The Impact of Inflation Targeting on the Canadian Stock Market: Examining Changes in the Announcement Effect

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Abstract

This study examines whether inflation targeting in Canada has reduced volatility in the Canadian stock market. While there are many factors other than monetary policy which can affect stock market volatility, this study theorizes that volatility due to monetary policy can be reduced if the Bank of Canada increases the accuracy of investors' expectations of the Bank's future actions. Investors value stock prices based on forecasts of future cash flows from ownership of stock (equity) and forecasts of future discount rates (required rates of return for investing in equity). Among the factors which are considered by investors in generating forecasts of future cash flows and discount rates are investors' forecasts of the Bank's future monetary policy actions as well as the economic consequences of those actions. This study will test for an announcement effect to evaluate how the accuracy of investors' expectations (forecasts) of the Bank's monetary actions has changed over time. The efficient market hypothesis argues that an announcement effect should only exist if interest rate announcements are "news", or in other words a surprise.

Even though inflation targeting became the Bank of Canada's monetary policy objective in 1991, this paper examines the period from 1994-2006. This study does not evaluate how investors' expectations react to a change in monetary policy regime. Instead, this paper examines the effect of an established policy on stock market participants' expectations. In December 1993 the Bank and the Government of Canada extended the agreement to practice inflation targeting for an additional three years (the prior agreement lasted till 1995 and the new agreement extended that date until 1998; Freedman, 2001). I believe this makes 1994 a strong candidate for a year when the policy became firmly established. Furthermore, in June 1994 the Bank began to phase in the

Target for the Overnight Rate as the key policy rate, although it was not formally announced until 2001. In the empirical analysis, I use sub-periods to test this paper's hypothesis and discuss how changes in the key policy rate or methods of announcing the key policy rate are used to define these sub-periods (explained in the section *Sample Period Selection*).

What is found is that the announcement effect was present from 1994-1996, meaning interest rate announcements generally came as a surprise to stock market participants; however, this announcement effect decreased from 1996-1999 and then disappeared in the following time periods. Based on this evidence, this paper argues that inflation targeting has been successful at reducing stock market volatility.

Introduction

Basic economic theory dictates that actions should be analyzed for both benefits and costs and chosen only when the benefits outweigh the costs. In Canada, the Bank of Canada makes decisions on monetary policy actions with the goal of maximizing the nation's economic welfare. From February 1991 till the present (this paper is written in August, 2006), the Bank of Canada (sometimes referred to in the paper as the Bank or the Central Bank) has conducted monetary policy actions under the objective of following an inflation targeting framework. Inflation targeting is a framework where the Central Bank attempts to maintain inflation, defined as the percentage change in the Consumer Price Index (CPI), within a pre-specified range. Over the lengthy 15 year regime of this form of monetary policy, Bank of Canada employees, economists and scholars have addressed at many times various benefits and costs of inflation targeting. In this paper I examine the

effect of inflation targeting on the Canadian stock market to determine whether the effect of inflation targeting on the Canadian stock market is a benefit or a cost of practicing the policy.

Although the volatility of the Canadian stock market is due to various factors, such as international correlation, business risk and behavioural factors, I will argue through an analysis of valuation theory that volatility can arise from monetary policy due to the errors in forecasts stock market participants generate with regards to future monetary policy actions and the effect of those actions on economic conditions. A policy which can reduce the errors in investors' forecasts will reduce the volatility of the stock market due to monetary policy. In fact, proponents of inflation targeting have made the claim that inflation targeting promotes financial market stability due to transparency, clarity and credibility (Bernanke, 1999; Freedman, 2001; Dodge, 2002); however, analysis has focused on estimating market participants' expectations of inflation by using surveys or measuring the spread between long-term Government of Canada bonds and real return bonds (Johnson 1997; Perrier and Amano, 2000). This study looks specifically at the stock market and analyzes the accuracy of investors' expectations of monetary policy actions.

To estimate the accuracy of stock market participants' forecasts of monetary policy actions, use is made of the efficient market hypothesis. Under the fair game model of the efficient market hypothesis, stock prices at any given time reflect all available information, so that only new information moves stock prices. In other words, if information was available that made it seem highly likely the Central Bank will change the key policy rate in the future, investors' will adjust prices at that time. If investors did

not adjust prices, then an individual investor could take advantage of the scenario and earn economic rent, which is a violation of the efficient market hypothesis. Stock prices should only move on the date of a key policy rate change if it was unanticipated. Testing for an announcement effect is a method of testing whether announcements were accurately anticipated by stock market participants. This study will use a model similar to the models used by Waud (1970) and Jones, Lih and Masih (2005) to analyze the announcement effect in the Canadian stock market due to key policy rate announcements and determine whether there is evidence of a downward trend.

It is hypothesized that a downward trend in the announcement effect will be found over the sample period, which I will argue is evidence that inflation targeting has increased the accuracy of investors' expectations of monetary policy actions and thus reduced the volatility in the Canadian stock market due to monetary policy.

Purpose

As stated in the Bank of Canada Act, the key role of Canada's central bank is to, "promote the economic and financial welfare of Canada" (Bank of Canada, 2006a). Setting a key policy rate is used as a tool by the Bank of Canada to achieve its monetary objective; however, the objective and goals of monetary policy in Canada have varied over time. Regardless of why the Central Bank chooses to change interest rates, its decision will affect business enterprises in the economy. Furthermore, equity markets are affected by the Central Bank's decision, since investors price assets based on firms' expected present value of future cash flows. For example, unexpected rate hikes raise firms' cost of capital, which can reduce growth and future cash inflows and increase the

rate at which investors discount future cash flows, leading to a sudden drop in equilibrium prices.

