

The Tandem Movement of Natural Resource Price and the Price of the Loonie: An Empirical Analysis

(Draft only, not to be quoted)

Kazi N. Islam
Statistics Canada
Ottawa, ON K1A 0T6
Kazi.islam@statcan.ca

To be presented at the 2007 CEA conference
Dalhousie University, Halifax
June 2007

The views expressed in this paper are those of the author, and
Statistics Canada is not responsible for them.

Abstract: Canada is a net exporter of natural resources such as oil and gas and gold. In recent years, the movement between the natural resource prices and the exchange rate has been widely reported in the media. However, there is a lack of empirical analysis regarding this movement. This paper discusses the magnitude of this movement by linking a newly created natural resource price index and the exchange rate.

Currently, Statistics Canada compiles annual data on production and sales revenues of a number of natural resources. Using these data from 1974 to 2006, a chained Fisher price index of natural resources is calculated. A regression model is used to examine the variation in the exchange rate due to the resource price growth along with other key variables.

The augmented Dickey-Fuller test is conducted to examine the stationarity of these variables. The Johansen cointegration test demonstrates that there is a long run relationship between the exchange rate and the resource price index. Finally, the regression analysis reveals that the coefficient of the resource price index is statistically significant.

1. Introduction

Canada extracts and exports a large amount of natural resources such as oil and gas and gold. In recent years, the prices of these resources have been rising due to increased world demand for resources. The increased prices have enabled Canada to post a substantial trade surplus despite a recent appreciation of the Canadian dollar¹. With the rapid growth of resource importing economies such as India and China, the demand as well as the prices of natural resources may continue to rise. In the past, during the 1997/98 east Asian financial crisis both resource prices and the exchange rate dropped. This evidence implies that the resource prices and the exchange rate are linked together.

In the short run, the demand for natural resources is price inelastic as these resources are essential inputs for other sectors of the economy including manufacturing and construction. The demand for natural resources mainly depends on manufacturing and construction activities. The resource supply, on the other hand, primarily depends on its endowment. Given the large resource endowment in Canada, resource prices can significantly affect the Canadian economy.

In the long run, however, the increased price may also increase exploration and drilling activities in many countries including the resource importing countries. This, in turn, may increase the supply of natural resources in the world market. High energy prices may intensify the production and use of renewable energy sources. In other words, resource prices may continue to play an important role in determining Canada's exports as well as its exchange rate in the coming years. Thus, it is important to investigate the relationship between resource prices and other economic variables including the price of the loonie.

Currently, however, there is a lack of empirical analysis of this issue. In particular, there is no index that captures the aggregate movement of resource prices². This paper seeks to shed some lights on this issue by creating a resource price index and linking the index with the exchange rate. The analysis is expected to help policymakers as well as Canadians to make informed decisions.

The rest of this paper is organized as follows. Section 2 briefly reviews the theories and studies on exchange rate determination. Section 3 shows the construction of the natural resource price index. The main index number formulas are discussed, and then used to calculate the natural resource price index. Section 4 outlines the exchange rate determination model. Section 5 discusses the findings; and Section 6 draws concluding remarks.

¹ Since 2002, the price of the loonie in terms of the US dollar has been appreciating by around 8% per year. Despite this high rate of appreciation, during this period, Canada's net exports to the US have increased slightly, and the overall trade surplus is substantial. It may be noted that the destination of close to 80% of Canada's exports is to the US.

² The indexes such as the Bank of Canada's commodity price index does not cover the natural resources discussed here.

2. Literature Review

Though empirical literature on exchange rate determination is quite extensive, there are mainly two basic hypotheses that explain the equilibrium exchange rate determination: the Purchasing Power Parity (PPP) hypothesis, and the Fisher effect.

The underlying principle of the PPP hypothesis is the law of one price. According to this law, under perfect competition and zero transportation costs, the exchange rate is simply the price ratio of identical commodities between two countries. Suppose in period 1, the price of a computer is US\$1000, and the price of an identical computer is CDN \$1100. Then the exchange rate should be 0.909 (price of the Canadian dollar in terms of the US dollar) or 1.10 (price of the US dollar in terms of the Canadian dollar). If in period 2, the price of the computer becomes CDN\$1050, while the US dollar price remains the same, then the Canadian dollar will appreciate—the exchange rate will become 0.95. In other words, the inflation rate differential between the two countries should explain the change in exchange rate.

