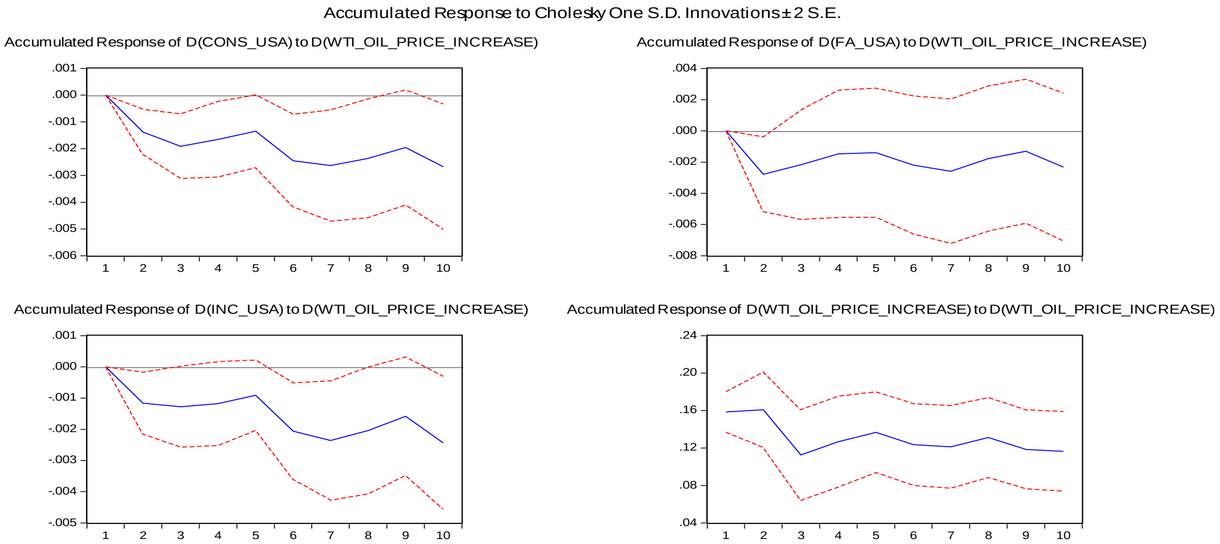


Figure 3e: Impulse Response Functions for USA


Accumulated Response to Cholesky One S.D. Innovations ± 2 S.E.
Accumulated Response of D(CONS_USA) to D(WTI_OIL_PRICE_INCREASE)
Accumulated Response of D(FA_USA) to D(WTI_OIL_PRICE_INCREASE)
Accumulated Response of D(INC_USA) to D(WTI_OIL_PRICE_INCREASE)
Accumulated Response of D(WTI_OIL_PRICE_INCREASE) to D(WTI_OIL_PRICE_INCREASE)

Chapter 6: Conclusion

The study empirically assess if global oil price change has any impact on household consumption. Our analysis shed light on few observations; first we find evidence that oil price change do affect household consumption in our selected countries particularly Canada and USA but the results are found inconclusive for Germany, Sweden and UK. Following the FEVD diagnosis it could also be inferred that oil price makes a proportionately increasing contribution to the movement in consumption series. Finally, plotting IRF infer that for a positive unit shock in 'Net oil price increase' consumption is negative and the effects on consumption persists for longer time. As before, our results for IRF are mostly consistent for Canada and USA and this reflects that oil price certainly affects consumers of the oil-exporting countries. While for Sweden and Germany some tests provide some evidence of impacts but on a general ground it remains inconclusive because of mixed results. Finally for UK, we find no evidence of either positive or negative impacts in consumption due to oil price innovations.

Based on our results we can argue that oil price may have significant impact on the consumer spending of large oil-dependent countries where Canada is one of the largest producer and exporter and USA is one of the largest consumers of oil (EIA). Although USA has changed its position from a net exporter to a net-importer of oil (EIA), yet oil remains an important component for the economy of USA. Although Germany and UK are among the largest importers of oil but we do not find much evidence of effects of oil price shocks on their household consumptions. Thus our result also reflect that it cannot be well classified if the shocks on consumption varies much between the oil-importing and oil-exporting nations. The probable reason one can assume is that the dependence of these countries on oil has substantially decreased over years and in regard to interest rate changes there is seen very little changes over the decades for these two countries (EIA). Our forecast error decomposition in the first set of analysis also depicts that oil alone does not have much predictive power in context of UK ad Germany.