To promote financial welfare in Canada, the Central Bank should attempt to smooth shocks in financial markets. If rate changes are highly unexpected, sudden equity price changes will be greater, leading to uncertainty and risk in the equity market. Therefore, a goal of monetary policy should be to gain confidence from economic agents in the sense that there is reduced error in their expectations of rate changes. By increasing the accuracy of investors' expectations of both interest rate changes and the economic conditions that result from the Bank's actions, the Bank of Canada can reduce the volatility of the Canadian stock market that is due to monetary policy (since volatility is due to many factors such as international correlation and behavioural factors).

This paper examines whether or not the effect of interest rate announcements by the Bank of Canada on the Canadian stock market has changed over the course of inflation targeting policy. The results first and foremost require the presence of an "announcement effect", such as the one found by Waud (1970) where evidence was found to suggest that the U.S. stock market reacts to rate changes announced by the Federal Reserve. Using the efficient market hypothesis, I will argue that the size of the announcement effect can be used as a proxy to measure the error in investors' forecasts of the Central Bank's actions. I will argue that a large announcement effect signals that investors are highly inaccurate in their forecasts. Therefore, to support the claim that inflation targeting in Canada has reduced Canadian stock market volatility, a downward trend in the announcement effect should be apparent.

Depending on the empirical findings of this paper, the contribution will be towards policy making by the Central Bank. This paper will outline the theoretical framework of how inflation targeting can reduce stock market volatility—through transparency, clarity and credibility—and then apply an empirical test to determine if inflation targeting in practice exudes the required traits (transparency, clarity and credibility) to successfully reduce stock market volatility.

Background Research

Monetary Policy in Canada – The Central Bank and its Objectives

Certainly a powerful tool at the disposal of Canada's central bank, the Bank of Canada, is its ability to influence the economy's interest rates through changes to the key policy rate. Because interest rates are an integral part of financial asset valuation—since they affect the opportunity cost of investing (time value of money), firms' cost of capital and output demand (future cash flows), and exchange rates (foreign demand for investment)—it is not surprising that changes to the key policy rate by the Central Bank should impact financial markets. However, the key policy rate is still merely a tool for the Central Bank to achieve its long term goals and objectives. This opens the door to the possibility that the effect of changes to the key policy rate on financial markets depends in part on the objectives of the Central Bank. Put another way, perhaps the reason for the change to the key policy rate affects the degree of financial market volatility in response to that change. In the *Efficient Market Hypothesis* section of this paper, I will argue that low volatility in response to rate changes is in fact proof of the predictability of monetary

policy. Putting the argument together into a more clear context, the effect of a rate change should be different in an era when monetary policy objectives are ambiguous than one in which monetary policy objectives are clear and credible. The analysis presented in this paper will suggest that clear, transparent and credible policy should reduce volatility of financial markets. If I can prove this argument in this paper and given that the Central Bank's objectives are to reduce and stabilize inflation as well as other macroeconomic variables, then emphasis should be placed on creating a clear, transparent and credible monetary policy objective to reduce the overall volatility of financial markets.

Before moving on, a brief note should be given to the characteristics I use to analyze monetary policy—clarity, transparency and credibility. First of all, transparency refers to how well the public knows the details of the Bank's monetary policy objectives. Clarity on the other hand refers to how well the public can understand the objectives of the Central Bank. Even if the public knows the Bank's objectives, for example targeting a monetary aggregate, the public may not understand what that means. Finally, credibility simply refers to whether the public believes the objectives set forth by the Central Bank. For example, if the Bank tells the public the details of following an inflation targeting framework (transparency) and the public understands the framework (clarity), the public would still have to believe that the Bank's actions will follow that framework. With these characteristics defined, I will now proceed with my analysis of monetary policy.

The preamble to the *Bank of Canada Act* is a well-worded statement which describes the broad role of the Bank of Canada, much like a mission statement to any other company:

> Whereas it is desirable to establish a central bank in Canada to regulate credit and currency in the best interest of the economic life of the nation,

> to control and protect the external value of the national monetary unit and to mitigate by its influence fluctuations in the general level of production, trade, prices and employment, so far as may be possible within the scope of monetary action, and generally to promote the economic and financial welfare of the Dominion. (Taken from Crow, 2002, pg. 8).

While this statement has stood the test of time and provided the public and politicians with a clear purpose for maintaining a central bank—best summed up as "to promote the economic and financial welfare of the Dominion" (later changed to Canada){Crow, 2002, pg. 8}—it is still a rather broad statement giving flexibility to Central Bankers to determine more specific objectives given the current economic conditions, as well as opening the door to criticism and debate on a specific objective.

