Is There A Cointegration Relationship of Long-term Bond Yield between U.S and Canada?

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ABSTRACT

As a small open-economy Canada's bond yields are said to be influenced by world financial markets, particularly the U.S. bonds market. As a result, I attempt to consider whether there is a close link between the Canadian and U.S. financial markets. In this study I use the cointegration test to analyze the 2-year bond yield and 10-year bond yield in Canada and the US, the real two year rate to see whether the US interest rate policies have an influence on the Canadian interest rate policies in the long run. We find that from January 1995 to October 2005, there is no cointegration relationship in the long-term bond yield between these two countries. That is to say, there is not a long-run relationship between the Canadian bond yield and the U.S Treasury bill rate.

Key Words: bond yield, cointegration test, monetary policy

I. Introduction

Canada is believed to be a "small open economy". As we all know, small open economies and their financial markets are affected by international economic conditions, in particular by economic conditions in large countries with which they have important links in terms of international trade and capital flows. As such, they are strongly influenced by the level of interest rates in the rest of the world. Therefore, it is useful to study the reactions of Canadian financial markets to economic events that occur outside of Canada, particularly in the United States. As a small open economy, having strong trade and capital market links with the United States, Canada's economy is expected to be affected by developments in the US economy. Consequently, Muller and Zelmer (1999) examined the reaction of spreads of Canadian over U.S. yields to official interest rate changes. This was of interest since it allowed them to control for Canadian interest rate movements that emanated from U.S. rate movements.

- **Monetary policy in Canada between 1962 to 2000**

Monetary policy is one of the tools that a national Government uses to influence its economy. The government uses the monetary authority to control the supply and availability of money, attempting to influence the overall level of economic activity and its political objectives. There are usually four goals: low unemployment, low inflation, economic growth, and a balance of external payments. Monetary policy is usually administered by a Government appointed "Central Bank", such as the Bank of Canada and the Federal Reserve Bank in the United States.

Canada experienced four regime periods between 1962 to 2000[1]. Each period involved a particular policy environment along with a set of policy objectives[2].The four periods are:

1. 1962~1970: fixed exchange rates period (a simple Mundell-Fleming model)

This is a period of little independence for monetary policy but enhanced power for fiscal policy. Thiessen argues that the fiscal policy emphasis was on growth while the power of the Bank to resist inflationary pressures was constrained by the exchange rate commitment[3]. In 1970, Canada changed the fixed exchange rate to a floating rate, which is said to provide greater independence, power and effectiveness for monetary policy.

2. 1971~1981: flexible exchange rate period

Because of the actions of the OPEC oil cartel during a time of strong overall demand in the international economy, the economy experienced stagflation in this period. In 1975, the Bank of Canada used money supply growth rate targets to control inflation. Targets for money supply growth rates where established within a framework of "gradualism" to minimize the negative effect such resistance to inflation might have on GDP growth, (Thiessen (2001) p.42).

Thus, it is not unreasonable to describe the first two periods, at least from the

[1] In a recent paper the Governor of the Bank of Canada, Gordon Thiessen (2001), discussed the historical evolution of Canadian monetary policy in terms of six time periods and the corresponding policy issues or regimes. Four of these regimes fall neatly within the 1961-2000 period in which the Canadian experience with GDP growth and fluctuations is considered in this paper, namely: 1962-1970, 1971-1981, 1982-1990 and 1991-2000.
[2] In some cases shorter sub-periods are identified by Duguay and Longworth (1998) based on particular policy concerns or actions.
[3] See Gordon Thiessen (2001), Bank of Canada

Bank's perspective, as times in which the broad orientation of both monetary and fiscal policies was towards growth and low unemployment, but with a growing, underlying concern about inflation[4].

3. 1982~1990: Transition period

During 1980 to 1981, both US and Canada had a sharp recession (observing from the large negative growth rate in real GDP during 1982-1984), because of the serious monetary restraints. Money supply growth rate targets were no longer satisfactory guides or targets for monetary policy. There was a need for a new policy target on which to base policy implementation[5].In 1988, Governor Crow's (1988) assert that the Bank of Canada would pursue "price stability". This policy objective was confirmed and given empirical content in 1991 when the Bank of Canada and the Minister of Finance, used official targets for inflation control in 1991 that ran until 1995, and declined over that time period. Gordon Thiessen (2001), the governor then, pointed out that

"Although inflation had been reduced significantly in the early 1980's, inflation control re-emerged in the late 1980's as the primary target for monetary policy"

4. 1991~2000: inflation targeting period

The Canada experienced inflation, unemployment and economic growth in the 1990s. During this period, The Bank of Canada implemented its policy by setting targets for the nominal overnight rate and announcing those targets through its announcements of

[4] See Douglas Curtis "Output Fluctuations, Monetary Policy and Fiscal Policy in Canada: 1961-2000"(2001)
[5] Duguay and Longworth (1998) and Thiessen (2001)

the Bank Rate[6]. Thus the policy regime shifted from one which emphasized growth and low unemployment to one which emphasized inflation control as the prime objective of monetary policy. After changing the monetary policy, inflation rates in Canada declined to the target levels and remained within or below the target ranges, but economic growth was unstable and the employment rate was low during this period. Canada experienced what Fortin (1996) called the "Great Canadian Slump".

- **Recent monetary policy**

Canada's monetary policy is built on a framework consisting of two key components[7]:

1. Flexible exchange rate

A flexible exchange rate permits Canada to pursue an independent monetary policy suited to the needs of the economy and acts as a "shock absorber."

2. Inflation-control target

The target range established by the Bank of Canada and the federal government within which the Bank aims to contain annual inflation I measured by the rate of change in total CPI. The target range currently extends from 1 to 3 per cent. To keep inflation within this range, monetary policy needs to aim at the 2 per cent target midpoint over the six to eight quarters that are required for monetary policy to have most of its effect. By

[6] In the 1990's the Bank applied the overnight rate as an instrument of monetary policy to set and control the interest rate, using techniques explained by Clinton (1991) and the Bank of Canada (1999).
[7] This information is collected from the HOME PAGE of Bank of Canada website.

consistently aiming at 2 per cent for the 12-month rate of inflation, monetary policy can enhance the predictability of average inflation over longer time horizons.

As Governor David Dodge (2002) said in his speech on Canada's Experience with Inflation Targets and a Flexible Exchange Rate: Lessons Learned

"The inflation target and a floating exchange rate work well together—indeed they reinforce each other. This approach has worked extraordinarily well for us over the last decade."

The Bank of Canada carries out monetary policy by influencing the short-term interest rate which is settle by raising and lowering the target for the overnight rate. The overnight rate is the interest rate at which major financial institutions borrow and lend one-day (or "overnight") funds among themselves. The Bank sets a target level for the overnight rate. This target for the overnight rate is often referred to as the Bank's key policy rate or key interest rate.

Changes in the target for the overnight rate influence other interest rates, such as those for consumer loans and mortgages. They can also affect the exchange rate of the Canadian dollar.

II. Reviews of literature on long term bond yield

- **Basic Conception**

The annualized yields on instruments with less than one year to run are generically referred to as short rates and those with several years to run as long rates.

Generally, it is believed that monetary policy actions are transmitted to the economy through their effect on market interest rates. From this point of view, we can get that an easier monetary policy will push up both short-term and long-term interest rates, stimulating economic activities, and vice versa.

Unfortunately, this description of the monetary policy process is difficult to reconcile with the actual behavior of interest rates[8]. In fact, there is a close connection between monetary policy actions and the short-term interest rates, but the relationship between policy and long-term interest rates appears much looser and more variable. Moreover, empirical studies also show that there is only a weak relationship between monetary policy actions and long-term interest rate. As V.Vance Roley and Gordon H.Sellon, Jr (1995) says "Taken together, the empirical studies and the observed behavior of interest rates appear to challenge the standard view of the monetary transmission mechanism and raise questions about the effectiveness of monetary policy".

There are a lot of theories about the relationships between short interest rates and long interest rates[9], such as the "segmented markets theory", the "preferred habitat theory", the "liquidity premium theory" and the "expectations theory"[10].

