The effect of oil price on the exchange rate of the Canadian dollar

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Abstract

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The purpose of the paper is to analyse the relationship between the WTI spot oil price and exchange rates. The data used covers from January 1991 to August 2012 with monthly data. The study used exchange rates for the U.S and Canada, spot oil prices, interest rate differential, CPI differential, export-trading ratio as variables to build the regression model. The methodology in this study includes generalized linear model and Augmented Dickey-Fuller (ADF) tests. The findings show that the coefficients between oil price and exchange rate are very different in over time. The results indicated that the relationship between oil price and exchange rate is tighter in the 2000's because of increasing oil exploitation in Canada. However, the coefficients in different time periods are less statistically significant.

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Chapter 1, Introduction:

1.1 Background

First of all, when people talk about exchange rates, they will consider a number of factors that will affect them including inflation, interest rates, competitiveness, relative strength of other currencies, balance of payments and government intervention. The inflation rate and interest rate of a country are depended on macroeconomic status and this will influence capital flows both FDI and portfolio. However, all of the factors listed above will influence the demand and supply of a domestic currency, which will lead to fluctuations in exchange rates. For those export dependent countries, trading balance will also be an important factor to affect the exchange rate.

The economy of Canada relies heavily on international trade. Particularly from its exports of natural resources. The major exports are natural gas, oil, commodities and equipment. The USA is the major export partner of Canada accounting for 75% of Canadian exports and account for 30% of GDP.

1.2 Overview

In recent decades, oil has played an important role in the global economic system with the demand for crude oil increasing during the 1980s to the present time. In the 1980s, the consumption of crude oil was about 56,000 thousand barrels per day on average. By 2010, the amount of consumption has almost doubled. From the 1980s to the early 2000s, oil prices remained between $20 and $30 per barrel. Since then, price have moved from $30 to over $100 per barrel. The analysts have concluded that the

increasing price may be the result of many factors. As Cooper (2006) discussed in his article, people were worried that oil reserves were drying up in the North Sea based on the speed of extraction. However, the depreciation of the US dollar, tension in the Middle East area, and price manipulation by investors and oil producers, take-together account for the jump in the oil price and the resultant energy crisis.

However, with risk also comes business opportunities and the rising oil price level encouraged oil production companies to seek new fields. Thus, the oil sands in Alberta became an alternative source. An essay from The Economist (2007) stated that the oil sands in Alberta contain 174 billion barrels of recoverable oil. In addition, there are extra 141 billion barrels that will be profitable to exploit if oil prices continue to climb. All of the reserves are larger than those of Saudi Arabia and which could make Canada the country with the largest oil reserves in the world. But, the production process is costly and there are environmental issues. Although the expense of production is very high, it will remain attractive for investors and producers provided oil prices remain above $40 per barrel.

1.3 Research Hypotheses

The research hypothesis in this paper is based on the phenomenon that happened in the 1960s in the Netherlands, which is similar with the oil sand boom in Canada. In Ebrahim-zadeh's (2003) article, the author indicated that higher demand on resources will drive up the exchange rate for the domestic currency which will lead to a less competitive environment for other export goods. Such a condition first appeared in the

Netherlands then it was named as the “Dutch disease”. Ebrahim-zadeh (2003) also stated that the “Dutch disease” not only appreciated the domestic currency, but shifted the resources to construction and extractive industries which may damage the economic system.

For Canada on sharply rising oil prices from 2000 made possible the extraction of oil from oil sand deposits. The paper will separate out the time period between 1991 to 2000 and 2000 to 2012 and it will examine the correlation between oil price and Canadian dollar for the different time periods.

1.4 Outline of the study

The paper will be divided into four parts. The first part, the current chapter provides an introduction for the over view and hypothesis of the relationship between commodity price and exchange rate. In Chapter 2, we will provide a brief literature review and in Chapter 3, the paper will discuss the methodology for the study, including the model, variables and some limitations. In Chapter 4, the paper will estimate and analyze the results from the regression model. In the final chapter, the paper will draw conclusions from the results. It will clarify the relationship between oil price and the value of the Canadian dollar and whether it is consistent with the the “Dutch Disease” hypothesis.

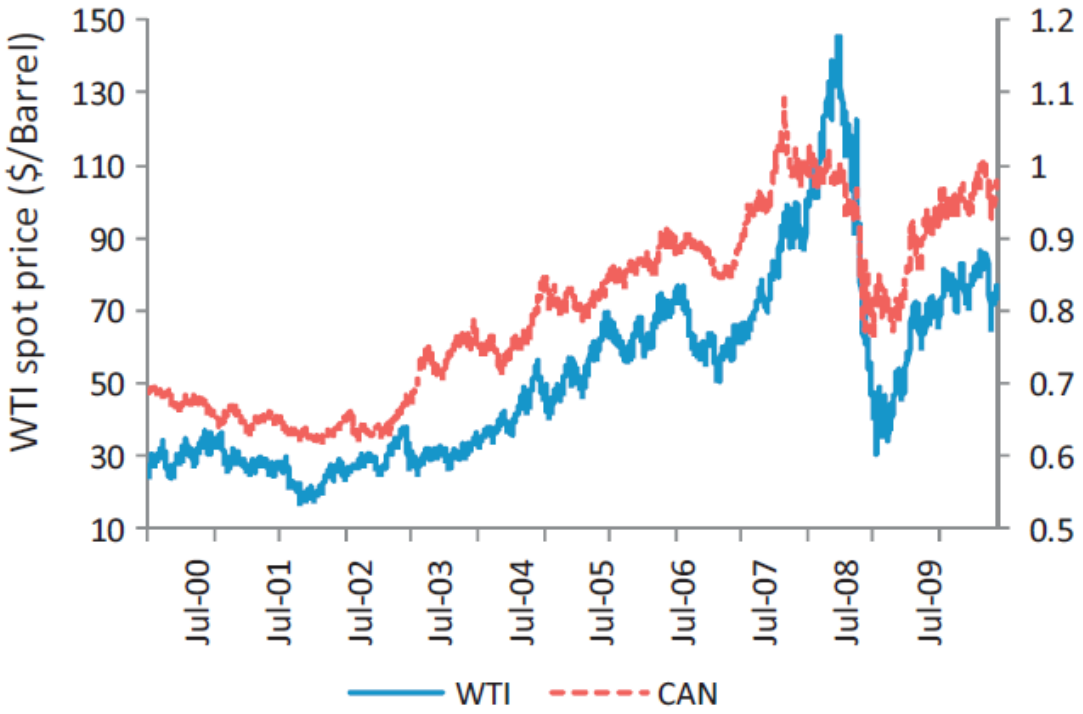
Chapter 2 Literature review:

In the literature's survey, we will study some previous research related to the topic. In general, the hypothesis has been supported by commodity traders. In some analysts' view, they believe that the changes of commodities prices will lead to fluctuations of currencies, which correlate with those commodities. In all of these commodities, oil will be one of the most popular indicator for traders because it is widely used around the world. Lien (2011) indicates that the Canadian dollar is one of the tightest correlation currencies with commodities. However, the linkage may not be immediate, but it will help investors or traders predict the market movement in the future. According to Lien's (2011) article, the status of Canada as an oil producer has changed. Canada has now become more important because oil sands exploration, oil reserves and production increases. Considering the instability in the Middle East and the advantage of the neighbourship between Canada and U.S, there will be more oil demand from the U.S.

Most studies that examine the relationship between oil price and exchange rate focus on major oil exporting countries, such as the OPEC members. In Reboredo's (2012) paper, he uses the copula model and marginal distribution model to examine the oil price and major exchange rate co-movement. His research is focused on the exchange rate amount USD and the other major oil export and import countries. Based on Reboredo's (2011) empirical results, the exchange rate of Canadian dollar has high co-movement with the oil spot price, as shown in Figure 2.1.

Figure 2.1 Co-movement of oil price and CAD vs. USD

(from 4 January 2000 to 15 June 2010)



Source: Reboredo (2012)

Reboredo (2012) also indicated that the correlation between oil price and exchange rate will be more intense for oil exporting countries, such as Canada, Norway and Mexico (p. 429). Such outcomes seem to support our hypothesis of a high correlation for oil price and the Canadian dollar.

There are some interesting facts about the Canadian dollar. According to Issa et al. (2008), they studied the relationship between energy prices and Canadian dollar. They determined that the coefficient will be negative before 1993, but positive after 1993. In other words, the Canadian dollar will now appreciate if energy prices increase. The reason for such situation is concluded for changing from net energy importer to net energy exporter.