Reflecting to our analysis, another observation that came up is that interest rates plays insignificant role in deciding the movement in consumption at least in the short-run. The FEVD without having the interest rate variable gives better results in this regard and based on that we can argue that oil price has better predictive power about the movement on consumption series without having the interest rate variable. One cannot really argue that monetary policy adoption in the aftermath of oil price shock has influence to consumption at least in the short-run.

Theory of rational expectation also suggest that when there is a major shock in the economy consumer's expectation about the future tends to impact their planned consumption and hence their current consumption. For an oil dependent country the rational expectation of consumers are likely to change more compared to countries depending less on oil. But such theoretical argument may not hold relevance in reality. For instance, it is difficult to classify what actually causes changes in the interest rates. Canada and USA being an inflation-targeting economy since 1970s one can argue that these economies are more likely to be volatile to oil price shocks. But it is also true that the Central banks may also decide to reduce interest rates for other factors such as to reduce unemployment. Thus in reality, it is difficult to decide what actually causes the interest rates to fluctuate around a given value. In other words, a more sensible argument could be that one shock does not occur 'ceteris paribus' to other factors and instead it is more real to have many exogenous shocks occurring/working together simultaneously.

Also it should be noted that, there could be other factors that can attribute to effects on consumption other than the only independent regressors considered in our model. Such omitted bias is likely to create heteroscedastic effects in the model which, to some extent, is reflected in large R-square values for each model. Scope of further research can help to shed light on these aspects.

However, the direct implication of oil price increase still remains debatable as fuel use for transportation varies substantially for different countries. For instance, while UK's dependence on oil still remains high due to its overuse in the transportation sector Sweden's dependence on oil has substantially reduced since 2005 by reducing its use in the transport sector. However, within the Eurozone, dependence on oil varies to a high extent. Beside the transport sector, the use of crude oil remains high in the industrial sector. While in case of UK and Germany industry has shifted from petroleum intensity to gas intensity products over decades, Sweden's petroleum intensive products remained high[10]. Thus despite the fact that

[10] See The Vienna Institute for International Economic Studies, (2008)

most of the industrialized countries have switched their production from fuel-intensive to gas-intensive products, the use of crude still remains important for many countries because of the fact that it's use could not be completely eliminated from the energy market.

Finally, reflecting back to our overall findings, an important implication that is put forward is that it remains inconclusive as to how oil price affects consumer decision for Germany, Sweden and UK. The dependence of Eurozone on oil has fluctuated a lot over last few decades. In context of Germany, the imports of oil from Russia have reduced considerably as they switched into gas consumption. The approximate 23% of energy imports from Russia consist of roughly one-third of oil imports. Hence for Germany there has been a net change from oil consumption to gas consumption (Morris, 2015). Similarly UK as well as Sweden has also lowered its oil dependence since the large global recession in 2008. Apart from the use for industrial production, Sweden's economy has promoted into making an oil-free society mainly due to high industrial oil price fluctuations since decades. As for UK, the economy's dependence on oil is mainly its heavy use in the transport sector. While the country was a net oil exporter in 2008. Total energy consumption stood nearly 38% on oil while 35% on natural gas[11] . Thus, for UK both oil and gas plays significant role in the private sector consumptions and the substitution of energy consumption has made oil a less important component over the years.

However, on a more realistic view, oil price also influences price of other substitute energy and consumption of oil cannot be well-separated from consumption of other forms of energy. Thus, our study may hold policy implications in general if other energy price change could also be included in the model. Since, some oil-importing countries have switched into using other form of energy (non-renewable and renewable) sources, further study should be conducted which can give true implications whether energy at all has power to influence household consumption.

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Appendix

Appendix 1

Table 2: Kwiatkowski-Phillips-Schmidt-Shin

KPSS Null Hypothesis: There is no Unit Root ($\gamma \neq 0$)

		KPSS LM-stat
Germany	C_t	0.459389*
	Y_t	0.428490*
	W_t	0.397702*
	r_t	0.165250**
USA	C_t	0.437699*
	Y_t	0.406412*
	W_t	0.342150*
	r_t	0.249251*
Sweden	C_t	0.254606*
	Y_t	0.208588**
	W_t	0.178072**
	r_t	0.214827**
UK	C_t	0.388985*
	Y_t	0.521028*
	W_t	0.553045*
	r_t	0.148491**
Canada	C_t	0.232766*
	Y_t	0.291447*
	W_t	0.521436*
	r_t	0.128942***
Brent_Europe	Oil price	0.271177*
WTI	Oil price	0.243481*