In reality, the "expectations theory" seems the most interesting. The expectations theory of the term structure suggests that monetary policy affects long-term rates by

[8] See Monetary Policy Actions and Long-Term Interest Rates, written by V.Vance Roley and Gordon H.Sellon, Jr. (1995).

[9] There are also a lot of alternative theories of interest rate determination as showed by Smithin (2005). They are (1) the "classical" theory, which argues that the rate of interest is determined by demand and supply in the market for real capital. (2) "Liquidity preference" theory, according to Keynes's theory the interest rate is determined by the relative demand for a given quantity of money and the existing stock of alternative financial assets. (3) "Horizontalist" theory, on this view, the interest rate is simply set by some central monetary authority. And the horizontal theory is associated in particular with the views of the Post Keynesian School (Kaldor 1986, Moore 1988, Lavoie 1992). (4) "Structuralist" theory, in this point of view, the interest rate is endogenous and the money supply is endogenous.

[10] See Mishkin and Serletis, 2005, 177-25.

directly influencing short-term rates and by altering market expectations of future short-term rates. From this point of view, there is no simple relationship between policy actions and the long-term rates. The reaction of long-term rates to policy actions can be highly variable depending on changing views of market participants as to the future direction of monetary policy.

In the expectations theory, long-term interest rates are related to short-term rates through market expectations of future short-term rates. So, we can just calculate the long-term interest rates using an average of current and expected future short-term interest rates. In this simple form of the expectations theory, the change of the current short term rate and factors that change market expectations of future short-term rates will change the long-term interest rate.

This theory assumes that the long rate is the geometric average of expected future short rate, with some allowance for risk. This helps us understand that an increase or decrease in the short rate is not transmitted to the long term rate immediately. For example, the "inverted yield curve" with short rates higher than long rates describes a situation where the short term interest rate is currently high but is expected to be fall in the future and to remain low. A "normal yield curve" with a mild upward slope shows that the short rates will not change a lot in the future because the risk premium rises with the length of the time horizon. If the short rate is determined by monetary factors, then the long rate must be a "monetary phenomenon", also in the sense of being primarily determined by expectations of future monetary conditions[11].

- **The long-term bond yield differentials between U.S and Canada**

From 1980 to 1995, the long-term interest rate was high in Canada relatively to the long-term interest in U.S. However, after 1995, the long-term interest rate in Canada declined rapidly.

Kevin Clinton (1998) shows that the interest rate spread between two countries, on assets of the same maturity and comparable issuers, denominated in the local currencies, may be broken down into four components of varying importance:

Interest rate spread =expected depreciation+ currency-risk premium+ default-risk premium+ liquidity premium

We can see that higher expected depreciation causes a relatively higher domestic bond rate. Investors will make an adjustment for expected exchange rate changes when comparing bonds yields. These include two aspects: An expected difference in trend inflation and an expected movement in the real exchange rate (the nominal rate adjusted for relative domestic price levels)[12].

Currency risk relates to the unpredictability of the exchange rate. As we all know, the exchange rates are very hard to predict, especially over a long run horizon. The currency risk, like expectations, includes two components: inflation and real exchange rate. Long-run inflation risk reflects uncertainty about monetary policy. As Clinton shows

[11] Smithin (2005).
[12] Clinton (1998).

that the long-run real exchange rate risk arises mainly from: (i) shocks in international markets for the country's output and for its terms of trade—since a high degree of economic diversification reduces vulnerability to such shocks, the United States would be more secure than Canada in this regard; and (ii) changes in savings-investment balances or in external indebtedness.

A default-risk premium is included in the formula because of any difference in perceptions of default risk that may be present.

A liquidity premium enters this formula. In Clinton's work, it is pointed out that relative to the United States, the Canadian bond market has (i) less capacity to absorb large transactions, at short notice, without adverse price movements, and (ii) more exposure to sharp, widespread shocks, given Canada's less-diversified economy and less-stable political environment..

In a recent paper, H.Sonmez Atesoglu and John Smithin (2005) use the Canadian overnight money market rate and US federal funds rate weekly data for the period 1975-2005 as a "policy-related" interest rate in each jurisdiction. They conclude that, when splitting the data into two sub-periods, from January1975 to January 1988, there was a strong co integrating relationship between the Canadian overnight rate and the federal funds rate. But from Feb.1988 to May 2005, there was no co integrating relationship. When using three sub-periods, from January1975 to November 1982 there is a cointegrating relationship, from December1982 to February 1991 results are mixed, and from March1991 to May 2005, there is no cointegrating relationship. This shows that in a floating exchange rate regime, the Canadian overnight money market rate depends on the decisions of the Bank of Canada, not the US and Canadian financial markets.

- **The nominal interest rate and real interest rate**

In economy, the distinction between nominal and real numbers is often made. Interest rates are often referred to as either being a real interest rate or a nominal interest rate. A nominal interest rate is not inflation-adjusted, while a real interest rate is inflation-adjusted which equals to the nominal interest rate less expected inflation. Real interest rates can show the actual purchasing power of the nominal return on a dollar of investment. Usually, the expected real interest rate is the nominal interest rate minus the expected inflation rate, while the realized real interest rate has the actual inflation rate subtracted from the nominal interest rate. In the real world, investors are generally more concerned about what they will be able to purchase with their dollars in the future rather than the number of dollars they have received. The real interest rate can only be seen in debt instruments such as Treasury Inflation Protected Instruments, which establishes a real interest rate before-hand.

In my paper, I suppose the investors have rational expectations and that they know with perfect certainty what will happen to future rates of inflation. Rational expectations theory is used to determine the expectations of future events used in economic models. As we all know, expectations are said to be "rational" if they make efficient use of all available information. Rational expectations theory is developed in response to the disadvantages of the adaptive expectations which thinks that the expectations of future values is predicted based on the past values. Under rational expectations the investors will use all available information to form the expectations. It's the basis for the efficient hypothesis and efficient markets theory.

In this study, I will examine the relationship of long term bonds rate between the Canada and US using the 2-year bond yield and 10-year bond yield (the nominal rate and the real rate) both in Canada and the U.S. But we will just consider the period from Jannuary1995 to October 2005 to see whether there will be a co integrating relationship.

III. Empirical part

- **Data**

1. The nominal interest rate data

For the Canada 2-year bond yield and 10-year bond yield monthly data used in this study are collected from the website of the BANK OF CANADA, using The Government of Canada benchmark bond yields[13]. For the U.S 2-year bond yield and

[13] "Benchmark bond yields: Selected benchmark bond yields are based on mid-market closing yields of selected Government of Canada bond issues that mature approximately in the indicated terms. The bond issues used are not necessarily the ones with the remaining time to maturity that is the closest to the indicated term and may differ from other sources. The selected 2-, 5-, 10-, or 30-year issues are generally changed when a building benchmark bond is adopted by financial markets as a benchmark, typically after the last auction for that bond. The selected 3-year issue is usually updated at approximately the same time as changes are made to the 2-year, and sometimes with the 5-year. The selected 7-year issue is typically updated at approximately the same time as the 5- or 10-year benchmarks are changed. The current benchmark bond issues and their effective dates, shown in brackets, are as follows.
2 year - 2007.12.01, 2.75% (2005.09.19);
3 year - 2008.09.01, 4.25% (2005.08.29);
5 year - 2010.09.01, 4.00% (2005.08.29);
7 year - 2012.06.01, 5.25% (2005.08.16);
10 year - 2015.06.01, 4.50% (2005.08.16);
Long - 2033.06.01, 5.75% (2004.07.19);
RRB - 2031.12.01, 4.00% (2001.11.23)"

10-year bond yields monthly data, we collect the data from the Federal Reserve Bank of ST. LOUIS website, using the constant maturity rate. These are the interest rates that can reflect the long-term bonds rates' changes. Because there is some consistency in monetary policy in Canada over the past ten years, we only choose the data from January 1995 to October 2005 that is the Inflation Target Period to analyze whether there is a co integrating relationship between the Canadian long-term bond rates and the U.S long-term bond rates in this period[14].