Also, the Amano and Van Norden's (1995) paper may provide support for this paper because they discover a significant effect on the exchange rate by terms of trade shocks. Their finding shows that the exchange rate will be affected by commodity prices. In another research paper, Al-mulali (2010) claims similar results for the oil exporting countries that the Dutch Disease existed from 2003 to 2008. However, Beine, et al (2009) challenged the previous theory develop by Amano and Van Norden. Their results concluded that the change of exchange rate may be not affected by oil price, but only U.S dollar. A related study, Alogeel (2009) studied the effect of oil shocks for oil-exporting countries. He studied Canada as an example and he concluded that the oil sector was connected with macro variables, including a high correlation with trade balance and GDP. This study will be a key reference for this paper to assist in determining the proper variables for the model.

The fact that Canada was not a major oil exporting country in the previous period of time, we would not expect the currency to be affected by oil price. The Canadian dollar should fluctuate with other commodities such as natural gas, mining products and agricultural products. Most of the studies of oil price and currency focus on oil producers whose revenue is highly depended by the oil sector, such as Saudi Arabia, Russia, Norway, Venzuela and Kuwait. There is some related research on such countries. Alotaibi (2006) studied the effect of oil price fluctuations to GDP growth, real exchange rate and trade deficit for The Gulf Cooperation Council (GCC) countries. In the exchange rate section, he found that the oil price shock had a long-term effect on GCC countries, such as Kuwait, Qatar, Saudi Arabia, UAE, Russia,

Norway, Iran, and Venezuela. There are other studies that use OPEC members which find similar results. For example, in an article of Journal of Economics and Finance, Korhonen and Juurikkala (2009) point out that the real oil price is the only consistent and statistically significant factor which will affect the sample countries of OPEC. Also, the coefficient of the variable is close to 0.5 which means that an oil price rise of 1% will lead to an appreciation of currency by 0.5%.

Nonetheless, some of the studies may doubt that there is a solid relationship between oil price and currency. Habib and Kalamova's (2007) paper investigated three oil exporting countries; Norway, Russia and Saudi Arabia. They found that only for Russia there is a strong relationship between oil price and currency. There is no significant evidence to prove such effect in Norway and Saudi Arabia, although they are defined as highly oil depended countries, especially Saudi Arabia.

However, the application of determining the relationship of energy price and currency can be used to control the circumstances of "Dutch disease" by central banks. Chen, et al (2008) found that the exchange rate can be applied to forecasting future commodity prices. Their research determined that there is a strong relationship between commodity price movements and exchange rates. A similar finding was reported by Ferraro, et al (2011), who claimed that oil prices can predict the CAD-USD exchange rate within daily frequency rather than quarter and monthly frequency.

Chapter 3 Methodology

3.1 Regression model design

The purpose of the paper is to analyze or measure the correlation of currency and commodity price, in this instance, the oil price. Generally, we consider that the commodity price is not the only factor of exchange rate volatility. Theoretically, trade balance, CPI, interest rate, government interaction can also be the factors that will affect the exchange rate between countries. Thus, the model used in this paper will be similar to Dawson's (2007) research which had included several variables to explain the regression model.

The designed model is as followed:

$$\boldsymbol{EXt = \beta 0 + \beta 1(OP)_t \ + \ \beta 2\left(\frac{Export\ to\ US}{total\ export}\right)_t \ + \ \beta 3(CPI_{ca} - CPI_{us})_t \ + \beta 4(R_{ca} - R_{us})_t \ + \ \mu} \quad \textbf{(3.1)}$$

Note: The variables of Exchange rate, Oil price and export ratio in natural log – "ln" form.

The dependent variable is the exchange rate of Canadian dollar against the U.S dollar. It is labeled as "$\boldsymbol{EXt}$". The first variable "$\boldsymbol{\beta 0}$"account is the constant factor. The variable of "$\boldsymbol{OP}$" stands for monthly oil prices from 1991 to 2012. The variable "$\left(\frac{\boldsymbol{Export\ to\ US}}{\boldsymbol{total\ export}}\right)_{\boldsymbol{t}}$" account for merchandise trade of Canada to United States as the share of total merchandise export, which measure the changes of currency value caused by demand of domestic assets.

The variable "$(\boldsymbol{CPI_{ca} - CPI_{us}})$" takes account of the CPI gap between Canada

and U.S. As Dawson (2007) stated in her research, that is the reflection of the Purchasing Power Parity theory of exchange rate determination. Similarly, the last variable "R_{ca}-R_{us}" controls for the difference of interest rates which will affect cash flow movements among countries in a floating exchange rate regime. Such a variable is associated with Asset Market Model theory and Covered Interest Rate Parity condition. As usual, the regression model also include with an error term "μ". The "t" in variables denotes for period of time.

There is an issue of missing values, which occurs when taking the natural log for the U.D-Canada differences for CPI and interest rate. Negative values cannot be calculated by natural logs.

3.2 Data Sources

In this paper, most of the data were acquired through the Bloomberg database. I the use WTI crude oil spot price in the model because it is the benchmark of oil trading contracts in the energy market.

The Bloomberg database also provides the data for merchandise trade exports, the CPI index, and the interest rate for Canada and U.S. As stated in Chapter 1, the time period of data is from January in 1991 to August in 2012 because of some missing monthly records for Canadian merchandise trade exports to the U.S. The data of the exchange rate between Canada and U.S were obtained from the Federal Reserve Economic data releases. The regression model uses direct quotes for the U.S dollar. All of the data used in the regression model are collected by month.

3.3 Data analysis procedures

3.3.1 Simple theoretical model:

At first, the relationship between exchange rate and oil price can stated with a simple regression model:

$$\textbf{Ln(Exchange rate)} = \boldsymbol{\beta 0} + \boldsymbol{\beta 1 ln(OP)_t} + \mu \qquad \textbf{(3.2)}$$

After measuring the model by running Stata, it turns out that the coefficient of oil price is negative (as shown in Appendix 2). The result will fit with the original hypothesis of the paper. As it means rising oil prices cause higher demand for Canadian dollars causing an appreciation relative to the U.S dollar. However, the R-squared is equal to 0.6227 and this means that only 62.27% of exchange rate data can be explained by the oil price factor. The outcome is also consistent with the literature review and economic theory, which demonstrates that the exchange rate will be affected by other macroeconomic factors. As this model ignores the stationarity issue; the outcomes can be biased and unreliable.

3.3.2 Augmented Dickey-Fuller (ADF) test for stationary:

To ensure an unbiased result for the model, there is the need for a test of stationarity because they are time series data. Otherwise, as mentioned in the results for Equation 3.2, the relationship among these variables can be spurious and unreliable. The stationary check will be used by Augmented Dickey-Fuller (ADF) test.

Thus, the variables in the model; such as **Oil price** (denoted as "OP" in STATA), $\frac{\textbf{\textit{Export to US}}}{\textbf{\textit{total export}}}$ (denoted as "trade" in STATA)**, CPI_{ca}-CPI_{us} (**denoted as "CPI" in STATA), **R_{ca} - R_{us} (**denoted as "rate" in STATA**), Exchange rate (**denoted as "EX" in STATA); it will be test for stationarity through Stata. The results of the ADF test will be shown as:

Table A3, 1−10 (shown in Appendix 3)

In the Tables A3.1; 3.3; 3.5; 3.7; 3.9, the paper is using the Akaike information criterion to choose lags for variables in the ADF test. As we can see that the lags of variables are beyond 1. It means the current monthly data can influence further monthly data. In the Tables A3.2; 3.4; 3.6; 3.8; 3.10; all of the results of the Augmented Dickey-Fuller test demonstrate that the variables are all facing nonstationary issues. The test statistic values of "z" are negative, but are still higher than the critical values, which leads to the conclusion of rejecting the null H0 and nonstationary issues.

Therefore, the paper will introduce the first difference method to fix the nonstationary problem for variables. According to Gujarati and Sangeetha (2007), he defined that the first difference method also can be written as an integrated process denoted as "I(n)". The propose of the process is try to make each of the variables denote as "variable's name ~ I(0)". It is said to be integrated of order zero, which is equivalent to a stationary time series. After taking the first difference method, all of the time series data are tested with ADF test for stationary. The results will be provided in Appendix 4.