According to the Fisher effect, under free mobility of capital, a change in real interest rate differential between two countries is to a great extent responsible for the change in the real exchange rate. If the real interest rate in Canada is higher than that in the US, then the Canadian dollar will appreciate as there will be an inflow of capital. Similarly, if the real interest rate in the US is higher than that in Canada, the Canadian dollar should depreciate.

Though the above two hypotheses are theoretically sound, due to the stringent assumptions, they do not perform well empirically. The empirical literature often uses other economic variables such as the real GDP growth rate, terms of trade, net export growth rate, debt to GDP ratio along with the inflation rate and interest rate differentials.

For example, a study done at the Bank of Canada by Lafrance and van Norden (1995) shows a strong link between the terms of trade and the real exchange rate. McCallum (1998) introduces debt to GDP ratio as an explanatory variable to study Canada-US exchange rate determination. He finds the debt to GDP as an important determinant of the real exchange rate. He argues that a debt is often associated with rising debt to foreigners. The increased interest payments to foreigners may put downward pressure on the currency. Also, a higher public debt might create an expectation that the debt might one day be monetized creating inflation.

According to a study by Cerisola, Swagel and Keenan (1998), in addition to the terms of trade and government debt to GDP ratio, the net foreign asset position, the Canada-US productivity differential, and the Canada-US real interest rate differential are also significant determinants of the real exchange rate.

A recent study by Issa, Lafrance and Murray (2006) finds non-energy commodity price and computer prices along with cumulated current account position played a significant role in the determination of the real exchange rate. Thus, the empirical literature suggests that a wide variety of economic variables are responsible for the variation in the Canada-US exchange rate.

Though the theoretical models suggest use of one or two variables, most empirical studies are based on several variables. It seems the number of variables used in empirical studies depends on the research question and the researcher's imagination. This study introduces a natural resource price index as an explanatory variable.

3. Natural Resource Price Index

The proposed natural resource price index is based on the theories of index numbers, which are well-established in economic literature and widely used to measure various economic phenomena such as the consumer price index.³ The widely used index number formulas are: the Laspeyres, the Paasche, and the Fisher.

3.1.a The Laspeyres Index

For the Laspeyres price index, a pre-selected base year's quantities are used as weights.

Symbolically the index can be written as follows:

$$P^L = \frac{\sum_{i=1}^n P_t^i q_0^i}{\sum_{i=1}^n P_0^i q_0^i} \dots\dots\dots 1$$

where

P^L = the Laspeyres price index

p = the price series

q = the quantity series

i = refers to the *i*th item, and n is the total number of resources

For simplicity, 'i' would be dropped from here on.

Since the data on natural resources are available in quantity and value ($V=pq$, or price multiplied by quantity sold) forms, through algebraic manipulation the above formula can be rewritten in a more usable form.

³ For details, see, Allen, R.G.D. 1975, *Index Numbers in Theory and Practice*, Aldine Publishing Company, Chicago.

$$P^L = \frac{\sum p_t q_0}{\sum p_0 q_0} = \frac{\sum \left[\frac{p_t}{p_0} \right] p_0 q_0}{\sum p_0 q_0} = \frac{\sum \left[\frac{p_t}{p_0} \right] V_0}{\sum V_0} \dots\dots\dots 2$$

where V_0 = value of the quantity produced in the base year

Equation 2 is used to calculate the fixed-base Laspeyres index. This formula is easy to interpret and additive—if separate indexes are calculated for subgroups such as mineral and energy resources, then they can be added together to get the aggregate natural resource price index. However, the formula is highly dependent upon the selection of the base year.