2. The CPI data

For the Canada data, we get it from CANSIM 326-0016: Consumer price index (CPI), all-items, seasonally adjusted, 2001 basket content, monthly (Index, 1992=100), Jan.1995 to Dec.2004

For the US data we get it from Federal Reserve Bank of ST.LOUIS: Consumer price index (CPI), all-items, seasonally adjusted, monthly (Index, 1982-84=100), Jan.1995 to Dec.2004

3. The real interest rate

To calculate the real interest rate, first we need to know the inflation rate. We don't have the inflation rate data directly, but we can calculate it from the CPI data:

First we need to use the following formula:

I = [CPI (this year) – CPI (last year)] / CPI (last year).

[14] This is a period that the Bank of Canada considers as the Inflation-rate target period.

In this equation “I” is the Inflation Rate. In the following, “n” stands for the Nominal Interest Rate and “r” stands for the Real Interest Rate.

Now we can calculate the real interest rate. The real rate of interest is approximated by taking the nominal interest rate and subtracting inflation. The real interest rate is the growth rate of purchasing power derived from an investment. The relationship between the inflation rate and the nominal and real interest rates is given by the expression: $(1+r) = (1+n)/(1+i)$. However for low levels of inflation we can use the much simpler Fisher Equation to calculate the real interest rate: $r = n - i$

I use the data from Jan.1995 to Dec.2002; I calculate the real interest rate as follows:

The Canadian real two-year bond yield in time *t* is equal to the nominal rate at time *t* minus the average inflation rate of year *t+1* and the year *t+2*. Similarly, the American real two-year Treasury bill rate at time *t* equals to the nominal rate at time *t* minus the average inflation rate of year *t+1* and the year *t+2*.

- **Cointegration test**

In this study I employ the Augmented Dickey-Fuller (ADF) unit root test, Elliott-Rothenberg-Stock DF-GLS (ADF^{GLS}) unit root test and Elliott-Rothenberg-Stock Spectral GLS-detrended AR (P_T^{GLS}) unit root test to determine the order of integration for all the series. To find out the long run relationship among the variables, I employed the residual based Engle-Granger (1987) test and the Johansen and Juselius (1990) test[15].

1. Why I use a cointegration test?

Generally, "time series variables are not stationary individually; one or more linear combinations of the variables are stationary even though individually they are not" (Dickey et.al. 1991). The finding that many macro time series may contain a unit root has spurred the development of the theory of non-stationary time series analysis. Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary linear combination exists, the non-stationary time series are said to be cointegrated. The stationary linear combination is called the cointegrating equation and may be interpreted as a long-run equilibrium relationship among the variables. So variables in the econometric model should show the property of stationary. We use the unit root test to decide the order of integration of every univariate time series. After using the unit root tests, if individual time series are found to be integrated of the same order, then these variables may be cointegrated. Cointegration deals with the relationships among a group of variables, which are all non-stationary (contain a unit root). "When this occurs, the time paths of the individual variables are ultimately constrained to an equilibrium relationship and are said to be cointegrated. While deviations from equilibrium are possible, they are eventually self-revising" (McNown, Wallace 1992, 107-114). Therefore, we can understand that the long-run paths of these variables are all interdependent.

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[15] All of these tests use software Eviews 5.1.

Cointegration shows the long-run equilibrium relationship between two or more variables. The economic interpretation of cointegration is that if two or more variables are linked to form an equilibrium relationship spanning the long run, even though the series themselves in the short run may deviate from the equilibrium, they will move closer together in the long run equilibrium (Harris and Sollis 2003, p.34).So, a non-stationary variable might have a long run relationship with other non-stationary variables, and this will not create a spurious regression if the deviation of this long run relationship is stationary. It implies that these variables are cointegrated.

Therefore, we can see that two variables will be cointegrated if they have a long-term or equilibrium relationship between them.

2. General Methods for Cointegration Analysis

Actually, there are a lot of methods available for conducting the cointegration test. There are three most widely used methods, that is the residual based Engle-Granger (1987) test, and maximum likelihood based Johansen (1988; 1991) and Johansen-Juselius (1990) tests.

The Engle-Granger cointegration test has two steps. The first step is to test whether the residual error is stationary or not. Variables Y and X might individually both have a unit root, but if the estimate of their residual error is stationary, Y and X are said to be cointegrated. This implies that Y and X have a long run relationship and the regression is not spurious[16]. Engle and Granger (1987) have shown that any cointegrated

[16] A test for cointegration can be thought of as a pre-test to avoid spurious regression.

series has an error correction representation. So, if the residual error of the estimation in the first step does not have a unit root, the error correction model will be estimated. The second step is to estimate the error correction model, which shows the short run dynamics of the model. Thus, this two-step procedure of Engle-Granger (1987) test will contain both the long run equilibrium and the short run adjustment process.

Sometimes the residual-based cointegration tests are inefficient and can lead to contradictory results, especially when we have more than two I (1) variables under consideration (Pesaran and Pesaran 1997, p.291). In this case the Johansen (1988; 1991) and Johansen and Juselius (1990) tests are used in multivariate case. These tests are based on the maximum likelihood procedure and supply a unified framework for testing cointegrating relations in the context of vector auto regressive (VAR) error correction models. Johansen suggests two tests to determine the number of cointegrating vectors. They are the likelihood ratio test based on the maximal eigenvalue and the likelihood ratio test based on the trace test. The power of the trace test is lower than the power of the maximal eigenvalue test (Johansen and Juselius 1990). If the null hypothesis of no cointegrating vector can be rejected, there will be a long run relationship among the variables in the model. Then we can use the error correction model.

In recent years, the OLS based autoregressive distributed lag (ARDL) approach to cointegration has become popular. The Engle-Granger (1987) test and maximum likelihood based Johansen (1988; 1991) and Johansen-Juselius (1990) tests have a requirement that the variables in the model must be of equal order of integration. These methods do not include the information on structural breaks in time series data and also suffer from low power.

- **Our Unit Root Test**

I use three different ways to do the unit root test:

1. ADF unit root test

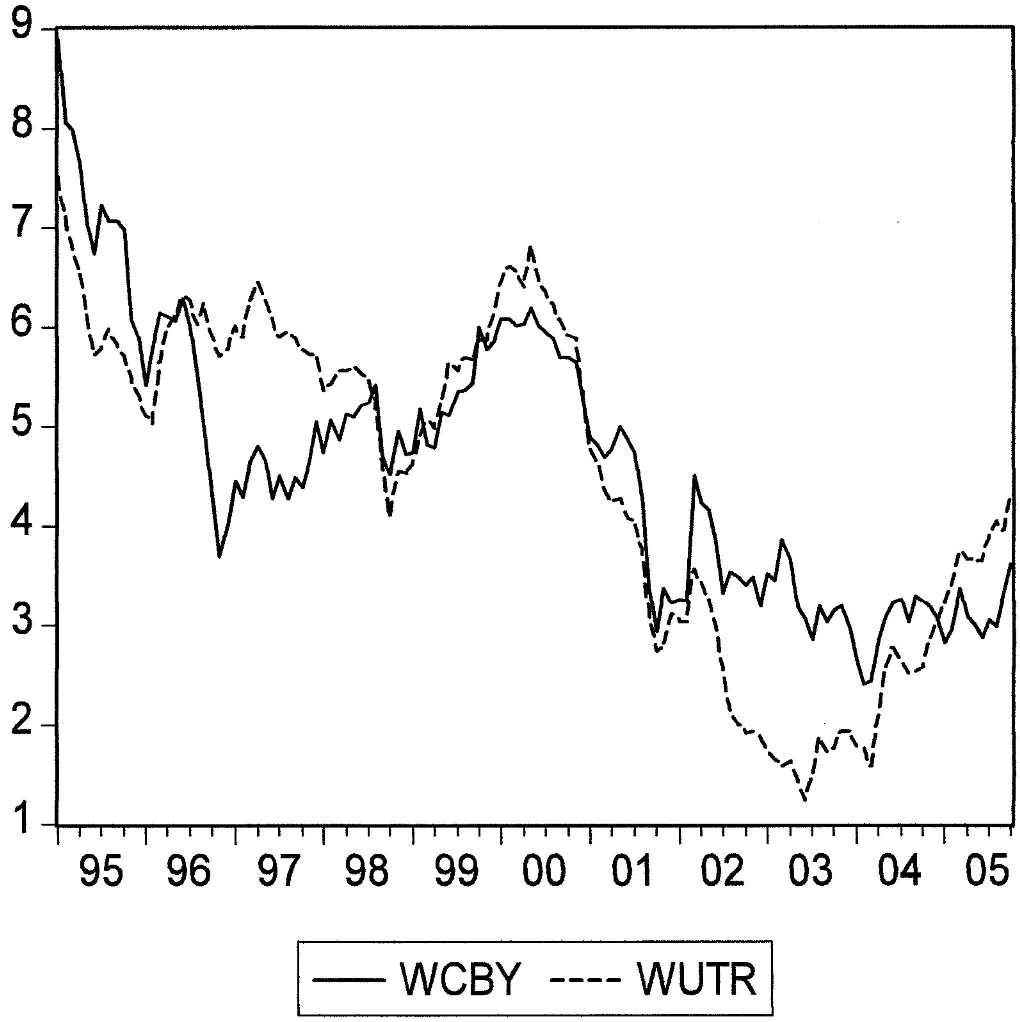
Before we run the co integration model, the first thing we should do is to use the ADF test to see whether all these monthly data series contain a unit root or not[17].