The time series are stationary after taking first difference except for Interest rate differencing. In other words, the results can be explained as: LER~I(1), LOP~I(1), Ltrade~I(1), CPI ~I(1), rate~I(2) (note: the letter “L” express for taking nature log “ln”). For the variable of interest rate differences, the results of the test show that there is still a nonstationary issue. But after taking second differences, rate~I(2), which means the time series is stationary (The results are also provided in Appendix 4).

Chapter 4. Analysis of the findings:

4.1 for the whole period of time, from year 1991 to 2012:

With the stationary data, we can estimate the regression model for the whole period. The results are presented in Appendix 5, Table A4.1:

When we looked the coefficients between LEX, LOP, Ltrade, CPI and rate, we can conclude that oil price and CPI index have a negative effect on exchange rates. The exporting ratio and interest rate differencing have positive effect to exchange rate. If the paper examines the details in each one of the independent variables, it can conclude as following:

(1). The coefficient of LOP is -0.0254 means that when oil prices increase by 1%, the exchange rate between CAD and USD will decrease by 0.0254%, and vice versa. If we put it in economic terms, the increasing oil price will lead to an appreciating Canadian dollar.

(2). For the variable of "ltrade", the coefficient is 0.021. It means that when the exporting ratio increases by 1%, it will affect the exchange rate by 0.021%. However, if the exports increase, it should increase the demand of domestic currency. In another words, the CAD should be appreciating. In this situation, there is a reason for an exporter to prefer keep USD because it is a more liquid asset compared to the CAD.

(3). The coefficient of CPI is -0.0041, which indicate a weak influence to exchange rate. Since the differences of CPI among Canada and U.S increases, the exchange rate will decrease.

(4). The coefficient of interest rate differences is also positive, which is 0.0007798. The figure is so small that we can conclude the factor of interest rate will not be a significant issue for exchange rates. Considering the size of the financial market, the market in Canada may be too small and less interested for investors to participate in. As a result, the change in interest rates will not influence the direct investment cash flow.

4.2 Measure the effect of oil price in different time period:

In the second part of the analysis, the paper will investigate the relationship of oil price and exchange rate into two time periods, from 1991 to 2000 and 2001 to 2012. The results will show in Table A4.2 (1991-2000) and A4.3 (2001-2012) (see in Appendix 5):

If we compare with two time-periods, we can find that the coefficient is negative from 2001 to 2012, and the figure is -0.0525, which means if oil price increases by 1%, the exchange rate will fall for 0.0525%. Conversely, the coefficient of the time-period from 1991 to 2000 is positive, which is 0.009. Specifically, if oil price increases by 1%, the exchange rate will also rise by 0.009%, and vice versa. Behind these figures, we can summarize that oil price is more tied up with Canadian dollar over years. Such results are consistent with the study of Issa et al (2008). In 1990's, the net export of energy of Canada was at a low level. Not only the coefficients, but the p valued also supports this summary. If we compare with two periods of time:

(1) From 1991 to 2000, the p value is 0.383, which is much higher than 0.05

alpha level. It means that the coefficient between oil price and exchange rate has a high probability of being equal to zero. Thus, the oil price has no influence on the exchange rate of CAD/USD.

(2) From 2001 to 2012, with the rising export in crude oil and other energy commodities, the situation had changed. The p value is 0.013, which is much more less than the previous period. This has only the probability of 1.3% that the coefficient is equal to zero. The oil price factor is more significant from 2001 to 2012.

However, the betas of macroeconomic factors are also at low levels. The values of $|\beta_n|$ are lower than 0.05. The p values are also significantly higher than 0.05 of alpha level. We cannot to conclude that there is strong and significant influence on the fluctuations of exchange rate.

In addition, the R-squared value of the designed model is not statistically significantly high. The values are around 33% to 43% for the different periods. The lower than 50% R-squared value indicates that the designed model cannot explain the relationship of macroeconomic factors and exchange rate between CAD and USD precisely. The exchange rate amount CAD and USD may affect by other variables rather than oil price, interest rate differences, CPI differences and export trading ratio. The details will be discussed more in final chapter of the paper.

4.3 Designed model without natural log "Ln":

In the original model:

$$EXt = \beta 0 + \beta 1(OP)_t + \beta 2\left(\frac{Export\ to\ US}{total\ export}\right)_t + \beta 3(CPI_{ca} - CPI_{us})_t \quad (4.1)$$

$$+\beta 4(R_{ca} - R_{us})_t + \mu$$

Some of the variables are taking the natural log to measure the percentage change. The research paper also investigates with the unit change process. None of the variables will take the log "Ln" to plug into the regression model. As in Section 4.2, it will also distinguish with two periods of time to estimate the difference in coefficients. After taking integrated process, the regression results will be presented as follows in Table A4.4; A4.5 (the stationary process in Appendix 6).

Similar to the previous results of the regression model, the parameters of the coefficients are still at low levels, especially for oil price. The coefficient is only 0.007098 in the period of 1991 to 2000 and -0.0007838 for the period of 2001 to 2012. It means that one unit change in oil price leads to 0.00071 unit change in exchange rate, which is a less significant effect from 1991 to 2000. From 2001 to 2012, the coefficient changed to -0.00078, which is consistent with the same trend in previous results of Section 4.2. The parameter had changed to negative, and it indicated that oil price had a tighter link to exchange rate. In the meantime, if we look at the critical value of R-squared value and P values for other variables, the results demonstrate that exchange rate only explain 33% or 43% by these independent variables. Moreover, the parameters of coefficient are not statistically significant.

Chapter 5. Conclusions, limitation and Extension:

To sum up, this research is consistent with the previous study by Ferraro, et al (2011). This study found that oil price and exchange rate have a high correlation in the daily datas, but the relationship will be weaken in the longer term forecasting.

This study also verifies that an oil producing country may not have solid coefficient with oil price, which is in accordance with Habib and Kalamova's (2007) paper. According to the regression results in Section 4.2 and 4.3 and tables in Appendix 5, the coefficient parameters are not significantly different from zero. Even so, the results still show the linkage between oil price and Canadian dollar is tighter in the 2000's. The explanation of course is Canada's increase in its oil exploitation in this time-period.

However, there are also some limitations for the study. For the purpose of time-consistency, the CPI and export time series data do not have daily data. Thus, the paper cannot verify the daily forecast ability of oil prices for exchange rates between CAD and USD. After a massive financial crisis, the dispirited economic environment may lead to lower oil demand from U.S, which will weaken the linkage. In the recovery period, the quantitative easing by Federal Reserve System after the financial crisis will also influence the intrinsic exchange rate between CAD and USD.

For an extension of this study, it should add that there is a need to verify the other variables to measure the relationship between oil price and exchange rate. In Canada's perspective, other commodities can be considered as factors in the model, such as natural gas and mining products.

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Appendix 1 Table A1 Time series data

date	trade ratio	CPI dif	interest rate dif	OP	EX
08/31/12	0.737832405	-106.534	1.1	96.47	0.9924
07/31/12	0.731262657	-107.639	1.1	88.06	1.0142
06/30/12	0.740623097	-109.544	1.15	84.96	1.028
05/31/12	0.72445609	-110.449	1.08	86.53	1.0097
04/30/12	0.726824603	-105.217	1.09	104.87	0.9928
03/31/12	0.731872887	-107.104	1.15	103.02	0.9938
02/29/12	0.736643419	-105.419	1.13	107.07	0.9967
01/31/12	0.764323739	-107.41	0.9375	98.48	1.013
12/31/11	0.731886349	-108.9	1.21	98.83	1.0235
11/30/11	0.717155063	-108.368	1.17	100.36	1.0248
10/31/11	0.721118921	-105.333	1.17	93.19	1.0198
09/30/11	0.708684217	-110.78	1.17	79.2	1.0025
08/31/11	0.701106664	-103.055	1.13	88.81	0.9817
07/31/11	0.713698775	-100.11	1.14	95.7	0.9553
06/30/11	0.724819869	-100.822	1.24	95.42	0.9766
05/31/11	0.7357222	-100.237	1.14	102.7	0.968
04/30/11	0.734055518	-97.548	1.15	113.93	0.958
03/31/11	0.728448113	-99.988	1.16	106.72	0.9766
02/28/11	0.744313792	-100.556	1.07	96.97	0.9876
01/31/11	0.748754133	-103.502	1.05	92.19	0.9939
12/31/10	0.725295756	-102.294	1.15	91.38	1.0081
11/30/10	0.715958498	-104.96	1.02	84.11	1.0129
10/31/10	0.709140752	-103.615	1.03	81.43	1.0179
09/30/10	0.723842149	-104.736	1.07	79.97	1.033
08/31/10	0.739082749	-108.617	0.77	71.92	1.0404
07/31/10	0.736127055	-104.104	0.79	78.95	1.0422
06/30/10	0.741271594	-107.913	0.71	75.63	1.0376
05/31/10	0.748135444	-106.246	0.3	73.97	1.0403
04/30/10	0.738335006	-103.186	0.3	86.15	1.0052
03/31/10	0.734650557	-103.544	0.48	83.76	1.0229
02/28/10	0.752027378	-107.741	0.38	79.66	1.0572
01/31/10	0.771281514	-109.525	0.38	72.89	1.0438
12/31/09	0.774230963	-108.663	0.49	79.36	1.0537
11/30/09	0.748518186	-108.188	0.36	77.28	1.0593
10/31/09	0.735269319	-110.489	0.39	77	1.0547
09/30/09	0.740010756	-108.563	0.48	70.61	1.0816
08/31/09	0.751601436	-110.97	0.35	69.96	1.0872
07/31/09	0.718495567	-108.497	0.3	69.45	1.1229