Note: *LM> C.V at 1% interval (trend+ intercept) ** LM>C.V at 5% interval (trend+ intercept) ***LM>C.V at 10% interval (trend+intercept)

Appendix 2
LM test for Autocorrelation

Canada

Lags	LM-Stat	Prob
1	52.94521	0.0009
2	37.33567	0.0536
3	32.58234	0.1418
4	29.77337	0.2329
5	50.24179	0.0020
6	25.57260	0.4307

Germany

Lags	LM-Stat	Prob
1	72.22900	0.0000
2	33.14032	0.1276
3	34.85329	0.0909
4	32.78500	0.1365
5	32.33927	0.1484
6	21.57003	0.6604

UK

Lags	LM-Stat	Prob
1	35.87283	0.0736
2	31.46333	0.1741
3	35.74644	0.0755
4	25.52870	0.4331
5	21.18536	0.6822
6	36.77881	0.0606

USA

Lags	LM-Stat	Prob
1	47.67085	0.0041
2	34.43956	0.0988
3	36.29081	0.0673
4	21.08564	0.6878
5	27.20245	0.3458
6	27.55706	0.3286

Sweden

Lags	LM-Stat	Prob
1	24.70247	0.4791

2	25.80369	0.4181
3	32.83219	0.1353
4	20.57764	0.7159
5	24.72224	0.4780
6	27.08759	0.3515

Appendix 3 VAR stability condition check

Canada

Root	Modulus
0.000711 - 0.970152i	0.970152
0.000711 + 0.970152i	0.970152
-0.969872	0.969872
0.837458 - 0.161559i	0.852899
0.837458 + 0.161559i	0.852899
-0.561844 + 0.616476i	0.834093
-0.561844 - 0.616476i	0.834093
0.341694 - 0.752123i	0.826101
0.341694 + 0.752123i	0.826101
-0.750370 + 0.337761i	0.822884
-0.750370 - 0.337761i	0.822884
-0.234693 + 0.778406i	0.813017
-0.234693 - 0.778406i	0.813017
0.604943 - 0.521618i	0.798775
0.604943 + 0.521618i	0.798775
0.782698	0.782698
0.106599 - 0.772058i	0.779383
0.106599 + 0.772058i	0.779383
-0.373340 - 0.623390i	0.726634
-0.373340 + 0.623390i	0.726634
0.632582 + 0.348636i	0.722293
0.632582 - 0.348636i	0.722293
-0.584912	0.584912
-0.137284 + 0.182268i	0.228185
-0.137284 - 0.182268i	0.228185

No root lies outside the unit circle.
VAR satisfies the stability condition.

Germany

Root	Modulus
-0.006983 + 0.947673i	0.947699
-0.006983 - 0.947673i	0.947699
-0.941176	0.941176
0.924629	0.924629
-0.827077 - 0.351907i	0.898830
-0.827077 + 0.351907i	0.898830
-0.180347 - 0.876431i	0.894794
-0.180347 + 0.876431i	0.894794
0.729432 - 0.442145i	0.852973
0.729432 + 0.442145i	0.852973
-0.543543 - 0.643497i	0.842334
-0.543543 + 0.643497i	0.842334
-0.380441 - 0.726330i	0.819934

-0.380441 + 0.726330i	0.819934
0.468000 - 0.648936i	0.800088
0.468000 + 0.648936i	0.800088
0.173564 - 0.776994i	0.796143
0.173564 + 0.776994i	0.796143
0.766212 + 0.213915i	0.795513
0.766212 - 0.213915i	0.795513
0.604425 - 0.507005i	0.788913
0.604425 + 0.507005i	0.788913
-0.119546 + 0.709799i	0.719796
-0.119546 - 0.709799i	0.719796
-0.719418	0.719418
-0.658001 - 0.275084i	0.713188
-0.658001 + 0.275084i	0.713188
0.659845	0.659845
0.400918	0.400918
0.146007	0.146007

No root lies outside the unit circle.
VAR satisfies the stability condition.