The Augmented Dickey-Fuller (ADF) test constructs a parametric correction for higher-order correlation by assuming that the y series follows an AR (p) process and adding p lagged difference terms of the dependent variable y to the right-hand side of the test regression.

Graph 1 shows the Canadian two-year bond yield and the U.S two-year Treasury bill rate[18]. From this graph we infer that both the Canadian two-year bond yield and the U.S two-year Treasury bill rate may have a unit root and have a trend.

[17] The simple Dickey-Fuller unit root test is valid only if the series is an AR (1) process. If the series is correlated at higher order lags, the assumption of white noise disturbances ε_t is violated.
[18] WCBY stands for the Canadian two-year bond yield and WUTR stands for the U.S two-year Treasury bill rate in our regression model.

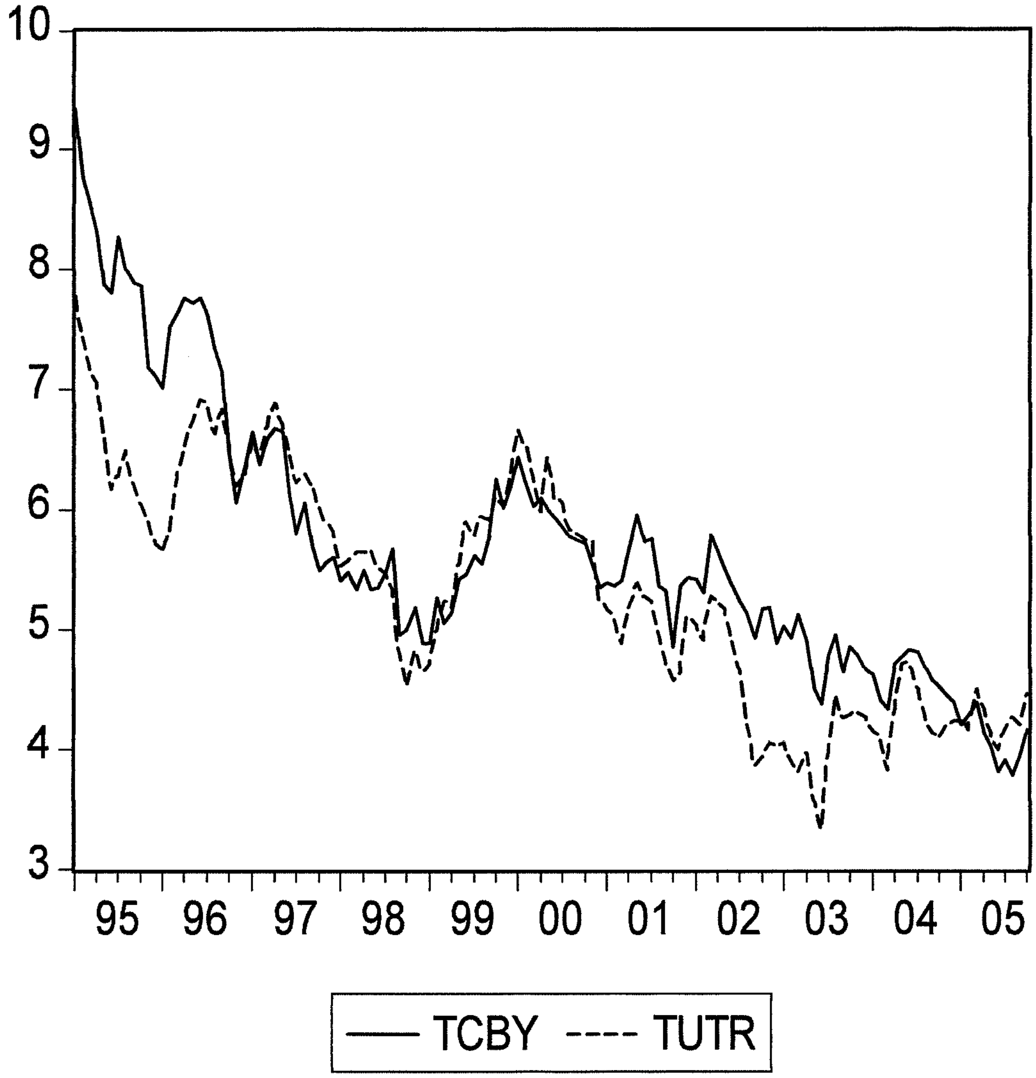
GRAPH 1



Graph 2 shows the Canadian ten-year bond yield and the U.S ten-year Treasury bill rate[19]. We can probably think that the Canadian ten-year bond yield and the U.S ten-year Treasury bill rate may also have a unit root and a trend.

[19] TCBY stands for the Canadian ten-year bond yield and TUTR stands for the U.S ten-year Treasury bill rate in our regression model.

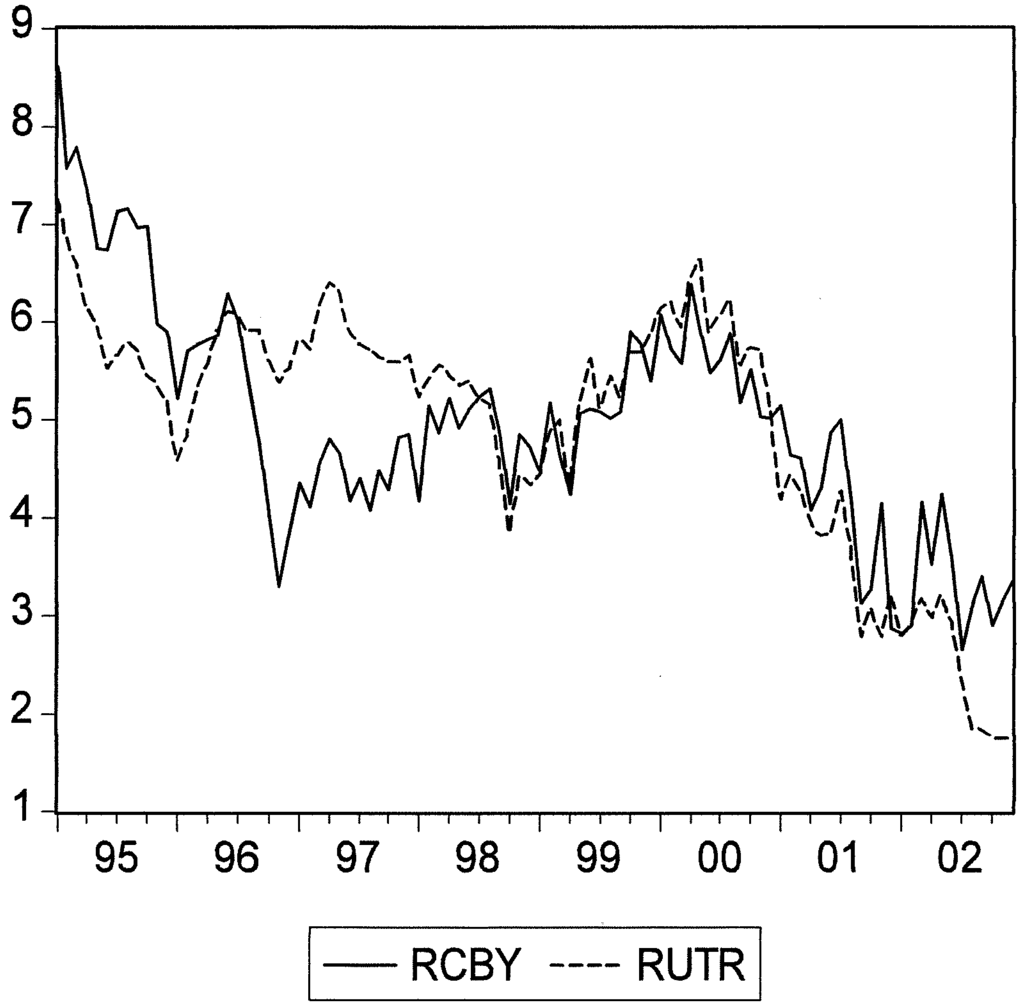
GRAPH 2



Graph 3 shows the Canadian real two-year bond yield and the U.S real two-year Treasury bill rate[20]. From this graph we infer that both the Canadian real two-year bond yield and the U.S real two-year Treasury bill rate may have a unit root and have a trend.