06/30/09	0.730222192	-115.669	0.1875	69.89	1.1264
05/31/09	0.715299891	-108	0.3125	66.31	1.1528
04/30/09	0.725850699	-117.495	0.29	51.12	1.2242
03/31/09	0.719855629	-122.205	0.4375	49.66	1.2645
02/28/09	0.748348947	-122.976	1.05	44.76	1.2452
01/31/09	0.744565818	-120.432	1.125	41.68	1.2248
12/31/08	0.754008526	-118.323	1.5	44.6	1.2337
11/30/08	0.749566444	-121.167	2	54.43	1.2171
10/31/08	0.746673549	-121.602	2.375	67.81	1.1847
09/30/08	0.757693321	-109.705	2.75	100.64	1.0582
08/31/08	0.758087807	-110.033	1.625	115.46	1.0535
07/31/08	0.757315102	-106.04	1.75	124.08	1.013
06/30/08	0.762659431	-104.115	0.75	140	1.0166
05/31/08	0.74365297	-100.067	2.25	127.35	0.9993
04/30/08	0.77362753	-101.399	0.875	113.46	1.0137
03/31/08	0.764469029	-103.84	1.25	101.58	1.0029
02/29/08	0.771141421	-98.267	1.125	101.84	0.9986
01/31/08	0.774825231	-100.731	1.0625	91.75	1.0099
12/31/07	0.783991344	-98.439	1.5	96	1.0021
11/30/07	0.75543305	-99.046	0.25	88.71	0.9672
10/31/07	0.763398657	-91.729	0.125	94.53	0.9754
09/30/07	0.779231246	-96.198	0.25	81.66	1.0267
08/31/07	0.76739336	-101.77	1.75	74.04	1.0579
07/31/07	0.762143083	-102.34	-0.4375	78.21	1.0502
06/30/07	0.762438999	-101.777	-0.875	70.68	1.0651
05/31/07	0.759971378	-101.998	-0.75	64.01	1.0951
04/30/07	0.766300763	-105.127	-0.8125	65.71	1.135
03/31/07	0.782254392	-108.956	-0.875	65.87	1.1682
02/28/07	0.789919873	-110.078	-0.9375	61.79	1.171
01/31/07	0.77951865	-110.678	-0.875	58.14	1.1763
12/31/06	0.788428625	-109.219	-0.875	61.05	1.1532
11/30/06	0.781648993	-106.328	-0.875	63.13	1.1359
10/31/06	0.772986692	-104.752	-0.8125	58.73	1.1285
09/30/06	0.780497239	-105.012	-0.8125	62.91	1.1161
08/31/06	0.797774312	-104.604	-0.875	70.26	1.1182
07/31/06	0.803006602	-106.037	-0.875	74.4	1.1294
06/30/06	0.798689548	-103.514	-0.5	73.93	1.1137
05/31/06	0.804742033	-101.817	-0.625	71.29	1.11
04/30/06	0.822248099	-103.061	-0.625	71.88	1.1441
03/31/06	0.803665419	-106.649	-0.875	66.63	1.1573
02/28/06	0.814740787	-104.472	-0.75	61.41	1.1489
01/31/06	0.827522536	-104.653	-0.75	67.92	1.1572

12/31/05	0.823110319	-105.533	-0.5	61.04	1.1615
11/30/05	0.827094415	-105.844	-0.75	57.32	1.1815
10/31/05	0.830953151	-107.853	-0.75	59.76	1.1774
09/30/05	0.821237708	-105.448	-1	66.24	1.1777
08/31/05	0.814981204	-105.367	-1	68.94	1.2043
07/31/05	0.822132176	-107.357	-0.5	60.57	1.2229
06/30/05	0.810549438	-106.598	-0.625	56.5	1.2402
05/31/05	0.82290156	-108.424	-0.375	51.97	1.2555
04/30/05	0.817369104	-108.814	-0.25	49.72	1.2359
03/31/05	0.823370465	-105.242	-0.25	55.4	1.216
02/28/05	0.823312627	-106.716	0.25	51.75	1.2401
01/31/05	0.816970262	-106.619	0.375	48.2	1.2248
12/31/04	0.816132253	-103.991	0.5	43.45	1.2189
11/30/04	0.821146727	-102.819	0.8125	49.13	1.1968
10/31/04	0.814585663	-104.5	1	51.76	1.2469
09/30/04	0.821594972	-106.487	0.5	49.64	1.2881
08/31/04	0.821747494	-109.492	0.875	42.12	1.3127
07/31/04	0.82485611	-110.064	1	43.8	1.3225
06/30/04	0.823310385	-110.291	1	37.05	1.3578
05/31/04	0.826247589	-111.17	1.25	39.88	1.3789
04/30/04	0.817582326	-111.509	1.25	37.38	1.342
03/31/04	0.819008217	-107.781	1.375	35.76	1.3286
02/29/04	0.820181234	-109.294	1.75	36.16	1.3299
01/31/04	0.81954645	-108.438	1.75	33.05	1.2958
12/31/03	0.821615648	-105.901	2.0625	32.52	1.3128
11/30/03	0.814912738	-105.564	2.0625	30.41	1.313
10/31/03	0.815878337	-106.927	2	29.11	1.3221
09/30/03	0.825275319	-108.696	1.625	29.2	1.3634
08/31/03	0.827635146	-110.263	2.3125	31.57	1.3963
07/31/03	0.839312613	-110.939	2.375	30.54	1.3821
06/30/03	0.833783784	-107.37	1.625	30.19	1.3525
05/31/03	0.821441503	-108.126	2.25	29.56	1.384
04/30/03	0.828493176	-111.801	2.25	25.8	1.4582
03/31/03	0.835496431	-113.716	1.75	31.04	1.4761
02/28/03	0.840383021	-114.491	1.75	36.6	1.5121
01/31/03	0.831471459	-115.623	1.75	33.51	1.5414
12/31/02	0.83539562	-117.65	2	31.2	1.5592
11/30/02	0.842361331	-116.619	1.875	26.89	1.5715
10/31/02	0.830479777	-116.362	1.1875	27.22	1.578
09/30/02	0.853302427	-117.137	1.0625	30.45	1.5761
08/31/02	0.845412068	-115.738	1.25	28.98	1.5694
07/31/02	0.836146447	-116.557	1.25	27.02	1.5456