Previous Monetary Policy Objectives

Since its inception in the 1930s, the Bank of Canada has gone through various regimes of monetary policy, including maintaining a fixed exchange rate, targeting money growth (using M1 as the targeted monetary aggregate), price stability without stating an explicit target, and most recently inflation targeting (Crow, 2002). In 1974 inflation peaked at 11.7 percent,[1], there was a flat yield curve,[2] GDP year over year growth was historically high at 15.81 percent,[3] and the Canadian exchange rate was trading on average above par[4]. All of these are undesirable traits for an economy and the Central Bank attempted to control the situation with wage and price controls that were put in place to control inflation. However, wage and price controls are a short term

[1] Table 5, the number stated refers to core inflation which excludes most volatile components of the consumer price index.
[2] Table 6, flat yield curve is when there is little spread between long and short term bonds of similar credit quality, in this case long term Government of Canada marketable bonds and short term Treasury Bills.
[3] Table 7, historically referring to the period from 1970-2004.
[4] $1 CAN was worth more than $1 US. Source: Statistics Canada, CANSIM (E-STAT) database

solution and in 1975 the Central Bank decided to adopt explicit public targets for monetary expansion to stabilize the economy (Crow, 2002). However, from 1975-1982 core inflation still averaged 8.55 percent per year[5] and both short term and long term interest rates continued to increase, with some quarters where average short term rates exceeded average long term yields.[6]

It is debatable as to why explicit targeting of monetary aggregates was unsuccessful in Canada. A general hypothesis as to why numerical targeting of variables through monetary policy fails is that policy is conducted in far too flexible a manner (Fellner, 1982). Fellner (1982) supports the targeting of money aggregates, but suggests two important criteria:

> As concerns a targeted variable, as I will interpret this concept, there must be *a high degree of reluctance to change the rule frequently or to play the desired value mostly by ear, as we go along…*Second, it must be regarded as promising to achieve the target over periods of sufficiently short duration to guide current policy action—the policy routine—in such a way that a accumulation of deviations should be avoided. (Pg. 642)

Crow (2002) suggested a few reasons for the undesirable results from explicit targeting of monetary aggregates. First of all, given the definition of M1, the relationship between spending (demand) and M1 was changing, making it difficult to predict the effect on demand by M1 growth. Secondly, there appears a relationship that rapid inflation induces high interest rates. Aggregate supply shocks such as oil price increases of the 1970s were surprises to economic models of the time (Romer, 2005) and the inflation that resulted, according to the relationship described by Crow (2002), drove up interest rates. Finally, a relationship between spending (demand) and money growth exists according to Crow (2002, pg. 152), "only if the definition of money is allowed to swing around in a wide

[5] Table 5
[6] Table 6. This situation is called an inverted yield curve.

and unpredictable way." However, a lack of credibility in this form of monetary policy arises in either case. As argued by Fellner (1982), in order to implement successful targeting of monetary aggregates there must be a degree of credibility. Whether it was a lack of credibility to begin with that resulted in the undesirable results or whether they were due to the other factors suggested by Crow (2002), it would be difficult to attempt to regain the confidence of the public in order to successfully implement further targeting of monetary aggregates to support the best economic interests of the nation as expressed in the preamble to the *Bank of Canada Act.*

Consequently, in late 1987 and early 1988, the Central Bank decided to take a direct stance on controlling inflation through a policy of targeting price stability; however, this policy did not include an explicit target for inflation (Crow, 2002). The Central Bank was successful in its tightening policy and maintained high interest rates in the late 1980s[7] until the public got the message that they were going to continue to promote price stability (Crow, 2002). Inflation dropped from 5.01 percent in 1988, to 4.01 percent in 1989 and finally to 3.22 percent in 1990.[8] Fluctuations in spending were also brought under control as GDP year over year growth declined from 10.8 percent in 1987 to 1.82 percent in 1990.[9]

Explicit Inflation Targeting as an Objective

In 1991, the Bank of Canada in a joint announcement with the Federal Government of Canada announced the implementation of explicit inflation targeting as the primary objective of monetary policy in Canada. According to Bernanke (1999), there

[7] Table 6
[8] Table 5
[9] Table 7

are three primary reasons for an economy to target an explicit level of inflation. First, economists are not confident that monetary policy is effective at continually smoothing short run fluctuations. Second, maintaining low inflation is important if not crucial in order to achieve other economic goals (such as stable output growth, low and stable interest rates, low unemployment). Finally, inflation targeting brings credibility to the actions of a central bank. In the words of Bernanke (1999, pg. 10):

> That framework helps policy-makers to communicate their intentions to the public and to impose some degree of accountability and discipline on the central bank and on the government itself…an inflation target serves as a *nominal anchor* for monetary policy. In doing so, it provides a focus for the expectations of financial markets and the general public, as well as a reference point against which central bankers can judge the desirability of short-run policies.

This last reason is particularly interesting since this paper examines more directly the credibility of inflation targeting on financial markets.

From a broad standpoint, there is evidence to support the claim that inflation targeting has proven to be a success at maintaining a healthy economy in Canada since its inception. Inflation has averaged an annual rate of 2.02 percent from 1991-2004,[10] interest rates remain relatively low compared to the period from 1970-1991 and for the most part there has been a normal yield curve,[11] and fluctuations in annual GDP growth has been managed.[12] When the Central Bank introduced inflation targeting in 1991, credibility was not acknowledged as an important part of the framework; however, over time the importance of credibility became more apparent (Dodge, 2002). It is now believed that an important aspect of the inflation targeting framework is to ensure

[10] Table 5
[11] Figure 2. Normal yield curve means that short term bonds have a lower yield than long term bonds with the same credit rating.
[12] Figure 3

financial market participants along with the public have expectations in line with the actions of the Central Bank (Freedman, 2001). For the Central Bank to ensure that inflation targeting will be a successful form of monetary policy, it is important that the financial market participants have accurate expectations—this paper attempts to find whether there is proof that expectations of stock market participants have fallen in line with the actions of the Central Bank.