[20] RCBY stands for the Canadian real two-year bond yield and RUTR stands for the U.S real two-year Treasury bill rate in our regression model.

GRAPH 3



For the ADF unit root test, the regression model is:

$$\Delta y_t = \alpha y_{t-1} + x_t{}'\delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \ldots + \beta_p \Delta y_{t-p} + v_t$$

Then we will use the t-ratio to decide whether to reject or accept the null hypothesis.

Table 1 collect all the t-statistics for the ADF unit root test of the Canadian two-year bond yield, Canadian ten-year bond yield, the U.S two-year Treasury bill rate, the U.S ten-year Treasury bill rate, the Canadian two-year real bond yield and the U.S two-year real Treasury bill rate. The lag length is chosen automatically by Eviews.

Table 1

	t-statistic	1%	5%	10%
WCBY	-3.263100	-4.030729	-3.445030	-3.147382
WUTR	-1.299545	-4.031309	-3.445308	-3.147545
TCBY	-2.742412	-4.034356	-3.446765	-3.148399
TUTR	-2.887519	-4.030729	-3.445030	-3.147382
RCBY	-2.596885	-4.059734	-3.458856	-3.155470
RUTR	-1.052731	-4.059734	-3.458856	-3.155470

As before, WCBY stands for the 2 year bond yield in Canada, TCBY stands for the 10 year bond yield in Canada, WUTR stands for the 2 year Treasury bill rate in U.S, TUTR stands for the 10 year Treasury bill rate in U.S, RCBY stands for the Canadian real two-year bond yield and RUTR stands for the U.S real two-year Treasury bill rate in our regression model.

From this table we can see that, for the Canadian two-year bond yield, the t-statistic is bigger than the 1% and 5% critical value. For the Canadian ten-year bond yields, the t-statistic is bigger than the 1%, 5% and 10% critical value. For the Canadian real two-year bond yield, the t-statistic is bigger than the 1%, 5% and 10% critical value. For the U.S two-year Treasury bill rate, the t-statistic is bigger than the 1%, 5% and 10% critical value. For the U.S ten-year Treasury bill rate, the t-statistic is bigger than the 1%, 5% and 10% critical value. For the U.S real two-year Treasury bill rate, the t-statistic is bigger than the 1%, 5% and 10% critical value. So we cannot reject the null hypothesis that there is a unit root for all of these series.

Then we can get a conclusion that the 2 year bond yield in Canada, the 10 year bond yield in Canada, the 2 year real bond yield in Canada, the 2 year Treasury bill rate in U.S, the 10 year Treasury bill rate in U.S and the 2 year real Treasury bill rate in U.S are all nonstationary, that is to say, theses series all contain a unit root[21].

2. ADF^{GLS} unit root test

ADF^{GLS} unit root test (the DF-GLS unit root test) is a modification of the ADF test. It has been showed that the DF-GLS test is more powerful than standard unit-root

[21] We will face two practical issues in performing an ADF test. First, you must choose whether to include exogenous variables in the test regression. You have the choice of including a constant, a constant and a linear time trend, or neither, in the test regression. One approach would be to run the test with both a constant and a linear trend since the other two cases are just special cases of this more general specification. However, including irrelevant regressors in the regression will reduce the power of the test to reject the null of a unit root. The standard recommendation is to choose a specification that is a plausible description of the data under both the null and alternative hypotheses. See, Hamilton (1994a, p. 501) for discussion. In our case we run the unit root test with a constant without a time trend. Second, you will have to specify the number of lagged difference terms (which we will term the "lag length") to be added to the test regression (0 yields the standard DF test; integers greater than 0 correspond to ADF tests). The usual (though not particularly useful) advice is to include a number of lags sufficient to remove serial correlation in the residuals. EViews provides both automatic and manual lag length selection options. In my paper, I choose the automatic lag length selected by Eviews.

tests. This time I use the ADF^{GLS} unit root test in Eviews to make sure whether all these monthly data series are contain a unit root or not.

Table 2 collect all the t-statistics for the ADF^{GLS} unit root test of the Canadian two-year bond yield, Canadian ten-year bond yield, the U.S two-year Treasury bill rate, the U.S ten-year Treasury bill rate, the Canadian two-year real bond yield and the U.S two-year real Treasury bill rate. The lag length is chosen automatically by Eviews.

Table 2

	t-statistic	1%	5%	10%
WCBY	-1.394043	-3.545200	-3.001000	-2.711000
WUTR	-1.387782	-3.546400	-3.002000	-2.712000
TCBY	-0.839522	-3.552400	-3.007000	-2.717000
TUTR	-2.131909	-3.547600	-3.003000	-2.713000
RCBY	-1.472352	-3.606600	-3.052400	-2.761000
RUTR	-1.641066	-3.599000	-3.046000	-2.755000

From this table we can see that, for the Canadian two-year bond yield, the t-statistic is bigger than the 1%, 5% and 10% critical value. For the Canadian ten-year bond yield, the t-statistic is bigger than the 1%, 5% and 10% critical value. For the Canadian real two-year bond yield, the t-statistic is bigger than the 1%, 5% and 10% critical value. For the U.S two-year Treasury bill rate, the t-statistic is bigger than the 1%, 5% and 10% critical value. For the U.S ten-year Treasury bill rate, the t-statistic is bigger than the 1%, 5% and 10% critical value. For the U.S real two-year Treasury bill rate, the t-statistic is bigger than the 1%, 5% and 10% critical value. So we cannot reject the null hypothesis that there is a unit root for all of these series.

Then we can get a conclusion that under ADF^{GLS} unit root test the 2 year bond yield in Canada, the 10 year bond yield in Canada, the 2 year real bond yield in Canada, the 2 year Treasury bill rate in U.S, the 10 year Treasury bill rate in U.S and the 2 year real Treasury bill rate in U.S are all nonstationary, that is to say, theses series all contain a unit root.

3. P_T^{GLS} unit root test

To improve the power of the unit root test, Elliot, Rothenberg & Stock (1996) proposed a local to unity detrending of the time series. ERS developed a feasible point optimal test, "P-test", which takes serial correlation of the error term into account. This time I use the P_T^{GLS} (ETS) unit root test in Eviews to make sure whether all these monthly data series are contain a unit root or not.

Table 3 collect all the P-statistics for the P_T^{GLS} (ETS) unit root test unit root test of the Canadian two-year bond yield, Canadian ten-year bond yield, the U.S two-year Treasury bill rate, the U.S ten-year Treasury bill rate, the Canadian two-year real bond yield and the U.S two-year real Treasury bill rate. The lag length is chosen automatically by Eviews.