06/30/02	0.854400658	-113.915	1.25	26.86	1.5318
05/31/02	0.841941226	-114.307	0.6875	25.31	1.5502
04/30/02	0.838184223	-115.86	0.625	27.29	1.5815
03/31/02	0.85758691	-116.502	0.625	26.31	1.5877
02/28/02	0.840502369	-116.801	0.4375	21.74	1.5964
01/31/02	0.830884058	-116.37	0.375	19.48	1.5997
12/31/01	0.84562984	-116.242	1.25	19.84	1.5788
11/30/01	0.82102473	-115.684	0.375	19.44	1.5922
10/31/01	0.834884803	-115.801	0.375	21.18	1.5717
09/30/01	0.841869599	-115.667	1	23.43	1.5679
08/31/01	0.843383999	-113.912	0.625	27.2	1.5399
07/31/01	0.840315441	-113.002	0.75	26.35	1.5308
06/30/01	0.844294612	-112.599	0.6875	26.26	1.5245
05/31/01	0.837194515	-113.523	0.5	28.37	1.5411
04/30/01	0.842214816	-112.77	0.3125	28.46	1.5578
03/31/01	0.830890422	-114.539	-0.125	26.3	1.5587
02/28/01	0.852227847	-112.856	0.125	27.4	1.5216
01/31/01	0.848256217	-111.366	0	28.66	1.5032
12/31/00	0.84479511	-110.219	-0.25	26.8	1.5219
11/30/00	0.849385816	-111.182	-0.75	33.82	1.5426
10/31/00	0.844245919	-110.744	-0.5625	32.7	1.5125
09/30/00	0.841382534	-109.767	-0.4375	30.84	1.4864
08/31/00	0.834930178	-107.713	-0.75	33.12	1.4828
07/31/00	0.838728889	-108.275	-0.6875	27.43	1.4778
06/30/00	0.837116246	-107.699	-1.125	32.5	1.477
05/31/00	0.833948453	-107.832	-1	29.01	1.4957
04/30/00	0.839858421	-107.083	-0.625	25.74	1.4689
03/31/00	0.833322736	-105.783	-0.5	26.9	1.4608
02/29/00	0.829656708	-105.179	-0.625	30.43	1.4512
01/31/00	0.836712604	-104.831	-0.875	27.64	1.4486
12/31/99	0.83604591	-104.041	-0.25	25.6	1.4722
11/30/99	0.834636131	-104.934	-0.6875	24.59	1.4674
10/31/99	0.838731929	-104.441	-0.4375	21.75	1.4776
09/30/99	0.839147633	-104.053	-0.625	24.51	1.4771
08/31/99	0.847482397	-104.705	-0.6875	22.11	1.4932
07/31/99	0.847425193	-104.848	0	20.53	1.489
06/30/99	0.841148788	-102.991	0.75	19.29	1.4695
05/31/99	0.842456882	-103.208	0.25	16.84	1.4611
04/30/99	0.84253105	-102.535	0.0625	18.66	1.4881
03/31/99	0.843725096	-103.812	-0.125	16.76	1.5176
02/28/99	0.834383993	-103.998	0.375	12.28	1.4977
01/31/99	0.836097811	-104.124	0.4375	12.76	1.5194

12/31/98	0.840598216	-105.006	0.25	12.09	1.5433
11/30/98	0.842682201	-104.309	0.375	11.26	1.5404
10/31/98	0.832261205	-104.45	0.25	14.45	1.5452
09/30/98	0.834286322	-103.74	0	16.17	1.5218
08/31/98	0.83448587	-105.124	0.0625	13.38	1.5346
07/31/98	0.825581128	-102.742	-0.5625	14.26	1.4869
06/30/98	0.824893502	-100.572	-1	14.26	1.4655
05/31/98	0.821425089	-99.8896	-0.6875	15.23	1.4452
04/30/98	0.814989786	-98.5547	-0.625	15.48	1.4298
03/31/98	0.814574853	-97.7047	-1.125	15.7	1.4166
02/28/98	0.809447134	-98.0865	-0.625	15.5	1.4334
01/31/98	0.80471863	-99.6671	-0.5625	17.21	1.4409
12/31/97	0.817854604	-98.5965	-1.0625	17.64	1.4271
11/30/97	0.80454441	-98.16	-1.6875	19.15	1.4128
10/31/97	0.808001273	-97.2128	-2	21.08	1.3869
09/30/97	0.806352877	-95.6286	-2.75	21.18	1.3872
08/31/97	0.798988088	-95.5403	-2	19.61	1.3905
07/31/97	0.801362334	-94.7156	-2.5	20.14	1.3775
06/30/97	0.803557938	-94.6488	-3	19.8	1.3843
05/31/97	0.798798666	-94.47	-2.375	20.88	1.3804
04/30/97	0.79493385	-95.2822	-2.75	20.21	1.3942
03/31/97	0.787989077	-94.6548	-2.5	20.41	1.3725
02/28/97	0.798157596	-93.8422	-2.375	20.3	1.3556
01/31/97	0.797865939	-92.669	-2.125	24.15	1.3494
12/31/96	0.807206825	-93.6303	-3.75	25.92	1.3622
11/30/96	0.802301042	-92.2211	-2.5	23.75	1.3381
10/31/96	0.785344219	-91.5532	-2.5	23.35	1.3508
09/30/96	0.79638465	-92.2671	-2	24.38	1.3694
08/31/96	0.798200183	-92.1415	-1	22.25	1.3722
07/31/96	0.801320914	-92.2821	-0.875	20.42	1.3697
06/30/96	0.814638312	-91.4746	-0.375	20.92	1.3658
05/31/96	0.803855668	-91.446	-0.375	19.76	1.3693
04/30/96	0.781829247	-90.9991	-0.4375	21.2	1.3592
03/31/96	0.781400242	-90.5745	0.25	21.47	1.3656
02/29/96	0.790136309	-90.7872	-0.5	19.54	1.3752
01/31/96	0.793227831	-90.7279	-0.63	17.74	1.3669
12/31/95	0.779217475	-89.5541	0.165	19.55	1.3693
11/30/95	0.777738138	-88.9513	0.12	18.18	1.3534
10/31/95	0.77356594	-88.1887	1.7125	17.64	1.3458
09/30/95	0.770801714	-87.6509	0.96	17.54	1.3509
08/31/95	0.771019766	-87.613	0.715	17.84	1.3552
07/31/95	0.776684953	-88.3597	0.9325	17.56	1.3612

06/30/95	0.767809628	-88.4787	0.72	17.4	1.3775
05/31/95	0.772335507	-88.0807	1.4525	18.89	1.3609
04/30/95	0.78125778	-87.272	1.9825	20.38	1.3762
03/31/95	0.784732508	-88.8698	2.47	19.17	1.4077
02/28/95	0.780132214	-88.4583	1.895	18.49	1.4005
01/31/95	0.788209415	-89.0074	2.48	18.39	1.4132
12/31/94	0.788963443	-88.5407	1.93	17.76	1.3893
11/30/94	0.800177135	-87.1228	0.415	18.05	1.3647
10/31/94	0.78869936	-86.0405	0.6825	18.17	1.3503
09/30/94	0.797669245	-85.3673	-0.46	18.39	1.354
08/31/94	0.805839268	-86.2348	0.725	17.58	1.3783
07/31/94	0.780776963	-86.5941	1.665	20.3	1.3826
06/30/94	0.78916323	-86.1725	2.545	19.37	1.3836
05/31/94	0.808237196	-85.9082	1.965	18.31	1.3808
04/30/94	0.799137307	-85.4189	2.07	16.9	1.383
03/31/94	0.786704036	-85.377	2.015	14.79	1.3644
02/28/94	0.808124166	-83.4407	0.6	14.48	1.3424
01/31/94	0.795264848	-81.5486	0.38	15.19	1.3173
12/31/93	0.788795946	-81.3385	1.11	14.17	1.3308
11/30/93	0.791339103	-81.38	1.215	15.43	1.3174
10/31/93	0.798305592	-80.5587	1.5675	16.92	1.3263
09/30/93	0.795849309	-80.7571	1.9	18.79	1.3215
08/31/93	0.790405927	-79.8512	1.8025	18.29	1.308
07/31/93	0.780743596	-77.9422	1.285	17.88	1.282
06/30/93	0.780726152	-77.6957	1.29	18.85	1.2789
05/31/93	0.786611118	-77.0247	2.1625	20.02	1.2698
04/30/93	0.78367731	-76.7714	2.475	20.53	1.2621
03/31/93	0.788100954	-75.6434	1.36	20.44	1.2471
02/28/93	0.78969402	-74.8108	2.84	20.51	1.2602
01/31/93	0.758476675	-75.7336	3.81	20.26	1.2779
12/31/92	0.772872777	-75.6228	4.36	19.5	1.2725
11/30/92	0.776795078	-76.3544	5.445	19.89	1.2674
10/31/92	0.761505495	-73.6832	3.2375	20.62	1.2453
09/30/92	0.76003601	-73.5238	0.69	21.71	1.2225
08/31/92	0.759150568	-70.3221	1.82	21.48	1.1907
07/31/92	0.753624991	-69.3611	2.045	21.87	1.1924
06/30/92	0.757963526	-69.9363	1.6	21.6	1.196
05/31/92	0.752368635	-70.1449	2.6425	22.11	1.1991
04/30/92	0.752607454	-69.4167	3.1575	20.85	1.1874
03/31/92	0.753735698	-68.8597	3.24	19.44	1.1928
02/29/92	0.744646434	-68.1262	3.3125	18.68	1.1825
01/31/92	0.730734201	-67.4184	2.79	18.9	1.1571