UK

Root	Modulus
-0.009032 + 1.011766i	1.011807
-0.009032 - 1.011766i	1.011807
-0.969108	0.969108
0.783268 - 0.398404i	0.878769
0.783268 + 0.398404i	0.878769
-0.219839 + 0.811616i	0.840862
-0.219839 - 0.811616i	0.840862
0.833767 - 0.038563i	0.834659
0.833767 + 0.038563i	0.834659
-0.823271	0.823271
0.072811 + 0.813290i	0.816543
0.072811 - 0.813290i	0.816543
0.410859 + 0.684336i	0.798198
0.410859 - 0.684336i	0.798198
0.568821 + 0.536774i	0.782102
0.568821 - 0.536774i	0.782102
-0.333527 - 0.704797i	0.779730
-0.333527 + 0.704797i	0.779730
-0.751695 + 0.195339i	0.776661
-0.751695 - 0.195339i	0.776661
0.588625 + 0.482832i	0.761319
0.588625 - 0.482832i	0.761319
-0.646328 - 0.367769i	0.743635
-0.646328 + 0.367769i	0.743635
-0.416152 - 0.603363i	0.732959
-0.416152 + 0.603363i	0.732959
0.570504	0.570504
-0.558967	0.558967
0.222369 - 0.213246i	0.308094
0.222369 + 0.213246i	0.308094

Warning: At least one root outside the unit circle.
VAR does not satisfy the stability condition.

USA

Root	Modulus
-0.981649	0.981649
0.004232 + 0.976901i	0.976910
0.004232 - 0.976901i	0.976910
0.842551 - 0.201345i	0.866275
0.842551 + 0.201345i	0.866275
0.698027 - 0.495091i	0.855778
0.698027 + 0.495091i	0.855778
-0.464462 - 0.697258i	0.837790
-0.464462 + 0.697258i	0.837790
-0.653580 - 0.510551i	0.829355
-0.653580 + 0.510551i	0.829355
-0.260227 + 0.786037i	0.827993
-0.260227 - 0.786037i	0.827993
0.531541 - 0.632097i	0.825882
0.531541 + 0.632097i	0.825882
0.809619	0.809619
-0.731094 - 0.331798i	0.802862
-0.731094 + 0.331798i	0.802862
-0.727484 - 0.252955i	0.770207
-0.727484 + 0.252955i	0.770207
0.267225 + 0.668971i	0.720369
0.267225 - 0.668971i	0.720369
0.500042 + 0.426363i	0.657136
0.500042 - 0.426363i	0.657136
-0.163151 - 0.613586i	0.634906
-0.163151 + 0.613586i	0.634906
0.118143 + 0.594393i	0.606020
0.118143 - 0.594393i	0.606020
0.352059	0.352059
0.139375	0.139375

No root lies outside the unit circle.
VAR satisfies the stability condition.

Sweden

Root	Modulus
-0.975514	0.975514
-0.001758 - 0.968886i	0.968887
-0.001758 + 0.968886i	0.968887
0.901869 + 0.164740i	0.916792
0.901869 - 0.164740i	0.916792
-0.415438 + 0.730957i	0.840766
-0.415438 - 0.730957i	0.840766
0.633140 - 0.532668i	0.827406
0.633140 + 0.532668i	0.827406
0.125590 - 0.804109i	0.813858
0.125590 + 0.804109i	0.813858
-0.228791 - 0.731116i	0.766078
-0.228791 + 0.731116i	0.766078
-0.581885 - 0.484520i	0.757199

-0.581885 + 0.484520i	0.757199
-0.646745 - 0.286777i	0.707474
-0.646745 + 0.286777i	0.707474
0.470207 - 0.506665i	0.691233
0.470207 + 0.506665i	0.691233
-0.680789	0.680789
0.432694 + 0.391553i	0.583557
0.432694 - 0.391553i	0.583557
0.511974 + 0.135436i	0.529585
0.511974 - 0.135436i	0.529585
-0.065666	0.065666

No root lies outside the unit circle.
VAR satisfies the stability condition.

Appendix 4 Lag Selection with 'Net oil price'