Table 3

	P-statistic	1%	5%	10%
WCBY	25.74817	4.197000	5.646000	6.811000
WUTR	15.65061	4.197000	5.646000	6.811000
TCBY	58.39962	4.197000	5.646000	6.811000
TUTR	10.20365	4.197000	5.646000	6.811000
RCBY	24.50801	4.256800	5.646400	6.788400
RUTR	15.64807	4.256800	5.646400	6.788400

From this table we can see that, for the Canadian two-year bond yield, the P-statistic is bigger than the 1%, 5% and 10% critical value. For the Canadian ten-year bond yields, the P-statistic is bigger than the 1%, 5% and 10% critical value. For the Canadian real two-year bond yield, the P-statistic is bigger than the 1%, 5% and 10% critical value. For the U.S two-year Treasury bill rate, the P-statistic is bigger than the 1%, 5% and 10% critical value. For the U.S ten-year Treasury bill rate, the P-statistic is bigger than the 1%, 5% and 10% critical value. For the U.S real two-year Treasury bill rate, the P-statistic is bigger than the 1%, 5% and 10% critical value. So we cannot reject the null hypothesis that there is a unit root for all of these series.

Then we can get a conclusion that under P_T^{GLS} unit root test the 2 year bond yield in Canada, the 10 year bond yield in Canada, the 2 year real bond yield in Canada, the 2 year Treasury bill rate in U.S, the 10 year Treasury bill rate in U.S and the 2 year real Treasury bill rate in U.S are all nonstationary, that is to say, theses series all contain a unit root.

Through above analysis, we get a conclusion that all of these series contain a unit root, which indicate that they are all nonstationary. So we can go on to our further test: the cointegration test.

- **Our Cointegration Test**

1. Engle-Granger (1987) Cointegration Test

In our cointegration test, because we only have two I (1) variables in our linear model, we can use the residual based Engle-Granger (1987) test. The purpose of the cointegration test is to determine whether a group of non-stationary series is cointegrated or not.

We start with the Cointegration test for the Canadian two-year bond yield and the U.S two-year Treasury bill rate. First, we run the linear combination model[22] (see

[22] In all the linear combination models we did not use the time trend in the model, because all of the time series have a

table 4). Then we can get the residual. Second we will use the ADF unit root test to see whether the residual has a unit root or not. In Table 5, the t-statistic is -3.003493, which is bigger than the 1%(-4.3628) 5%(-3.8000) 10%(-3.5184) critical level[23], so we can accept the null-hypothesis that there is a unit root. Therefore, the residual of the linear combination of the Canadian two-year bond yield and the U.S two-year Treasury bill rate contains a unit root, in other words, this linear combination is non-stationary. Finally, we get a conclusion that there may not be a cointegrating relationship between the Canadian two-year bond yield and the U.S two-year Treasury bill rate. So there may not be a long-run relationship between the Canadian two-year bond yield and the U.S two-year treasury.

For the cointegration test for the Canadian ten-year bond yield and the U.S ten-year Treasury bill rate, I use the same method that I used previously to test the cointegration relationship of the Canadian two-year bond yield and the U.S two-year Treasury bill rate (see Table 6). Then I find out that the ADF unit root test for the residual of the Canadian ten-year bond yield and the U.S ten-year treasury bill rate (see Table 7) shows that it has a unit root because the t-statistic is -1.879046, it is bigger than the1%(-4.3628) 5%(-3.8000) 10%(-3.5184) critical value, so we cannot reject the null hypothesis that the residual has a unit root, so this linear combination is non-stationary. Finally, we get a conclusion that there is no cointegrating relationship between the

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time trend.

[23] See Phillips and Ouliaris (1990). For all of the ADF unit root tests on residuals, we will use the critical value in this paper.

Canadian ten-year bond yield and the U.S ten-year Treasury bill rate. So there may not be any long-run relationship between the Canadian ten-year bond yield and the U.S ten-year treasury bill rate.

Then we do the Cointegration test for the Canadian two-year real bond yield and the U.S two-year real Treasury bill rate. First, we run the linear combination model (see table 8). Then we can get the residual. Second we will use the ADF unit root test to see whether the residual has a unit root or not. In Table 9, the t-statistic is -2.442666, which is bigger than the 1%(-4.3628) 5%(-3.8000) 10%(-3.5184) critical level, so we can accept the null-hypothesis that there is a unit root. Therefore, the residual of the linear combination of the Canadian two-year real bond yield and the U.S two-year real Treasury bill rate contains a unit root, in other words, this linear combination is non-stationary. Finally, we get a conclusion that there may not be a cointegrating relationship between the Canadian two-year real bond yield and the U.S real two-year Treasury bill rate. So there may not be a long-run relationship between the Canadian two-year real bond yield and the U.S two-year real treasury bill rate.

In conclusion, under the Engle-Granger (1987) Cointegration Test, I find out that there may not be a long-run relationship between the Canadian two-year bond yield and the U.S two-year treasury bill rate, the Canadian ten-year bond yield and the U.S ten-year treasury bill rate, the Canadian two-year real bond yield and the U.S two-year real treasury bill rate.

2. Johansen and Juselius (1990) Cointegration Test

Eviews 5.1 automatically chooses the Johansen and Juselius (1990) procedures to run the Cointegration Test.

Table 10 shows the Johansen (1990) Cointegration Test for the Canadian two-year bond yield and the U.S two-year treasury bill rate, the Trace Statistic is 10.51725 for the null-hypothesis of no cointegration, which is well below the corresponding 5% critical value 15.49471. The Max-Eigen Statistic is 8.349616 for the null-hypothesis of no cointegration, which is well below the corresponding 5% critical value 14.26460. So we cannot reject the null hypothesis that there is no cointegration relationship between the Canadian two-year bond yield and the U.S two-year Treasury bill rate, that is to say there is no long-run relationship between them.

Table 11 shows the Johansen (1990) Cointegration Test for the Canadian ten-year bond yield and the U.S ten-year treasury bill rate. The Trace Statistic is 7.901387 for the null-hypothesis of no cointegration, which is well below the corresponding 5% critical value 15.49471. The Max-Eigen Statistic is 4.651281 for no cointegration equation is well below the corresponding 5% critical value 14.26460. So we cannot reject the null hypothesis that there is no cointegration relationship between the Canadian ten-year bond yield and the U.S ten-year Treasury bill rate, that is to say there is no long-run relationship between them.

Table 12 shows the Johansen (1990) Cointegration Test for the Canadian two-year real bond yield and the U.S two-year real treasury bill rate. The Trace Statistic is 8.775326 for null hypothesis of no cointegration equation, which is well below the corresponding 5% critical value 15.49471. The Max-Eigen Statistic is 8.689661 for the null-hypothesis of no cointegration equation, which is well below the corresponding 5% critical value 14.26460. So we cannot reject the null hypothesis that there is no cointegration relationship between the Canadian two-year real bond yield and the U.S two-year real treasury bill rate, that is to say there is no long-run relationship between them.

We can conclude from the Johansen and Juselius (1990) procedure that there is no long-run relationship whatsoever between the Canadian two-year bond yield and the U.S two-year treasury, the Canadian ten-year bond yield and the U.S ten-year treasury bill , the Canadian two-year real bond yield and the U.S two-year real treasury.

IV. Conclusion

From the above Cointegration analysis, we see that there is no long-run relationship between the Canadian two-year bond yield and the U.S two-year Treasury bill rate and that there is no long-run relationship between the Canadian ten-year bond yield and the U.S ten-year Treasury bill rate. There is also no long-run relationship between the real bond yields of the two countries. Therefore, we can conclude that the Canadian long-term bonds yield and the U.S long-term Treasury bills rate have no long-run relationship after 1995. This is similar to the finding of Atesoglu and Smithin's (2005) recent paper; they demonstrate that after 1995, there is no cointegrating relationship between the Canadian overnight target rate and the U.S Federal funds rate.

In recent years, Federal Reserve monetary policy has focused on the domestic economy. The monetary policies have been subordinated to domestic concerns. Federal Reserve monetary policy has two basic goals, and these goals are prescribed in a 1977 amendment to the Federal Reserve Act. First, the Fed must promote a "maximum" sustainable output and employment, that is to say the amount of goods and services the economy produces (output) and the number of job it generates (employment); but both depend on factors other than monetary policy. These factors include technology and people's preferences for saving, risk, and work effort. So, maximum sustainable output and employment means the levels consistent with these factors in the long run[24]. Second, the Fed must promote "stable" prices. The Fed cannot directly govern the inflation rate or affect output and employment; instead, it influences them by raising or lowering the "federal funds" rate indirectly, the short-term interest rate at which banks make loans to one another. The Fed often does this through open market operations in the market for bank reserves, which is the federal funds market. It would adjust the target interest rate in response to different economic conditions, but it would allow the money supply to move in whatever way is necessary to keep the interest rate on target. In Canada, the Bank of Canada pays more attention to controlling its inflation rate.