More than simply allowing the Central Bank to achieve low inflation and other broad macroeconomic goals, ensuring that financial market participants have accurate expectations of policy actions reduces volatility in financial markets, including volatility arising from re-valuation of markets in response to the direction of monetary policy actions (Freedman, 2001). Previous research that has studied credibility used inflation forecasts from surveys, as well as the spread between long-term Government of Canada bonds and Real Return Bonds as proxies to measure credibility (Johnson, 1997; Perrier and Amano, 2000). However, this study focuses on the credibility of monetary policy on the Canadian stock market and uses the theory of efficient markets to show that the degree of market movement following an interest rate announcement by the Central Bank provides evidence of the accuracy of expectations of stock market participants of the Central Bank's policy actions and thus provides insight to the credibility of the Central Bank's policy. A similar approach has been used by Bell (2005) to analyze the credibility of the Monetary Policy Committee's (MPC) actions due to their policy of inflation targeting; however, Bell (2005) also used a survey as well as movements in sterling three-month implied forward rates, not the stock market.

Valuation of Equity

Although there are various valuation models available to investors, the general concept behind these models is actually a simple application of the opportunity cost of deferring income from one period to another (time value of money). To value each stock in the market, participants attempt to find the intrinsic value of that stock, which is the present value of future cash flows (Bodie, 2005). The stock market, like other economic marketplaces, brings buyers and sellers together to maintain an equilibrium price. In a way, this price could be interpreted as the consensus intrinsic value of the stock; although, some market participants trade on technical analysis or other non-fundamental basis (Bodie, 20005). What complicates valuation of equity is determining the two components of the basic definition: determining expected future cash-flows and the appropriate discount rate. Furthermore, international trade has brought foreign investors to the domestic market and they must include their expectations of future exchange rates in their analysis.

In a world of certainty, a discounted cash flow analysis would provide the intrinsic value of equity to an investor:

(Equation 1) $V_t = \sum_{n=t}^{n=\infty} \frac{CFE_n}{(1+k_n)^n}$ (Damodaran, 2005)

where V_t is the value of a share at time t, CFE_n is the cash flow allotted to one share in period n, and k_n is an investors required discount rate in period n. Of course uncertainty is present in reality and market participants must make expectations of future cash flows and of future discount rates given all information currently available (this is discussed further in the *Efficient Market Hypothesis*).

When the Central Bank makes a decision on the key policy rate it affects investors' expectations in both direct and indirect ways. Since changes in the key policy rate influence the movements of other interest rates in the economy,[13] the interest rate offered on loans to firms is affected by the change. As can be seen when analyzing firm investment models, a higher interest rate reduces a firm's desired capital stock (Romer, 2005). This reduction in investment and future capital reduces the future cash the firm could have generated from the forgone investment. The indirect effect of key policy rate changes by the Central Bank deals with how the change in the key policy rate affects expectations for other macroeconomic variables that affect future cash flows. For example, more than moderate inflation is believed to affect the profitability of businesses (Campbell and Vuolteenaho, 2004). Another important variable is the expected future exchange rate. The interest rate parity theorem indicates that a change in the risk-free rate of a country will cause a change in exchange rates (Bodie, 2005). Therefore, a change in interest rates or expected future interest rates will cause foreign investors to revaluate equity.

Equity interest rates (previously referred to as required discount rate in equation 1) are also sensitive in various ways to the Central Bank's actions regarding the key policy rate. There are three components of nominal equity interest rates—the risk-free interest rate, inflation premium, and the equity risk premium (Bodie, 2005). A change in the key policy rate has a direct and indirect impact on equity interest rates. In a direct sense, the change in the key policy rate affects the risk-free rate of return, often measured by Treasury Bills (Bodie, 2005). Indirectly, any changes to the expectation of future inflation will impact the inflation premium, while changes to expectations of other

[13] Figure 2

economic variables may affect the equity risk premium (for example, if investors feel the Central Bank's actions indicate a possible recession they may feel the risk of a firm going out of business is higher).

Putting the analysis together, the role of credibility and transparency in maintaining equity price stability begin to emerge, as was claimed by Bernanke (1999) and Freedman (2001). The role of expectations and the market's reaction to new information will be discussed further in the section entitled *The Efficient Market Hypothesis*. For now, it is sufficient to point out that since both future cash flows and future interest rates are based on investors' expectations, the higher the accuracy of investors' expectations, the less they have to adjust their valuations as events unfold. If the monetary policy objectives are clear and transparent, investors will more accurately forecast future interest rates so that they do not have to make substantial changes to their valuation due to the change in future cash flows based on the investment level at the new interest rate and the change in the discount factor due to the new risk-free rate. As previously mentioned, expected future cash flows and the expected future risk premium and inflation premium rely on expectations of output growth, inflation, exchange rate, trade and other macroeconomic variables. Transparent monetary policy reduces changes in expectations, since investors have a better understanding as to whether a rate change is due to a change in the Central Bank's expectations of a particular variable. For example, in 1962 the Bank of Canada's objective was to maintain a fixed exchange rate (Crow, 2002). With such a transparent policy, investors should not misinterpret a key policy rate change as an indication that the Central Bank expects inflation to increase and thus change their valuation accordingly. However, under a policy with less transparent

objectives, an investor might misinterpret a rate change to lower inflation as the Central Bank's expectation that future output growth will increase. Furthermore, credibility can also increase the accuracy of investors' expectations. Freedman (2001) believes that inflation targeting in Canada is a clear and transparent objective. Under this assumption, if the Central Bank changes its key policy rate, investors should be accurate in interpreting this as a signal by the Central Bank that they have a certain expectation of future inflation (although Bernanke {1999} explains that maintaining an operating band as well as having a long-term goal allows the Bank of Canada to use monetary policy in the short run to affect other economic variables). Despite the accuracy in understanding the intentions of the Central Bank, if the policy is not credible, investors will be unsure as to how to form their expectations on the targeted variable in response to the Central Bank's actions.