12/31/91	0.732731793	-66.4748	3.17	19.12	1.1467
11/30/91	0.741684296	-64.4079	2.785	21.48	1.1302
10/31/91	0.744401575	-63.2908	2.79	23.48	1.1279
09/30/91	0.757614069	-63.5771	3.09	22.23	1.137
08/31/91	0.749565217	-63.6706	3.3425	22.26	1.1452
07/31/91	0.734038038	-63.9715	3.065	21.72	1.1493
06/30/91	0.731237088	-63.2584	3.025	20.54	1.1439
05/31/91	0.738220839	-63.3918	3.06	21.13	1.1499
04/30/91	0.726908707	-63.659	3.5525	20.94	1.1535
03/31/91	0.736737503	-63.8211	3.8575	19.6	1.1572
02/28/91	0.715167696	-63.4895	3.22	19.12	1.1549
01/31/91	0.739781052	-64.1866	3.605	21.6	1.156

Appendix 2

Equation 3.2

Linear regression

Number of obs	= 260
F(1, 258)	= 766.02
Prob > F	= 0.0000
R-squared	= 0.6227
Root MSE	= .08984

lnEX	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnOP	-.1773329	.0064072	-27.68	0.000	-.1899499	-.1647158
_cons	.8638831	.0257972	33.49	0.000	.8130832	.9146831

Appendix 3

Spot oil price variable "***OP***":

Table A3.1 Spot oil price variable "***OP***" lag selection:

Selection-order criteria
Sample: 11 - 260 Number of obs = 250

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-237.889				.395831	1.91111	1.91678	1.92519
1	251.029	977.84	1	0.000	.007986	-1.99223	-1.98089*	-1.96406*
2	252.339	2.62	1	0.106	.007966	-1.99471	-1.97771	-1.95246
3	252.424	.16884	1	0.681	.008024	-1.98739	-1.96471	-1.93105
4	254.354	3.861	1	0.049	.007965	-1.99483	-1.96649	-1.9244
5	255.586	2.463	1	0.117	.00795	-1.99668	-1.96267	-1.91217
6	255.769	.36788	1	0.544	.008002	-1.99016	-1.95047	-1.89156
7	255.795	.05095	1	0.821	.008065	-1.98236	-1.93701	-1.86967
8	259.251	6.9117*	1	0.009	.007908*	-2.00201*	-1.95098	-1.87523
9	259.393	.28476	1	0.594	.007963	-1.99515	-1.93845	-1.85429
10	259.571	.35572	1	0.551	.008015	-1.98857	-1.92621	-1.83362

Endogenous: lOP
Exogenous: _cons

Table A3.2 Spot oil price variable "***OP***" ADF test result

Augmented Dickey-Fuller test for unit root Number of obs = 251

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.743	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.7314

D.lOP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lOP						
L1.	-.0380681	.0218358	-1.74	0.083	-.0810825	.0049462
LD.	.12257	.0657208	1.87	0.063	-.0068932	.2520331
L2D.	-.0317565	.0647651	-0.49	0.624	-.1593371	.095824
L3D.	.1310284	.0648312	2.02	0.044	.0033177	.2587392
L4D.	-.0635886	.0652054	-0.98	0.330	-.1920367	.0648594
L5D.	-.0231565	.0641317	-0.36	0.718	-.1494893	.1031763
L6D.	.0156194	.0641444	0.24	0.808	-.1107385	.1419773
L7D.	-.1458477	.0640249	-2.28	0.024	-.2719702	-.0197251
L8D.	-.0202422	.0644422	-0.31	0.754	-.1471866	.1067022
_trend	-.0002326	.0001902	-1.22	0.222	-.0006072	.000142
_cons	.1587394	.1012346	1.57	0.118	-.0406824	.3581612

Export trading ratio variable "$\frac{\textbf{\textit{Export to US}}}{\textbf{\textit{total export}}}$":

Table A3.3 Export trading ratio variable "$\frac{\textbf{\textit{Export to US}}}{\textbf{\textit{total export}}}$" lag selection

Selection-order criteria
Sample: 11 - 260 Number of obs = 250

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	396.537				.002473	-3.1643	-3.15863	-3.15021
1	728.875	664.68	1	0.000	.000175	-5.815	-5.80366	-5.78683
2	737.822	17.893	1	0.000	.000164	-5.87857	-5.86157	-5.83632
3	742.901	10.158	1	0.001	.000159*	-5.9112*	-5.88853*	-5.85486*
4	742.955	.10953	1	0.741	.00016	-5.90364	-5.8753	-5.83321
5	743.086	.26111	1	0.609	.000161	-5.89669	-5.86267	-5.81217
6	745.555	4.9376*	1	0.026	.000159	-5.90844	-5.86875	-5.80984
7	746.635	2.1596	1	0.142	.000159	-5.90908	-5.86372	-5.79639
8	747.059	.84853	1	0.357	.00016	-5.90447	-5.85345	-5.7777
9	748.071	2.0247	1	0.155	.00016	-5.90457	-5.84788	-5.76371
10	748.538	.93425	1	0.334	.00016	-5.90031	-5.83795	-5.74536

Endogenous: ltrade
Exogenous: _cons

Table A3.4 Export trading ratio variable "$\frac{\textbf{\textit{Export to US}}}{\textbf{\textit{total export}}}$" ADF test result

Augmented Dickey-Fuller test for unit root Number of obs = 256

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.779	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.9674

D.ltrade	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ltrade						
L1.	-.0131901	.0169239	-0.78	0.436	-.0465217	.0201414
LD.	-.3419843	.0651197	-5.25	0.000	-.4702374	-.2137311
L2D.	-.2507649	.0662027	-3.79	0.000	-.381151	-.1203787
L3D.	-.0539988	.0643727	-0.84	0.402	-.1807806	.0727831
_trend	-.0000212	.0000115	-1.84	0.066	-.0000438	1.45e-06
_cons	-.0002773	.0047095	-0.06	0.953	-.0095527	.0089981

Variable “CPI”:

Table A3.5 Variable “CPI” lag selection

Selection-order criteria
Sample: 11 - 260 Number of obs = 250

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1020.3				206.954	8.17038	8.17604	8.18446
1	-545.414	949.77	1	0.000	4.6713	4.37931	4.39065	4.40749
2	-541.65	7.5277	1	0.006	4.56915*	4.3572*	4.37421*	4.39946*
3	-541.646	.00893	1	0.925	4.6057	4.36517	4.38784	4.42151
4	-541.645	.00181	1	0.966	4.64267	4.37316	4.40151	4.44359
5	-538.796	5.6982*	1	0.017	4.57451	4.35837	4.39238	4.44288
6	-538.795	.00144	1	0.970	4.61125	4.36636	4.40605	4.46496
7	-537.663	2.2642	1	0.132	4.60642	4.36531	4.41066	4.47799
8	-537.312	.70235	1	0.402	4.63043	4.3705	4.42152	4.49727
9	-537.237	.14932	1	0.699	4.66489	4.3779	4.43459	4.51876
10	-535.4	3.6751	1	0.055	4.6338	4.3712	4.43356	4.52614

Endogenous: CPI
Exogenous: _cons

Table A3.6 Variable “CPI” ADF test result

Augmented Dickey-Fuller test for unit root Number of obs = 257

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.125	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.9247

D.CPI	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
CPI						
L1.	-.0162661	.0144553	-1.13	0.262	-.0447347	.0122025
LD.	-.1755895	.0635673	-2.76	0.006	-.3007804	-.0503987
L2D.	.0062078	.0632195	0.10	0.922	-.118298	.1307137
_trend	.0049943	.0026944	1.85	0.065	-.0003121	.0103007
_cons	-2.065509	1.723394	-1.20	0.232	-5.4596	1.328581

Variable “interest rate”:

Table A3.7 Variable “interest rate” lag selection

Selection-order criteria
Sample: 11 - 260 Number of obs = 250

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-448.199				2.12914	3.59359	3.59926	3.60768
1	-204.353	487.69	1	0.000	.305118	1.65082	1.66216	1.67899*
2	-202.268	4.1697	1	0.041	.302482	1.64214	1.65915*	1.6844
3	-201.334	1.8672	1	0.172	.302643	1.64267	1.66535	1.69902
4	-201.331	.00746	1	0.931	.305066	1.65064	1.67899	1.72107
5	-199.603	3.4551	1	0.063	.303297	1.64482	1.67884	1.72934
6	-198.856	1.493	1	0.222	.303914	1.64685	1.68654	1.74545
7	-198.754	.20534	1	0.650	.306106	1.65403	1.69938	1.76672
8	-198.739	.02995	1	0.863	.30853	1.66191	1.71293	1.78868
9	-198.409	.65878	1	0.417	.310193	1.66728	1.72397	1.80813
10	-191.35	14.119*	1	0.000	.295519*	1.6188*	1.68116	1.77374

Endogenous: r
Exogenous: _cons

Table A3.8 Variable “interest rate” ADF test result

Augmented Dickey-Fuller test for unit root Number of obs = 249

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.078	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.5586

D.r	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
r						
L1.	-.0567679	.0273232	-2.08	0.039	-.1105964	-.0029394
LD.	-.1638206	.0671976	-2.44	0.016	-.2962044	-.0314368
L2D.	-.1026721	.0673763	-1.52	0.129	-.2354078	.0300637
L3D.	-.0196071	.0675498	-0.29	0.772	-.1526848	.1134705
L4D.	-.1107738	.0675265	-1.64	0.102	-.2438055	.0222578
L5D.	-.0339585	.0677409	-0.50	0.617	-.1674126	.0994956
L6D.	-.0022811	.0674221	-0.03	0.973	-.1351073	.130545
L7D.	.0415452	.0664102	0.63	0.532	-.0892875	.1723778
L8D.	.0102342	.0661976	0.15	0.877	-.1201795	.140648
L9D.	.2519609	.0652749	3.86	0.000	.1233651	.3805568
L10D.	.0880781	.0656133	1.34	0.181	-.0411845	.2173406
_trend	.0006029	.0004814	1.25	0.212	-.0003454	.0015512
_cons	-.0361673	.0726599	-0.50	0.619	-.1793122	.1069776

Dependent variable of Exchange rate amount CAD and USD, "***EXt***"

Table A3.9 Dependent variable of Exchange rate, "EX" lag selection

Selection-order criteria
Sample: 11 - 260 Number of obs = 250

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	134.793				.020076	-1.07034	-1.06467	-1.05626
1	664.472	1059.4	1	0.000	.000292	-5.29978	-5.28844	-5.27161
2	674.35	19.755*	1	0.000	.000272*	-5.3708*	-5.35379*	-5.32854*
3	674.441	.18202	1	0.670	.000274	-5.36353	-5.34085	-5.30718
4	674.554	.22635	1	0.634	.000276	-5.35643	-5.32809	-5.286
5	676.472	3.8369	1	0.050	.000274	-5.36378	-5.32976	-5.27926
6	677.079	1.2131	1	0.271	.000275	-5.36063	-5.32095	-5.26203
7	678.073	1.9884	1	0.159	.000275	-5.36058	-5.31523	-5.2479
8	678.272	.39686	1	0.529	.000277	-5.35417	-5.30315	-5.2274
9	678.273	.0031	1	0.956	.000279	-5.34618	-5.28949	-5.20533
10	678.276	.00511	1	0.943	.000281	-5.33821	-5.27584	-5.18326

Endogenous: lER
Exogenous: _cons

Table A3.10 Dependent variable of Exchange rate, "EX" ADF test result

Augmented Dickey-Fuller test for unit root Number of obs = 257

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.911	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.9550

D.lER	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lER						
L1.	-.0077348	.0084894	-0.91	0.363	-.0244541	.0089844
LD.	.2643755	.0630799	4.19	0.000	.1401446	.3886064
L2D.	.0076462	.0632302	0.12	0.904	-.1168808	.1321733
_trend	-.0000116	.0000168	-0.69	0.490	-.0000447	.0000215
_cons	.003681	.0022398	1.64	0.102	-.0007302	.0080922

Appendix 4
Results after the integrated process:

Spot oil price variable "$\boldsymbol{OP}$":

ADF test result:

Augmented Dickey-Fuller test for unit root — Number of obs = 250

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-6.112	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.0000

Export trading ratio variable "$\frac{\boldsymbol{Export\ to\ US}}{\boldsymbol{total\ export}}$":

ADF test result:

Augmented Dickey-Fuller test for unit root — Number of obs = 255

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-10.455	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.0000

CPI differencing "$\boldsymbol{CPI_{ca} - CPI_{us}}$":

ADF test result:

Augmented Dickey-Fuller test for unit root — Number of obs = 256

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-9.893	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.0000

Interest rate differencing "$\boldsymbol{R_{ca} - R_{us}}$":

ADF test result:

Augmented Dickey-Fuller test for unit root — Number of obs = 248

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-3.938	-3.991	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.0108

ADF test result for second differencing:

Augmented Dickey-Fuller test for unit root — Number of obs = 247

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-9.034	-3.991	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.0000

Exchange rate:

ADF test result:

Augmented Dickey-Fuller test for unit root — Number of obs = 256

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-8.133	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.0000

Appendix 5:

Table A4.1 Result of regression model: from 1991 to 2012:

```
Linear regression                               Number of obs =     258
                                                F(  4,   253) =    8.27
                                                Prob > F      =  0.0000
                                                R-squared     =  0.3367
                                                Root MSE      =   .0139
```

D.lEX	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lOP						
D1.	-.0254479	.0133491	-1.91	0.058	-.0517373	.0008416
ltrade						
D1.	.021032	.0796331	0.26	0.792	-.1357962	.1778602
CPI						
D1.	-.0040599	.0008089	-5.02	0.000	-.0056528	-.0024669
rate						
D2.	.0007798	.000932	0.84	0.404	-.0010556	.0026152
_cons	.0010503	.0008555	1.23	0.221	-.0006346	.0027352

Table A4.2 Result of regression model
From 1991 to 2000

```
Linear regression                               Number of obs =     118
                                                F(  4,   113) =   28.19
                                                Prob > F      =  0.0000
                                                R-squared     =  0.4371
                                                Root MSE      =  .00826
```

D.lex	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lop						
D1.	.0089763	.0102455	0.88	0.383	-.0113218	.0292744
ltrade						
D1.	.034072	.0558097	0.61	0.543	-.076497	.144641
cpi						
D1.	-.0083025	.0007852	-10.57	0.000	-.0098581	-.0067469
rate						
D2.	.0006004	.0007261	0.83	0.410	-.0008382	.0020391
_cons	.0009312	.0008041	1.16	0.249	-.0006618	.0025241

Table A4.3 Result of regression model
From 2001 to 2012

Linear regression

Number of obs	138
F(4, 133)	6.29
Prob > F	0.0001
R-squared	0.3593
Root MSE	.0167

D.lEX	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lOP						
D1.	-.0525312	.0209755	-2.50	0.013	-.09402	-.0110424
ltrade						
D1.	.020343	.1145183	0.18	0.859	-.2061697	.2468557
CPI						
D1.	-.0033001	.0008223	-4.01	0.000	-.0049266	-.0016736
rate						
D2.	.001354	.0019354	0.70	0.485	-.0024742	.0051822
_cons	.0023144	.0014718	1.57	0.118	-.0005969	.0052256

Appendix 6:

Stationary process:

Spot oil price variable "***OP***":
Lag selection:

Selection-order criteria
Sample: 11 - 260 Number of obs = 250

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1188.5				794.813	9.51598	9.52165	9.53007
1	-744.824	887.35	1	0.000	23.0281	5.97459	5.98593	6.00276
2	-736.036	17.576	1	0.000	21.6371	5.91229	5.92929	5.95454*
3	-735.525	1.0213	1	0.312	21.722	5.9162	5.93888	5.97254
4	-734.301	2.4486	1	0.118	21.6831	5.91441	5.94275	5.98484
5	-733.509	1.5833	1	0.208	21.7194	5.91607	5.95009	6.00059
6	-726.756	13.506*	1	0.000	20.7426	5.87005	5.90974*	5.96865
7	-725.475	2.5622	1	0.109	20.6962*	5.8678*	5.91316	5.98049
8	-724.625	1.6999	1	0.192	20.7212	5.869	5.92003	5.99578
9	-724.511	.22836	1	0.633	20.8688	5.87609	5.93278	6.01695
10	-724.441	.14127	1	0.707	21.0248	5.88353	5.94589	6.03847