A more appropriate version is the chained Laspeyres index, where every preceding year is used as a base year for the successive year. To calculate the chained index, first the year-over-year index (also known as the unlinked/unchained index) is calculated using the following formula:

$$P_{t/t-1}^{UCL} = \frac{\sum p_t q_{t-1}}{\sum p_{t-1} q_{t-1}} = \frac{\sum \left[\frac{p_t}{p_{t-1}} \right] p_{t-1} q_{t-1}}{\sum p_{t-1} q_{t-1}} = \frac{\sum \left[\frac{p_t}{p_{t-1}} \right] V_{t-1}}{\sum V_{t-1}} \dots\dots\dots 3$$

In other words, to calculate the unchained Laspeyres price index, one needs to calculate the weighted average of the price relatives where the previous period's value (v_{t-1}) is assigned as the weight. Using the value from formula 3, the chained Laspeyres index can be calculated as follows:

$$P_{t/1}^{CL} = 1 \times (P_{period2}^{UCL}) \times (P_{period3}^{UCL}) \dots (P_{periodt}^{UCL}) \\ = \prod_{y=1}^t P_{y/y-1}^{UCL} \dots\dots\dots 4$$

The chained Laspeyres index is simply the cumulative product of unchained Laspeyres indexes, where the index for the reference period is assumed to be 1 or 100%. Because of its multiplicative form, it is easy to shift the reference year without losing the trend.

3.1.b The Paasche Index

In a time series, if the final or end year's quantity is considered as the weight, then the index becomes the Paasche price index.

$$P^P = \frac{\sum p_t q_t}{\sum p_0 q_t} = \frac{\sum p_t q_t}{\sum \left[\frac{p_0}{p_t} \right] p_t q_t} = \frac{\sum V_t}{\sum \left[\frac{p_0}{p_t} \right] V_t} \dots\dots\dots 5$$

where P^P is the Paasche price index, and

V_t = value of the quantity in period t

The unchained version of equation 5 is,

$$P_{t/t-1}^{UCP} = \frac{\sum p_t q_t}{\sum p_{t-1} q_t} = \frac{\sum p_t q_t}{\sum \left[\frac{p_{t-1}}{p_t} \right] p_t q_t} = \frac{\sum V_t}{\sum \left[\frac{p_{t-1}}{p_t} \right] V_t} \dots\dots\dots 6$$

Similar to the chained Laspeyres index, the chained Paasche index can be calculated using the following formula:

$$P_{t/1}^{CP} = \prod_{y=1}^t P_{y/y-1}^{UCP} \dots\dots\dots 7$$

Although the chained Laspeyres and the chained Paasche indexes are more relevant than the fixed based ones, both of them typically suffer from a bias. If the price relatives (p_t/p_{t-1}) and the quantity relatives (q_t/q_{t-1}) are negatively correlated, then the Laspeyres index becomes upward bias and the Paasche index becomes downward bias. The opposite happens if the price and quantity relatives are positively correlated. To resolve this problem, Irving Fisher proposed an index that removes the bias by averaging the two indexes.

3.1.c The Fisher Index

The Fisher price index (P^F) is the geometric mean of the Laspeyres and Paasche indexes.

$$P^F = \sqrt{P^L \times P^P} = \sqrt{\frac{\sum \left[\frac{p_t}{p_0} \right] V_0}{\sum V_0} \times \frac{\sum V_t}{\sum \left[\frac{p_0}{p_t} \right] V_t}} \dots\dots\dots 8$$

or the unchained version

$$P_{t/t-1}^{UCF} = \sqrt{P_{t/t-1}^{UCL} \times P_{t/t-1}^{UCP}} = \sqrt{\frac{\sum \left[\frac{p_t}{p_{t-1}} \right] V_{t-1}}{\sum V_{t-1}} \times \frac{\sum V_t}{\sum \left[\frac{p_{t-1}}{p_t} \right] V_t}} \dots\dots\dots 9$$

The chained Fisher index

$$P_{t/1}^{CF} = \prod_{y=1}^t P_{y/y-1}^{UCF} \dots\dots\dots 10$$

The Fisher index not only removes the bias but also fulfills the time and factor reversal tests of index numbers—two important criteria for an ideal index formula. The time reversal test requires that if the base and current periods are interchanged, the formula produces the reciprocal of the original index, i.e. $1/\text{time-interchanged-index} = \text{original index}$. The factor reversal test requires that the product of price and volume indexes will produce the value index, i.e., $P_{01}Q_{01}=V_{01}$.