Lag	**FPE**	**AIC**	**SC**
0	3.90e-15	-18.98768	-18.82042*
1	4.82e-15	-18.77853	-17.77497
2	5.67e-15	-18.63146	-16.79159
3	6.68e-15	-18.50141	-15.82524
4	3.92e-15	-19.10399	-15.59152
5	3.23e-15*	-19.41330	-15.06453
6	3.37e-15	-19.55625*	-14.37117
Germany			
Lag	FPE	AIC	SC
0	5.06e-16	-21.03037	-20.86311*
1	4.90e-16	-21.06585	-20.06229
2	3.59e-16	-21.38890	-19.54904
3	4.93e-16	-21.10852	-18.43235
4	2.40e-16	-21.89486	-18.38239
5	1.61e-16	-22.41479	-18.06601
6	8.28e-17*	-23.26118*	-18.07610
UK			
Lag	FPE	AIC	SC
0	3.60e-15	-19.06868	-18.90142*
1	4.56e-15	-18.83428	-17.83072
2	4.85e-15	-18.78776	-16.94790
3	4.21e-15	-18.96259	-16.28642
4	1.58e-15	-20.01308	-16.50061
5	1.54e-15	-20.15567	-15.80689
6	1.42e-15*	-20.42138*	-15.23631
USA			
Lag	FPE	AIC	SC
0	3.38e-16	-21.43373	-21.26647*
1	2.19e-16	-21.87103	-20.86747
2	2.80e-16	-21.63754	-19.79768
3	3.26e-16	-21.52099	-18.84482
4	1.03e-16	-22.74281	-19.23034
5	9.95e-17	-22.89331	-18.54454
6	9.86e-17*	-23.08721*	-17.90213
Sweden			
Lag	FPE	AIC	SC
0	1.35e-13	-15.44266	-15.27540
1	3.12e-14	-16.91225	-15.90869*
2	3.31e-14	-16.86483	-15.02496

3	3.57e-14	-16.82682	-14.15065
4	7.93e-15	-18.39817	-14.88570
5	8.39e-15	-18.45863	-14.10985
6	7.78e-15*	-18.71829*	-13.53322

Appendix 5 ***VAR Estimates for Consumption***

Canada	*Consumption*	***t-stat (p-values)***
Δ(Net_oil_price_increase(-1))	-0.005295*	-2.970317 (0.0042)
Δ(Net_oil_price_increase (-2))	0.002633	-0.490313 (0.6256)
Δ(Net_oil_price_increase (-3))	-0.007190	-0.022101 (0.9824)
Δ(Net_oil_price_increase (-4))	-0.002987	0.948503 (0.3466)
Δ(Net_oil_price_increase(5))	0.002256	1.086511 (0.2815)
R-squared	0.791250	
Adj. R-squared	0.660782	
F-statistic	6.064686*	
Prob(F-statistic)	0.000000	
Germany		***t-stat (p-values)***
Δ(Net_oil_price_increase(-1))	-0.002293	-0.198356 (0.8439)
Δ(Net_oil_price_increase (-2))	-0.018376	-1.649497 (0.1083)
Δ(Net_oil_price_increase (-3))	0.017660	1.493480 (0.1445)
Δ(Net_oil_price_increase (-4))	-0.016871	-1.434418 (0.1606)
Δ(Net_oil_price_increase (-5))	-0.007998	-0.937607 (0.3551)
Δ(Net_oil_price_increase (-6))	0.003488	0.536410 (0.5952)
R-squared	0.809350	
Adj. R-squared	0.641130	
F-statistic	7.535018*	
Prob(F-statistic)	0.000000	
Sweden		***t-stat (p-values)***
Δ(Net_oil_price_increase(-1))	-0.007061	-1.384830 (0.1728)
Δ(Net_oil_price_increase (-2))	-0.004023	-0.758045 (0.4523)
Δ(Net_oil_price_increase (-3))	-1.96E-05	-0.005215 (0.9959)
Δ(Net_oil_price_increase (-4))	9.05E-05	0.039475 (0.9687)
R-squared	0.885057	
Adj. R-squared	0.835082	

F-statistic	7.709961*	
Prob(F-stat)	0.000000	
USA		***t-stat (p-values)***
Δ(Net_oil_price_increase(-1))	-0.002496	-0.895255 (0.3753)
Δ(Net_oil_price_increase (-2))	0.004259	1.598642 (0.1167)
Δ(Net_oil_price_increase (-3))	-0.000319	-0.154460 (0.8779)
Δ(Net_oil_price_increase (-4))	-0.000369	-0.300155 (0.7654)
R-squared	0.863201	
Adj. R-squared	0.803723	
F-statistic	14.51295*	
Prob(F-statistic)	0.000000	
UK		***t-stat (p-values)***
Δ(Net_oil_price_increase(-1))	-0.006130	-0.821050 (0.4159)
Δ(Net_oil_price_increase (-2))	0.001363	0.201514 (0.8412)
Δ(Net_oil_price_increase (-3))	0.007999	1.370220 (0.1773)
Δ(Net_oil_price_increase (-4))	-0.004863	-1.134165 (0.2626)
R-squared	0.786471	
Adj. R-squared	0.693632	
F-statistic	8.471368*	
Prob(F-statistic)	0.000014	

Note: Level of significance is represented as follows: * for 1% level