Under the assumption that stock market prices are the equilibrium of investors' valuations of equity based on expectations of future cash flows and future interest rates, analysis explains how transparency and credibility reduce volatility specifically in the stock market (as opposed to referring to the financial market as a whole, which was done in the analysis of inflation targeting by Bernanke {1999}, Freedman {2001}, and Dodge {2006}). Since the argument for reduced volatility is based on the expectations of stock market participants, it is important to know more about how expectations are formed and when they change. If there is a way to test the accuracy of stock market participants' expectations of the Central Bank's actions given a particular objective of monetary policy, then one could apply this theoretical link that has been made between accuracy of expectations and stock market volatility to determine if a particular policy objective is

successful in reducing market volatility—such as this paper which is primarily concerned with whether inflation targeting reduces stock market volatility. The next section, *The Efficient Market Hypothesis*, will discuss how prices reflect expectations and how testing for an "announcement effect" gives insight to the accuracy of investors' expectations.

Efficient Market Hypothesis

This paper has so far reviewed the claim by proponents of inflation targeting that one benefit from this form of monetary policy is the increased stability it provides financial markets. Tests of credibility in Canada have tested whether inflation expectations are accurate using as a measurement tool either forecast surveys or spreads between Government of Canada long-term bonds and Real Return bonds (Johnson, 1997; Perrier and Amano, 2000). However, I also argued in this paper that clear and transparent policy leads to accurate expectations of the actions of the policy—the setting of interest rates—as well as expectations on inflation, output growth and other macroeconomic variables. Then, I explained that valuation of equity is based on expectations of future cash flows and future discount rates, which in part depend on expectations of interest rates, inflation, output and other economic conditions attached to the Central Bank's actions. Therefore, the less often expectations change and the less the magnitude of the expectation changes of those variables, the less valuation of equity changes, which produces a more stable stock market. It is under this argument that this paper attempts to test whether inflation targeting does help stabilize the stock market (as opposed to defining the more broad financial market). This section of the paper focuses on

evaluating price setting behaviour and price movements using a backbone theory of finance, the efficient market hypothesis.

The efficient market hypothesis has become a cornerstone theory in understanding price movements in equity markets. As Fama (1970, pg. 383) puts it, an efficient market is one in which "prices fully reflect all available information." An important model within the efficient market hypothesis is the Fair Game model:

$$\text{(Equation 2)} \quad E(\tilde{p}_{j,t+1} \mid \Phi_t) = [1 + E(\tilde{r}_{j,t+1} \mid \Phi_t)]p_{jt}$$

where $p_{j,t+1}$ is the price of security j at time t+1, p_{jt} is the price of security j at time t, $r_{j,t+1}$ is the period percentage return: $(p_{j,t+1} - p_{jt})/p_{jt}$, the tildes represent random variables, the E is the expectations operator and finally Φ_t represents the information set available to investors at time t.

Two important implications of the Fair Game model, according to Fama (1970), are that the role of the stock market can be expressed as finding the equilibrium return among agents and that the information set is fully utilized to give an unbiased property to expected returns. In other words, let z represent economic rent:

$$\text{(Equation 3)} \quad \begin{aligned} z_{j,t+1} &= r_{j,t+1} - E(\tilde{r}_{j,t+1} \mid \Phi_t) \\ E(z_{j,t+1} \mid \Phi_t) &= 0 \end{aligned}$$

What is implied by equation 3 is that an efficient market is a fair game, since—given the available information set—investors cannot expect to earn economic rent. Furthermore, an important implication for this study is that all available information that can form expectations to determine the price (or alternatively the return) of a security at any point in time is included in determining the appropriate price, otherwise investors could earn economic rent. Therefore, the price of equity at a point in time before the Central Bank

makes a key policy rate announcement includes investors' expectations about what action the Central Bank will take given information available at that time. At the time of the key policy rate announcement, prices will only change if investors were wrong in their expectations or the press announcement attached with the rate change creates a change in expectations for future rate changes or economic variables. From the fair game model, it can be seen how the accuracy of investors' expectations can be tested by determining whether equity prices change when the announcement is made. The efficient market hypothesis is important for this paper, since it provides the insight necessary to develop a model to test the accuracy of expectations in order to test the hypothesis that the practice of inflation targeting has reduced stock market volatility.

In addition to the Fair Game model, the efficient market hypothesis includes the Submartingale model and the Random Walk model. The details of those models are useful in specific tests of the efficient market hypothesis, but less important in developing the theory for this study. Potential sources of inefficiency in the equity market are transaction costs, information that is not freely available to all investors and disagreement among investors about the implications of given information (Fama, 1970).