The main weakness of the chained Fisher index, like other chained indexes, is its non-additivity, i.e., the index calculated using components does not add up to the aggregate index. Despite this limitation the Canadian System of National Accounts is currently based on the chained Fisher index because of its superiority over other indexes. In order to produce a consistent and coherent natural resource price index, the chained Fisher index is mainly used in the analysis discussed in this paper.

3.2 Natural Resource Price Index

Statistics Canada's compiles production and market value data on a number of resources: natural gas, crude oil, crude bitumen, and coal, gold, nickel, iron ores, molybdenum, uranium, potash, cooper, zinc, and timber.⁴

Chart 1: Natural resource price index (chained Fisher, 1992=100)

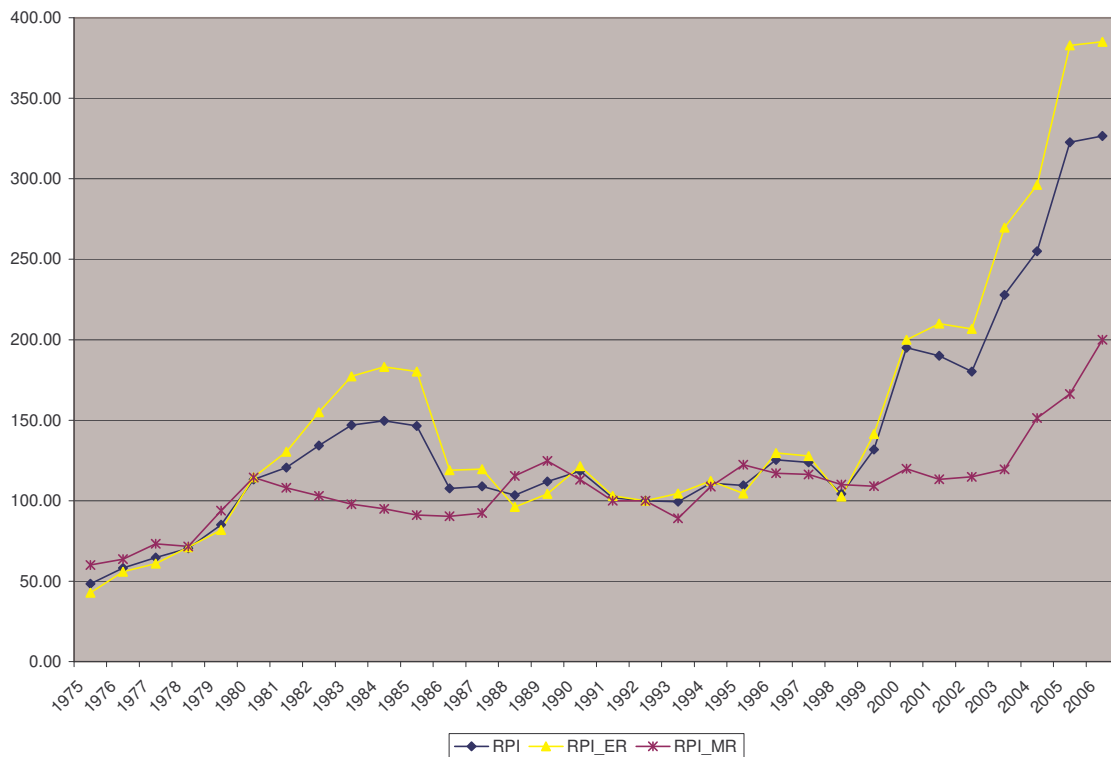


Chart 1 depicts the natural resources price index: 1) RPI for all the resources except timber; 2) RPI_ER for natural gas, crude oil, crude bitumen, and coal; and 3) RPI_MR for the 8 mineral resources⁵. The year 1992 is used as the reference year for the indexes in order to be compatible with the CPI series used in this paper.

⁴ The timber data are yet to be included in this index. With some additional work these data can and should be added. The production and market value data of a number of resources are confidential. It may be noted that gold-silver, nickel-copper, copper-zinc, and lead-zinc are often jointly produced. However, the price and quantity data used here are based on the main component, i.e. gold, nickel, copper, and zinc respectively.