Endogenous: OP
Exogenous: _cons

Before taking first difference:

Augmented Dickey-Fuller test for unit root Number of obs = 252

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.228	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.4740

After first difference:

Augmented Dickey-Fuller test for unit root Number of obs = 251

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-6.990	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.0000

Export trading ratio variable "$\frac{\textbf{\textit{Export to US}}}{\textbf{\textit{total export}}}$":

Lag selection:

Selection-order criteria
Sample: 11 - 260 Number of obs = 250

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	457.202				.001522	-3.64961	-3.64394	-3.63553
1	791.633	668.86	1	0.000	.000106	-6.31706	-6.30572	-6.28889
2	801.164	19.063	1	0.000	.000099	-6.38532	-6.36831	-6.34306
3	807.183	12.038	1	0.001	.000095*	-6.42547*	-6.40279*	-6.36912*
4	807.189	.01191	1	0.913	.000096	-6.41751	-6.38917	-6.34709
5	807.374	.36928	1	0.543	.000096	-6.41099	-6.37698	-6.32648
6	809.66	4.5722*	1	0.032	.000095	-6.42128	-6.3816	-6.32268
7	810.921	2.5219	1	0.112	.000095	-6.42337	-6.37802	-6.31068
8	811.184	.52659	1	0.468	.000096	-6.41747	-6.36645	-6.2907
9	812.411	2.4524	1	0.117	.000095	-6.41928	-6.36259	-6.27843
10	812.941	1.0607	1	0.303	.000096	-6.41553	-6.35317	-6.26058

Endogenous: trade
Exogenous: _cons

Before taking first difference:

Augmented Dickey-Fuller test for unit root Number of obs = 256

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.758	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.9690

After first difference:

Augmented Dickey-Fuller test for unit root Number of obs = 255

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-10.456	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.0000

CPI differencing "$\boldsymbol{CPI_{ca} - CPI_{us}}$":

Lag selection:

Selection-order criteria
Sample: 11 - 260 Number of obs = 250

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1020.3				206.954	8.17037	8.17604	8.18446
1	-545.416	949.76	1	0.000	4.67137	4.37933	4.39067	4.4075
2	-541.652	7.5284	1	0.006	4.56921*	4.35722*	4.37422*	4.39947*
3	-541.647	.00892	1	0.925	4.60575	4.36518	4.38786	4.42152
4	-541.647	.00181	1	0.966	4.64272	4.37317	4.40152	4.4436
5	-538.798	5.698*	1	0.017	4.57457	4.35838	4.3924	4.4429
6	-538.797	.00142	1	0.970	4.61131	4.36637	4.40606	4.46498
7	-537.664	2.2648	1	0.132	4.60646	4.36532	4.41067	4.478
8	-537.313	.70197	1	0.402	4.63048	4.37051	4.42153	4.49728
9	-537.239	.14918	1	0.699	4.66495	4.37791	4.4346	4.51877
10	-535.401	3.6754	1	0.055	4.63385	4.37121	4.43357	4.52615

Endogenous: CPI
Exogenous: _cons

Before taking first difference:

Augmented Dickey-Fuller test for unit root Number of obs = 257

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.125	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.9247

After first difference:

Augmented Dickey-Fuller test for unit root Number of obs = 256

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-9.893	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.0000

Interest rate differencing "$\boldsymbol{R_{ca} - R_{us}}$":

Lag selection:

Selection-order criteria
Sample: 11 - 260 Number of obs = 250

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-448.199				2.12914	3.59359	3.59926	3.60768
1	-204.353	487.69	1	0.000	.305118	1.65082	1.66216	1.67899*
2	-202.268	4.1697	1	0.041	.302482	1.64214	1.65915*	1.6844
3	-201.334	1.8672	1	0.172	.302643	1.64267	1.66535	1.69902
4	-201.331	.00746	1	0.931	.305066	1.65064	1.67899	1.72107
5	-199.603	3.4551	1	0.063	.303297	1.64482	1.67884	1.72934
6	-198.856	1.493	1	0.222	.303914	1.64685	1.68654	1.74545
7	-198.754	.20534	1	0.650	.306106	1.65403	1.69938	1.76672
8	-198.739	.02995	1	0.863	.30853	1.66191	1.71293	1.78868
9	-198.409	.65878	1	0.417	.310193	1.66728	1.72397	1.80813
10	-191.35	14.119*	1	0.000	.295519*	1.6188*	1.68116	1.77374

Endogenous: rate
Exogenous: _cons

Before taking first difference:

Augmented Dickey-Fuller test for unit root Number of obs = 249

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.078	-3.990	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.5586

After second difference:

Augmented Dickey-Fuller test for unit root Number of obs = 247

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-9.034	-3.991	-3.430	-3.130

MacKinnon approximate p-value for Z(t) = 0.0000

Exchange rate:

Lag selection:

Selection-order criteria
Sample: 11 - 260 Number of obs = 250

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	77.0439				.031866	-.608351	-.602682	-.594265
1	612.333	1070.6	1	0.000	.000444	-4.88266	-4.87132	-4.85449
2	622.586	20.506*	1	0.000	.000412*	-4.95669*	-4.93968*	-4.91443*
3	622.602	.03173	1	0.859	.000415	-4.94881	-4.92614	-4.89247
4	622.672	.14057	1	0.708	.000418	-4.94137	-4.91303	-4.87095
5	624.342	3.3397	1	0.068	.000416	-4.94673	-4.91272	-4.86222
6	624.83	.97609	1	0.323	.000418	-4.94264	-4.90295	-4.84404
7	625.816	1.9722	1	0.160	.000418	-4.94253	-4.89717	-4.82984
8	625.868	.10532	1	0.746	.000421	-4.93495	-4.88393	-4.80818
9	625.871	.00488	1	0.944	.000424	-4.92697	-4.87028	-4.78611
10	625.889	.03707	1	0.847	.000428	-4.91912	-4.85675	-4.76417

Endogenous: EX
Exogenous: _cons

Before taking first difference:

```
. dfuller EX, lag(2) trend reg

Augmented Dickey-Fuller test for unit root         Number of obs   =       257

                                 ———— Interpolated Dickey-Fuller ————
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value            Value
——————————————————————————————————————————————————————————————————————————
 Z(t)             -0.838           -3.990            -3.430           -3.130
——————————————————————————————————————————————————————————————————————————

MacKinnon approximate p-value for Z(t) = 0.9623
```

After first difference:

```
Augmented Dickey-Fuller test for unit root         Number of obs   =       256

                                 ———— Interpolated Dickey-Fuller ————
                    Test         1% Critical       5% Critical      10% Critical
                Statistic           Value             Value            Value
——————————————————————————————————————————————————————————————————————————
 Z(t)             -8.231           -3.990            -3.430           -3.130
——————————————————————————————————————————————————————————————————————————

MacKinnon approximate p-value for Z(t) = 0.0000
```

Regression result:

Table A4.4 regression model result from 1991 to 2000 (without “Ln”)

From 1991 to 2000

```
Linear regression                               Number of obs =     118
                                                F(  4,   113) =   25.43
                                                Prob > F      =  0.0000
                                                R-squared     =  0.4256
                                                Root MSE      =  .01156
```

D.EX	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
OP						
D1.	.0007098	.0006945	1.02	0.309	-.0006662	.0020859
CPI						
D1.	-.0113521	.0011275	-10.07	0.000	-.0135858	-.0091184
trade						
D1.	.0710639	.0980654	0.72	0.470	-.1232214	.2653492
rate						
D2.	.0008997	.0009947	0.90	0.368	-.001071	.0028705
_cons	.0013777	.0011182	1.23	0.220	-.0008376	.0035929

Table A4.5 regression model result from 2001 to 2012 (without “Ln”)

From 2001 to 2012

```
Linear regression                               Number of obs =     138
                                                F(  4,   133) =    6.40
                                                Prob > F      =  0.0001
                                                R-squared     =  0.3342
                                                Root MSE      =  .02016
```

D.EX	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
OP						
D1.	-.0007838	.000402	-1.95	0.053	-.001579	.0000114
trade						
D1.	-.0378343	.1603119	-0.24	0.814	-.354925	.2792564
CPI						
D1.	-.0038133	.0009327	-4.09	0.000	-.0056581	-.0019684
rate						
D2.	.0011531	.0023759	0.49	0.628	-.0035463	.0058525
_cons	.0031362	.00176	1.78	0.077	-.0003449	.0066174