The efficient market hypothesis is analyzed at three levels: weak-form efficiency, semi-strong form efficiency, strong form efficiency. Weak form efficiency was the first form of testing of the efficient market hypothesis and deals with whether information to do with past price history is fully utilized in the information sub-set. Fama (1970) reviews popular tests of weak-form efficiency and the consensus agreement is that past price information is not relevant for future price movements and thus do not belong in the information sub-set. However, in the few cases where potential return through utilizing

past information was found useful in generating an excess return (economic rent), either small transaction costs were enough to offset gains or the information required was monopolized by the market maker (the agent who manages the book of buy and sell orders). Semi-strong form efficiency tests whether publicly available information is fully reflected in current prices. This is the area of research where announcement effect studies such as this study are categorized. The section *Announcement Effects on the Stock Market* will discuss more research in this area. Finally, strong form efficiency looks at the issue of information that is not freely available to the public. In particular, the question of whether market makers have access to monopolized information about buy and sell orders or whether corporate insiders utilize knowledge of future actions of the firm. With regards to this study, testing for strong form efficiency would be interested in whether or not insiders at the Bank of Canada use their knowledge of interest rate announcements to make a profit; however, this study will focus first and foremost on testing the semi-strong form efficiency and leave the issue of insiders for future research on this topic.

This paper will then test for an announcement effect resulting from Bank of Canada key policy rate announcements. Under the fair game model of the efficient market hypothesis, all available information is used to form expectations and is included in the price of the market before the announcement, otherwise there would be economic rent. If the objectives of the Central Bank are clear, transparent and credible, the Central Bank's announcement should come as little surprise—since data on inflation, unemployment, output and other economic variables the Central Bank may use is publicly available—and prices should not change in response to the announcement. Large announcement effects would then provide evidence that the Central Bank's actions are

very unclear or not credible or both, since investors cannot make accurate expectations beforehand given the publicly available information. Similarly, a low or non-existent announcement effect would provide evidence that the Central Bank's actions are clear, transparent and credible, since investors are able to generate highly accurate expectations as to the Bank of Canada's actions beforehand, given the publicly available information.

Announcement Effects on the Stock Market

As reviewed by Fama (1970), early work on announcement effects provided analysis at the micro level, often looking at the effect on a specific firm due to an announcement such as a stock split. However, analysis on the macro level was first conducted by Waud (1970), who looked at an "announcement effect" on the S&P 500 due to discount rate (interest rate) changes by the Federal Reserve. His empirical model was:

$$\text{(Equation 4)}\ \ln p_t - \ln p_{t-1} = \alpha + \beta(\ln p_{t-1} - \ln p_{t-2}) + \ln \varepsilon_t$$

where $\ln p_t$ is the natural log of prices at time t, $\ln p_{t-1}$ is the natural log of prices at time t-1, $\ln \varepsilon_t$ is the error term, α and β are the parameters of the model.

Estimates were obtained for dates excluding those surrounding the Federal Reserve's rate announcement. Then, the following statistic was calculated:

$$\text{(Equation 5)}\ u_m = \frac{\sum_{j=1}^{m} \hat{\varepsilon}_{jm}}{n}$$

where m represents the days before or after an announcement effect (negative if before an announcement effect, positive if after), j is an announcement, n is the total number of announcements and $\acute{\varepsilon}_{jm}$ is the estimated residual based on the previous models estimation.

Waud (1970) separated his announcements into rate increases and rate decreases and calculated a separate statistic (u_m). However, a separate notation was not given to distinguish the u_m statistic for rate increases from the u_m statistic for rate decreases, they were simply discussed in different sections of the paper; to remedy this, I will use $u_m(I)$ to refer to the rate increase statistic and $u_m(D)$ to refer to the rate decrease statistic. Therefore, $u_m(I)$ is the average residual of day m before or after an interest rate increase announcement by the Federal Reserve and $u_m(D)$ is the average residual of day m before or after an interest rate decrease announcement. Under ordinary least squares (OLS) estimators, the sum of all residuals will equal zero. The concept of Waud's (1970) model was to look just and the residuals during the 30 day period surrounding increase announcements and decrease announcements. The reason for looking and the days surrounding the announcement date rather than simply looking at the announcement date is a common practice in announcement effect studies; however, since efficient markets assume no monopolized information (the Central Bank does not leak out information to special parties) and given how quickly markets react to new data, the only important date in the statistic is the one for the announcement date. If $u_m(I)$ is statistically negative—recall that the sum of residuals for every day in the sample period equals zero; however $u_m(I)$ is the average residual just on rate increase announcement days—then this would suggest markets reacted to the interest rate announcement on the day of the announcement. The statistic for an increase should be negative, because the general effect of increased interest rates is to reduce future cash flows and increase the discount rate (see the section *Valuation of Equity* for more explanation). Similarly, the statistic for $u_m(D)$ was tested to determine if it was statistically positive, which would provide

evidence of an announcement effect. Waud (1970) used as his sample period June 2, 1952 to June 30, 1967 and found evidence of an announcement effect—there was increased market volatility attributable to the Federal Reserve's discount rate change announcement. During this sample period there were 25 discount rate changes, although in 9 cases the rate changes were not first announced at the New York Federal Reserve, so Waud (1970) had to decide whether to use the date of the first announcement or the New York Federal Reserve's announcement date. The efficient market hypothesis would suggest using the date of the first announcement, because that signals new information to investors; however, Waud (1970, pg. 242) argued that the New York Federal Reserve's "actions have a special bellwether significance even when they are a follower." The data supported the first hypothesis, which is consistent with the efficient market hypothesis.