⁵ As stated earlier, the chained Fisher index of energy and mineral resources would not add up to the aggregate index—the main limitation of the chained index.

Chart 1 shows that from 1975 to 1984, the resource price index more than tripled and rose to 183% from 50%. Up until 1980, both energy and mineral resources price contributed to this rapid growth. From 1981 to 1984, the rapid growth of RPI_ER moved the RPI despite a decline in the RPI_MR. This also implies that the value of energy resources is higher than that of mineral resources. All the three indexes dropped in 1986 and hovered slightly above 100% till 1998. From 1999, all the indexes increased rapidly and by 2006 the natural resource price index stood at 326%.

The RPI series has undergone three main phases: first, increased till 1984; second, dropped in 1986 and remained relatively steady till 1998; and finally increased rapidly since 1999. However, the growth rate of the series changed more frequently (Appendix-- Chart 2A). Also, the time series properties of the growth rates are compatible with the other variables used to model the exchange rate determination.

4. The Model

As suggested by the literature, the empirical models on exchange rate determination are based on researcher's imagination—number of explanatory variables is quite diverse ranging from debt to GDP ratio to the rate of interest. However, a relatively simple model is used here.⁶

$$RER = \phi(RPG, RIRD, D) \dots \dots \dots 11$$

Where $RER = NER * (CPI^{US} / CPI^{Can})$

RER = Real exchange rate

NER = Nominal exchange rate

CPI = Consumer price index

RPG = Resource price growth

RIRD = Real interest rate differential = $(R_{Can} - \pi_{Can}) - (R_{US} - \pi_{US})$

R = Nominal interest rate

π = Inflation rate

D = 1 between 1997 to 2002, and 0 otherwise

Except the resource price growth, all other variables are taken from CANSIM. The original source of the exchange rate and interest rate data are the Bank of Canada and the US Federal Reserve. The RER and RIRD are calculated using the definitions stated above.

The dummy is introduced to capture the dampening effect on the Canadian dollar due to the east Asian crisis, and the effect of 9/11. The former affected the exchange rate of major commodity exporting countries and continued for a while. The latter event, though

⁶ I have tried real GDP growth rate, inflation rate differential, and net export growth rate. However, these variables were dropped because either the variable became insignificant or the variable did not fulfill the time series properties.

occurred in the US, affected the currencies of other countries due to the uncertainty in the world economy. Usually, an uncertainty in the world economy increases the price of the US dollar as it is considered as a strong currency both by the central banks as well as the other players in the foreign exchange market.

4.1 Time Series Properties

The time series data often produces spurious relationship—regression results may indicate that the variables are statistically significant just because the time series data typically move together (Granger and Newbold 1974). Following this observation by Granger and Newbold, it has become a routine to test for the stationarity of time series data before running a regression.

4.1.a Stationarity Test

The two widely used tests are: the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron test. For series $\{y_t\}$, the basic ADF test can be defined as follows:

$$\Delta y_t = \gamma + \beta t + \alpha y_{t-1} + \sum_{i=1}^k \eta_i \Delta y_{t-i} + \vartheta_t \quad \dots\dots\dots 12$$

$$H_0 : \alpha = 0$$

$$H_1 : \alpha < 0$$

The basic framework of the Phillips Perron (PP) test is similar to that of the ADF test, the only difference being that in the case of a PP test, the effect of higher-order serial correlation is controlled by a nonparametric method.

Table 1: Stationarity test

Series	ADF		Phillips-Perron	
	$\hat{\alpha}$	$t_{\hat{\alpha}}$	$\hat{\alpha}$	PP test statistic
Real exchange rate	-0.19	-3.18	-0.17	-2.98
Resource price growth	-0.22	-2.53	-0.18	-2.47
Real interest rate differential	-0.24	-2.34	-0.21	-2.04

Table 1 reports both the ADF and PP tests results for all the three series. According to the ADF t-statistics all the three coefficients are different from zero at the 5% level of significance. According to the PP test both the real exchange rate and resource price

growth rate are stationary at the 5% level. However, the real interest rate differential is stationary at the 10% level. Therefore, all the three variables are stationary, i.e. I [0].