This finding to some extent shows that there are some changes in Canada's and the U.S economic conditions. Despite recognition that financial capital is increasingly

[24] See Federal Reserve Bank of San Francisco web-site, http://www.frbsf.org/publications/federalreserve/monetary/tools.html

mobile, and financial markets are evermore globally integrated, international concerns are rarely an important rationale influencing a country's monetary policy decisions.

We know that there is usually a close relationship between the monetary policy actions and the short-term interest rates, but the relationship between monetary policy and long-term interest rates appears much looser and more variable. The relationship between monetary policy and the long-term interest rate changes over the business cycle because of the changing views of the financial market participants on the persistence of policy actions. Our results seem to indicate that central banks have some freedom in fixing short-term interest rates of their choice, and in influencing long-term rates in the direction that they see fit.

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APPENDIX

Table 4: OLS test: linear combination of the Canadian two-year bond yield and the U.S two-year Treasury bill rate

Dependent Variable: WCBY
Method: Least Squares
Date: 11/05/05 Time: 20:00
Sample: 1995:01 2005:10
Included observations: 130
WCBY=C(1)+C(2)*WUTR

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.618180	0.189687	8.530798	0.0000
C(2)	0.668635	0.039742	16.82442	0.0000

R-squared	0.688611	Mean dependent var	4.605846
Adjusted R-squared	0.686178	S.D. dependent var	1.357228
S.E. of regression	0.760317	Akaike info criterion	2.305101
Sum squared resid	73.99439	Schwarz criterion	2.349217
Log likelihood	-147.8316	Durbin-Watson stat	0.113573

Table 5: ADF unit root test for the residual of the Canadian two-year bond yield and the U.S two-year Treasury bill rate

Null Hypothesis: WRESIDUAL has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on Modified AIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.003493	0.0372
Test critical values:	1% level	-3.481623	
	5% level	-2.883930	
	10% level	-2.578788	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WRESIDUAL)
Method: Least Squares
Date: 12/14/05 Time: 10:55
Sample (adjusted): 1995M02 2005M10
Included observations: 129 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WRESIDUAL(-1)	-0.086841	0.028913	-3.003493	0.0032
C	-0.023656	0.021787	-1.085825	0.2796

R-squared	0.066320	Mean dependent var	-0.024240
Adjusted R-squared	0.058969	S.D. dependent var	0.255073
S.E. of regression	0.247438	Akaike info criterion	0.060068
Sum squared resid	7.775639	Schwarz criterion	0.104406
Log likelihood	-1.874393	F-statistic	9.020970
Durbin-Watson stat	2.096612	Prob(F-statistic)	0.003216

Table 6: OLS test: linear combination of the Canadian ten-year bond yield and the U.S ten-year Treasury bill rate

Dependent Variable: TCBY
Method: Least Squares
Date: 11/05/05 Time: 19:30
Sample: 1995:01 2005:10
Included observations: 130
TCBY=C(1)+C(2)*TUTR

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.366807	0.284654	1.288605	0.1999
C(2)	0.998882	0.052498	19.02694	0.0000

R-squared	0.738789	Mean dependent var	5.692308
Adjusted R-squared	0.736748	S.D. dependent var	1.152157
S.E. of regression	0.591150	Akaike info criterion	1.801771
Sum squared resid	44.73065	Schwarz criterion	1.845887
Log likelihood	-115.1151	Durbin-Watson stat	0.123382

Table 7: ADF unit root test for the residual of the Canadian ten-year bond yield and the U.S ten-year Treasury bill rate

Null Hypothesis: TRESIDUAL has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on Modified AIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.879046	0.3413
Test critical values:	1% level	-3.482035	
	5% level	-2.884109	
	10% level	-2.578884	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TRESIDUAL)
Method: Least Squares
Date: 12/14/05 Time: 11:00
Sample (adjusted): 1995M03 2005M10
Included observations: 128 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TRESIDUAL(-1)	-0.057987	0.030860	-1.879046	0.0626
D(TRESIDUAL(-1))	-0.207032	0.086199	-2.401799	0.0178
C	-0.015643	0.017708	-0.883406	0.3787

R-squared	0.079763	Mean dependent var	-0.012448
Adjusted R-squared	0.065039	S.D. dependent var	0.206700
S.E. of regression	0.199865	Akaike info criterion	-0.359186
Sum squared resid	4.993275	Schwarz criterion	-0.292342
Log likelihood	25.98791	F-statistic	5.417270
Durbin-Watson stat	1.993163	Prob(F-statistic)	0.005543

Table 8: OLS test: linear combination of the Canadian two-year real bond yield and the U.S two-year real Treasury bill rate

Dependent Variable: RCBY
Method: Least Squares
Date: 12/05/05 Time: 13:54
Sample: 1995M01 2002M12
Included observations: 96
RCBY=C(1)+C(2)*RUTR

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.582994	0.327750	4.829877	0.0000
C(2)	0.682863	0.063991	10.67123	0.0000

R-squared	0.547805	Mean dependent var	4.968982
Adjusted R-squared	0.542995	S.D. dependent var	1.189942
S.E. of regression	0.804426	Akaike info criterion	2.423238
Sum squared resid	60.82755	Schwarz criterion	2.476662
Log likelihood	-114.3154	Durbin-Watson stat	0.299104

Table 9: ADF unit root test for the residual of the Canadian two-year real bond yield and the U.S two-year real Treasury bill rate

Null Hypothesis: RRESIDUAL has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on Modified AIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.442666	0.1330
Test critical values:	1% level	-3.501445	
	5% level	-2.892536	
	10% level	-2.583371	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESIDUAL)
Method: Least Squares
Date: 12/14/05 Time: 11:09
Sample (adjusted): 1995M03 2002M12
Included observations: 94 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDUAL(-1)	-0.133250	0.054551	-2.442666	0.0165
D(RESIDUAL(-1))	-0.296616	0.096000	-3.089744	0.0027
C	-0.017046	0.041185	-0.413886	0.6799

R-squared	0.178140	Mean dependent var	-0.007843
Adjusted R-squared	0.160077	S.D. dependent var	0.435145
S.E. of regression	0.398799	Akaike info criterion	1.030674
Sum squared resid	14.47267	Schwarz criterion	1.111843
Log likelihood	-45.44168	F-statistic	9.862230
Durbin-Watson stat	2.029336	Prob(F-statistic)	0.000133

Table 10: Johansen and Juselius (1990) Cointegration Test for the Canadian two-year bond yield and the U.S two-year Treasury bill rate

Date: 12/14/05 Time: 10:52
Sample (adjusted): 1995M06 2005M10
Included observations: 125 after adjustments
Trend assumption: Linear deterministic trend
Series: WCBY WUTR
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.064615	10.51725	15.49471	0.2430
At most 1	0.017192	2.167631	3.841466	0.1409

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.064615	8.349616	14.26460	0.3443
At most 1	0.017192	2.167631	3.841466	0.1409

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

WCBY	WUTR
-1.571571	0.887231
-0.239657	0.753615

Unrestricted Adjustment Coefficients (alpha):

D(WCBY)	0.072378	-0.012102
D(WUTR)	0.019354	-0.026203

1 Cointegrating Equation(s): Log likelihood 24.21702

Normalized cointegrating coefficients (standard error in parentheses)

WCBY	WUTR
1.000000	-0.564550
	(0.13800)

Adjustment coefficients (standard error in parentheses)

D(WCBY)	-0.113747
	(0.04256)
D(WUTR)	-0.030417
	(0.03121)

Table 11: Johansen and Juselius (1990) Cointegration Test for the Canadian ten-year bond yield and the U.S ten-year Treasury bill rate

Date: 12/14/05 Time: 10:38
Sample (adjusted): 1995M06 2005M10
Included observations: 125 after adjustments
Trend assumption: Linear deterministic trend
Series: TCBY TUTR
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.036526	7.901387	15.49471	0.4760
At most 1	0.025666	3.250105	3.841466	0.0714