More recently, Jones, Lin, and Masih (2005) examined the effect of a variety of macroeconomic announcements on the UK interest rate and equity markets. For the examination on the equity market, the authors used the FTSE 100 as the market and the sample period of December 1, 1998 to November 18, 1999 (just under one trading year, 243 observations) and used 9 macroeconomic announcements as explanatory (dummy) variables—retail sales, public sector borrowing rate, retail price index, producer price index, industrial production, unemployment, national statistics, UK monetary policy change and US monetary policy change. Their model was as follows:

$$\text{(Equation 6)} \quad \left|R_{tj} - \overline{R_j}\right| = \alpha_{0j} + \sum_{k=1}^{K} \alpha_{kj} D_{ktj} + e_{tj}$$

where R is returns measured as the log difference in prices, $\overline{R}$ is the average return, D is a dummy variable which takes the value of 1 if an announcement is made (0 otherwise), k is from 1 to 9 and represents which announcement the dummy variable measures, t is the

day and j is the interval, e is the stochastic error term and the alphas are the parameters. The use of time intervals is due to the belief that most of the volatility takes place within 5 minutes of the announcement as prices quickly adjust; therefore, the authors examine the five minute interval j immediately following the announcement. For example, if an announcement is made before trading begins, the interval j is 9:30 to 9:35, but if an announcement is made at noon, the interval j is 12:30-12:35.

There exist three noticeable differences between the model of Jones, Lih, and Masih (2005) and Waud (1970). First, dummy variables are used by Jones, Lih, and Masih (2005), but not by Waud (1970) although this difference is minor in the analysis of an announcement effect. If a dummy variable is included, the analysis is to determine if the parameter of the model is statistically different from zero. In Waud's (1970) model the analysis is to examine the behaviour of the residual on announcement days, since the expectation of the residual is assumed zero by OLS. Therefore, an announcement effect is observed if the residuals on announcement days are statistically non-zero. Second, Waud (1970) adds a variable that accounts for the movement (return) of the previous trading day prices in his model; however, the efficient market hypothesis suggests at its weak-form level that past price information has no bearing on future price movements (Fama, 1970). Third, the dependent variable used by Waud (1970) is the one day percentage change in prices, whereas the dependent variable used by Jones, Lih, and Masih (2005) is the absolute value of the difference between the one day percentage change in price and the average daily percentage change in price. This changes the interpretation of the parameters of the model. The α parameter in equation 4 can be interpreted as the average daily percentage change in prices (under the assumption that β should be insignificant

according to the efficient market hypothesis, which was actually the case when the model was tested by Waud {1970}). Note that since the absolute value is not used, this percentage change in prices, or daily return, has direction, meaning that the average can be positive or negative. However, in equation 6, α_{0j} is the standard deviation of returns during an interval j, on days where there are no announcements and $\alpha_{0j}+ \alpha_{kj}$ is the standard deviation of returns during an interval j, on days when an announcement k is made (Ederington and Lee, 1993).

As mentioned, Jones, Lih, and Masih (2005) also examined the effect of these announcements on interest rates through the use of the Short Sterling and Long Gilt and found in general the relationship between macroeconomic announcements and the equity market (FTSE 100) are more ambiguous than the relationship between macroeconomic announcements and interest rates. However, the foreign and domestic monetary policy (interest rate) change, producer price index and industrial production have significant announcement effects on the market. The relationship between industrial production and producer price index and the stock market has been identified by Chen, Roll, and Ross (1986) as significant macroeconomic variables used by investors in their information set to determine equilibrium price. Furthermore, Jones, Lih, and Masih (2005) justify the significance of the monetary policy announcements on the FTSE 100 due to cash flows and discount rates in valuation of equity—consistent with the arguments made in the *Valuation of Equity* section of this paper.

Both the previous studies examine the whether changes in domestic interest rates by the respective central banks generate news within the stock market. Bredin, Gavin, and O'Reilly (2005) look at how U.S. monetary policy announcements affect the Irish

stock market (ISEQ). Since Ireland is a small open economy, Bredin, Gavin and O'Reilly (2005) hypothesize that there should be a "spillover" of returns and volatility from large equity markets to smaller markets such as the ISEQ. To test whether U.S. announcements affect ISEQ, the model used was:

$$\text{(Equation 7)}\ ISEQ_{t+1} = \beta_0 + \beta_1 \Delta FFF_t + \beta_2 S\,\&\,P_t + u_{t+1}$$

where $ISEQ_{t+1}$ is the daily percentage price change with a 1 day lead to account for the different time zone, ΔFFF_t is the change in federal fund futures on day t and $S\&P_t$ is the percentage price change in the S&P 500 index on day t. Through definition and examination of the error term, Bredin, Gavin and O'Reilly (2005) determined that volatility was higher on U.S. announcement days then the day before and the day after the announcement.

There are some useful implications from the study of Bredin, Gavin and O'Reilly (2005). First, examining the volatility of the market on the announcement day in comparison with the days immediately surrounding the announcement day can give insight as to the news information content. This is due to a "calm before the storm" effect, where the price change is less volatile the day before the announcement since investors feel their expectations anticipate and have already priced the next day's news. Then, on the announcement day, investors are surprised and react to the news creating market volatility. Second, the hypothesis that the actions of a large open economy would affect the market of a small open economy is reasonable. Furthermore, the addition of a variable for the percentage price change of the S&P 500 is beneficial because of increasing global correlation between markets (Solnik, Boucrelle, Le Fur, 1996).