Because these variables are I (0), a cointegration test is not needed for the purpose of rejecting the spurious regression. However, the Johansen's cointegration test is performed to determine whether the parameters fulfill the identification condition.

4.1.b Cointegration Test

The Johansen cointegration test (1988, 1991) is conducted to determine whether the explanatory variables are exogenous or not. In order to find the number of cointegrating vectors, Johansen proposes two tests: the trace test (ω_{trace}) and the maximum eigenvalue test (ω_{max}). Johansen and Juselius (1990) suggest that the maximum eigenvalue test, which tests the hypothesis that there are r cointegrating vectors against the alternative $r+1$ cointegrating vectors, performs better.

Table 2a: Johansen's Trace Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	probability
None**	0.52	37.05	29.79	0.01
At most 1	0.31	15.02	15.49	0.06
At most 2**	0.12	4.06	3.84	0.04

** Indicates that the corresponding null hypothesis is rejected at the 5% level of significance.

Table 2b: Johansen's Eigenvalue Test

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	probability
None**	0.52	17.34	13.43	0.00
At most 1	0.31	10.02	10.07	0.06
At most 2**	0.12	2.17	2.01	0.03

** Indicates that the corresponding null hypothesis is rejected at the 5% level of significance.

Table 2a indicates that according to the trace statistics the possibility of having no cointegrating equation can be rejected at the 5% level, as the trace statistic (37.05) is higher than the 5% critical value (29.79). Similarly, the possibility of having two cointegrating equation can also be rejected at the 5% level. However, the possibility of having one cointegrating equation cannot be rejected at the 5% level. Similar results also hold for the maximum eigenvalue test as shown in table 2b. Thus, there is a long run relationship among these variables, and the estimated parameters would fulfill the identification condition.

5. Findings

This study uses mainly two categories of natural resources—energy resources and mineral resources. First, the aggregate resource price growth rate is used as an explanatory variable. Later, to see the price effect of each category, the resource price growth rates for the two categories are used. The results obtained are reported below:

$$\begin{aligned}
 RER &= 84.49 + 0.27RPG + 2.10 RIRD - 9.95D \dots\dots\dots 13 \\
 S.E. &\quad (0.07) \quad (0.65) \quad (3.92) \\
 R^2 &= 0.51
 \end{aligned}$$

$$\begin{aligned}
 RER &= 83.02 + 0.21RPG_{ER} + 0.28RPG_{MR} + 1.44 RIRD - 7.86D \dots\dots 14 \\
 S.E. &\quad (0.07) \quad (0.13) \quad (0.65) \quad (3.75) \\
 R^2 &= 0.55
 \end{aligned}$$

where $D = 1$ between 1997 to 2002, and 0 otherwise.

Equation 3 shows that both the resource price growth and the real interest rate differential are significant at the 5% level. This implies that the resource price growth has played a positive role in determining the exchange rate. Equation 4 reinforces this hypothesis. The energy resource price growth rate is significant at the 1% level, while the mineral resource price growth is significant at the 5% level. The coefficient of mineral resource price index is slightly higher than that of the energy resources.

The dummy variable is also significant at the 5% level. Following the east Asian crisis, the exchange rate of the Canadian dollar dropped substantially and the low rate persisted till 2002. Much of this could be due to factors such as uncertainty, currency substitution, and hedging. Usually, in uncertain situations, most central banks as well as businesses hedge their portfolio by purchasing the US dollar as it has been considered as a strong currency.

6. Conclusions

The supply of non-renewable natural resources largely depends on a country's resource endowment. This implies that the short run price elasticity of supply of these resources is very low. Hence, the market prices of these resources are mainly determined by their demand, which largely depends on the growth of the world economy. In recent years, the world's populous economies such as India and China grew rapidly. As a result, the resource prices in the recent years increased rapidly.

The increased price has enabled Canada, with a large resource endowment, to increase its export earnings. Despite the recent appreciation of the loonie, Canada has posted substantial trade surpluses defying the traditional relationship between the exchange rate and trade. This new reality has encouraged us to investigate the link between the resource price growth and the Canadian exchange rate.