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.036526	4.651281	14.26460	0.7850
At most 1	0.025666	3.250105	3.841466	0.0714

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

TCBY	TUTR
-1.858864	1.796236
0.052470	1.050690

Unrestricted Adjustment Coefficients (alpha):

D(TCBY)	0.018810	-0.033531
D(TUTR)	-0.015509	-0.030304

1 Cointegrating Equation(s):	Log likelihood	64.51289

Normalized cointegrating coefficients (standard error in parentheses)

TCBY	TUTR
1.000000	-0.966308
	(0.28365)

Adjustment coefficients (standard error in parentheses)

D(TCBY)	-0.034965
	(0.03996)
D(TUTR)	0.028829
	(0.03558)

Table 12: Johansen and Juselius (1990) Cointegration Test for the Canadian two-year real bond yield and the U.S two-year real Treasury bill rate

Date: 12/14/05 Time: 11:11
Sample (adjusted): 1995M04 2002M12
Included observations: 93 after adjustments
Trend assumption: Linear deterministic trend
Series: RCBY RUTR
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.089205	8.775326	15.49471	0.3866
At most 1	0.000921	0.085665	3.841466	0.7698

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.089205	8.689661	14.26460	0.3129
At most 1	0.000921	0.085665	3.841466	0.7698

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

RCBY	RUTR
-1.325830	0.668193
0.354108	-1.076435

Unrestricted Adjustment Coefficients (alpha):

D(RCBY)	0.140612	-0.003404
D(RUTR)	0.038272	-0.009393

1 Cointegrating Equation(s):	Log likelihood	-70.80460

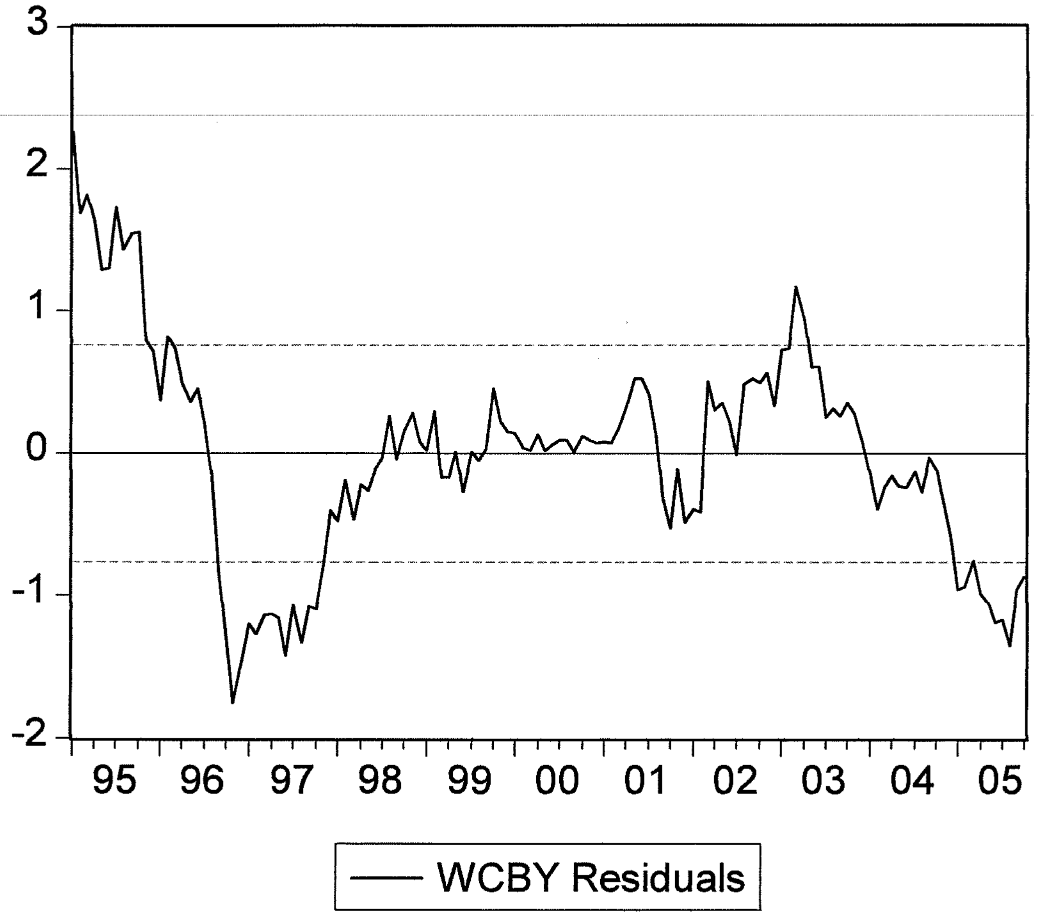
Normalized cointegrating coefficients (standard error in parentheses)

RCBY	RUTR
1.000000	-0.503981
	(0.22417)

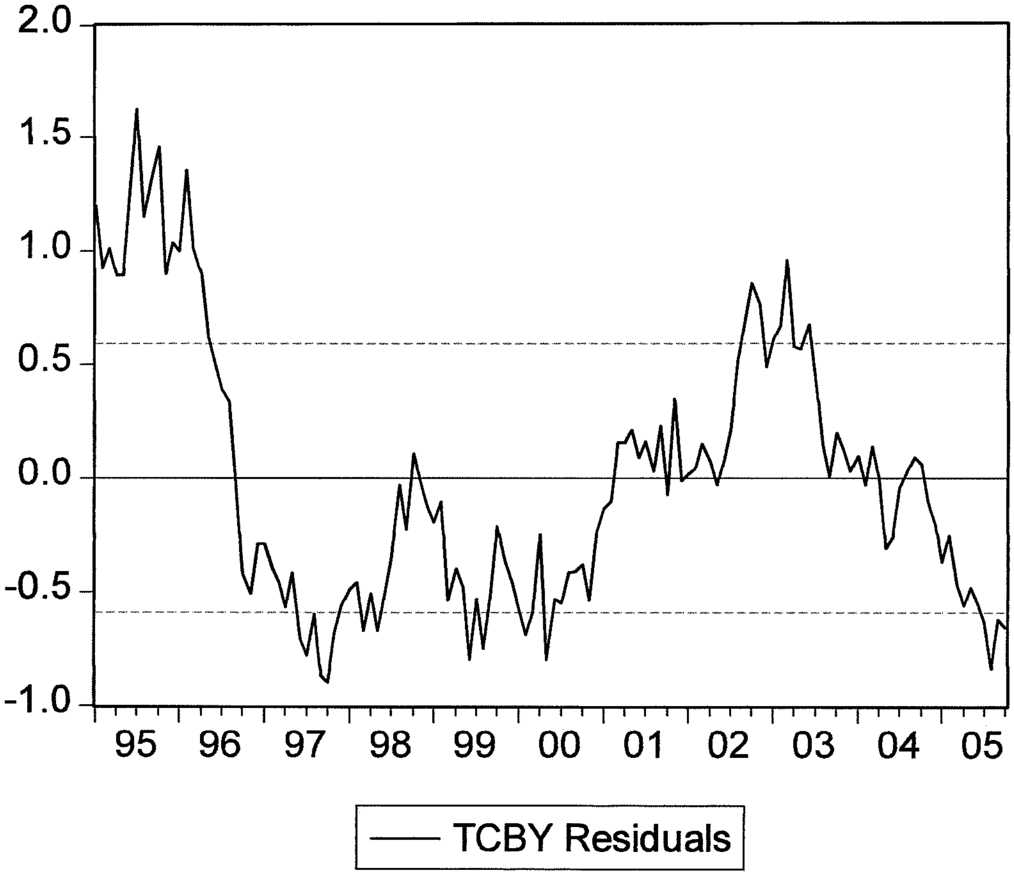
Adjustment coefficients (standard error in parentheses)

D(RCBY)	-0.186428
	(0.06583)
D(RUTR)	-0.050742
	(0.04731)

Graph 4: The residual graph for the Canadian two-year bond yield and the U.S two-year Treasury bill rate



Graph 5: The residual graph for the Canadian ten-year bond yield and the U.S ten-year Treasury bill rate



Graph 6: The residual graph for the Canadian two-year real bond yield and the U.S two-year real Treasury bill rate