Using the resource prices and the market values of extracted resources, a chained Fisher resource price index is computed. The resource price growth is then used along with the interest rate differential to examine the Canada-US real exchange rate determination. Findings indicate that the real interest rate differential accounted for the most changes in the Canada-US exchange rate. In addition to this, the resource price growth is a significant determinant of the exchange rate. This confirms the widely held view that, other things remaining the same, the exchange rate moves in tandem with the natural resource prices.

Finally, this study can be improved in a number of ways: first, by using monthly or quarterly data as it will better reflect the dynamics of the series; second, by including other resources such as timber and fish as it will broaden the index; and, by incorporating other currencies and variables in the model. Hence, the conclusions drawn here should be interpreted accordingly.

Appendix A

Chart 1A: Real and Nominal Exchange rates

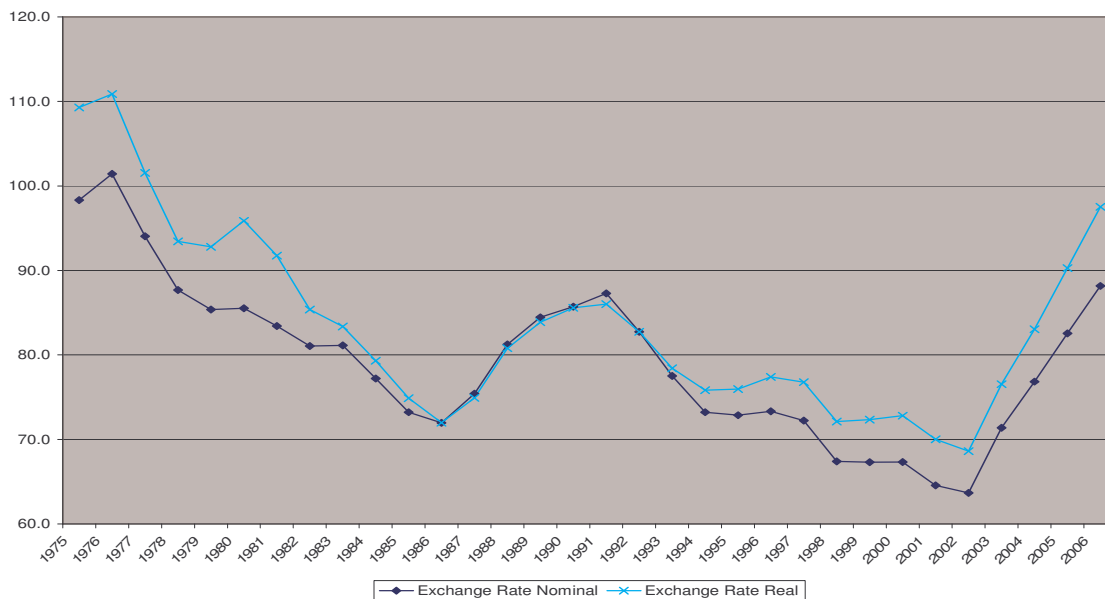
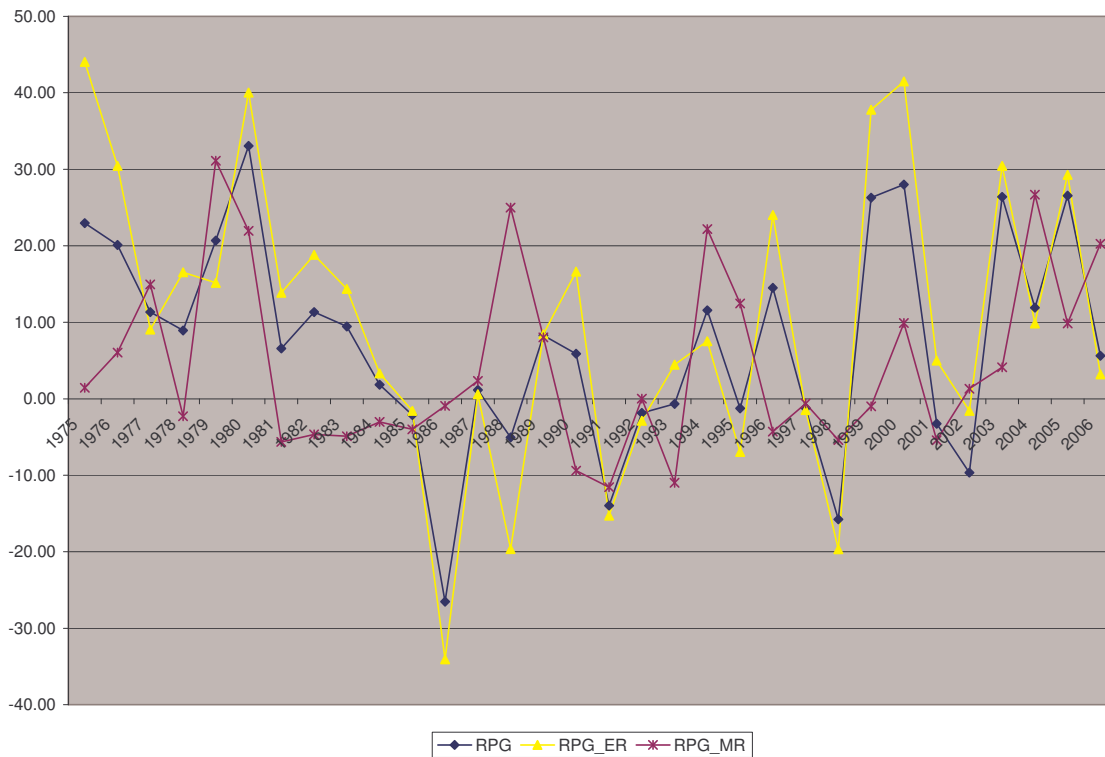


Chart 2A: Resource price growth



References

- Allen, R.G.D. 1975, *Index Numbers in Theory and Practice*, Aldine Publishing Company, Chicago.
- Amino, R. and S. van Norden, 1995. "Terms of Trade and Real Exchange Rates: The Canadian Evidence." *Journal of International Money and Finance* 14(1): 83-104.
- Balassa, B. 1964. "The Purchasing Power Parity Doctrine: A Repappraisal." *Journal of Political Economy* (December): 584-96
- Cerisola, Martin, Phillip Swagel, and Alex Keenan. 1998. "The Behaviour of the Canadian Dollar." *Mimeograph, International Monetary Fund*, Washington, D.C.
- Chen, Y. and K. Rogoff. 2003. "Commodity Currencies" *Journal of International Economics* 60(1):133-60.
- Diewert, W.E. 1976. Exact and Superlative Index Numbers, *Journal of Econometrics*, vol. 4, pp 115-145.
- Fisher, I. 1922. "The Making of Index Numbers." Boston.
- Granger, C. and Newbold, P. 1974. "Spurious Regressions in Econometrics." *Journal of Econometrics*, vol. 2, pp 111-120
- Issa Ramzi, Robert Lafrance, and John Murray. 2006. "The turning black tide: Energy prices and the Canadian dollar." Presented at the 2006 CEA meeting.
- Johansen, S. (1988), *Statistical Analysis of Cointegration Vectors. Journal of Economic Dynamics and Control*, Vol. 12, pp. 231-254.
- Johansen, S and K. Juselius (1990), "Maximum Likelihood Estimation and Inference on Cointegration- with Applications to the Demand for Money," *Oxford Bulletin of Economics and Statistics*, Vol. 52, pp. 169-210.
- Lafrance, R. and S. van Norden. 1995. "Exchange Rate fundamentals and the Canadian Dollar." *Bank of Canada Review* (Spring)
- Laspeyres, E. (1864), *Hamburger Warenpreise 1850-1863*, *Jahrbucher fur Nationalokonomie und Statistik*, 3, 81 and 209.
- McCallum, John. 1998. "Government Debt and the Canadian Dollar" *Royal Bank of Canada Current Analysis*, September.
- Paasche, H. (1874), *Über die Preisentwicklung der letzten Jahre*, *Jahrbucher fur Nationalokonomie und Statistik*, 23, 168.
- Perron, Pierre (1989). The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis, *Econometrica*, Vol. 57, pp. 1361-1401.
- Statistics Canada. 1982. "The Consumer Price Index reference paper." Ottawa.