Although the studies by Waud (1970), Jones, Lih and Masih (2005) and Bredin, Gavin and O'Reilly (2005) all use different specific methodology in order to test for an announcement effect, they all offer practical insight into how to determine whether volatility on an announcement day is evidence of an announcement effect. Furthermore, evidence of an announcement effect was found by Waud (1970) in the U.S., evidence of an announcement effect in the U.K. was found by Jones, Lih and Masih (2005) and evidence of an announcement effect in Ireland due to U.S. announcements was found by Bredin, Gavin and O'Reilly (2005). This paper extends these studies by looking at whether the size of the announcement effect can trend in a direction over time to offer insight into the performance of a particular domestic monetary policy.

Standard Deviation of Daily Returns

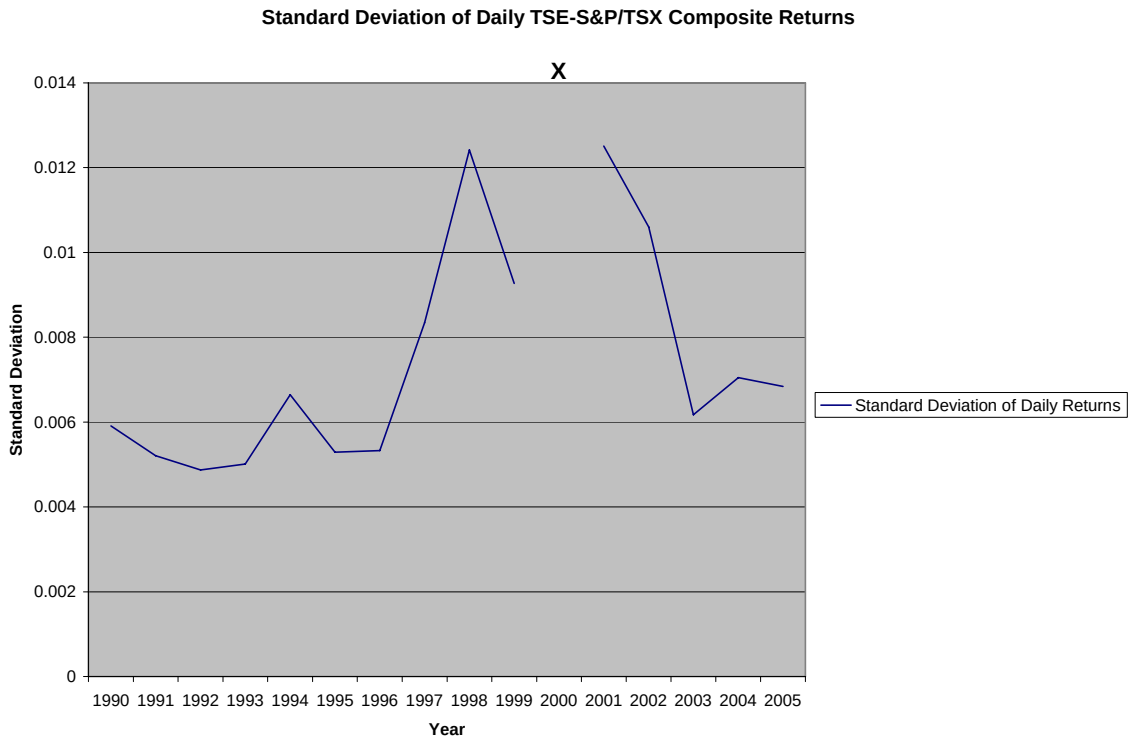
Perhaps the question that may have arisen to this point is why not simply analyze the standard deviation or variance of daily percentage price movements to determine if inflation targeting has reduced stock market volatility? Although this seems logical and direct, it does not specifically identify monetary policy's effect on volatility. If one were to look at the trend in volatility of the market since the inception of inflation targeting, the results would show no downward trend (Table 1, Figure 1). However, many other factors affect market volatility.

Table 1: Annual Standard Deviation of Canadian Stock Market Daily Price Returns

Year	St. Dev
1990	0.005911
1991	0.005207
1992	0.004869
1993	0.005008

1994	0.006646
1995	0.00529
1996	0.005328
1997	0.008345
1998	0.012414
1999	0.009271
2000	0.583616
2001	0.012506
2002	0.010599
2003	0.006175
2004	0.00705
2005	0.006842

Figure 1: Standard Deviation of Daily TSE-S&P/TSX Composite Returns



[14]

Stock prices are dependent on a variety of factors, including interest rates and economic data that result from interest rate announcements, but there are many others. Solnik, Boucrelle and Le Fur (1996) studied international equity and bond market

[14] Year 2000 standard deviation is far above the graph. This is notated with an "X" above the graph.

correlations and volatility and concluded that there exists a link between correlation and volatility, this finding was also discovered by Hassler (1999). Foreign market crashes or volatility due to foreign factors under this argument would make the stock market more volatile regardless of domestic policy. For example, on October 27, 1997 there was a global stock market crash that was due to an Asian economic scare (Zang, 1997). Looking at Table 1, 1997 had the highest annual standard deviation of daily percentage price returns, with the exception of 1999 and 2000.

Another issue is whether or not the theory that asset prices represent fundamental values, as assumed in this study, is reflected in reality. There are short periods of time where it is believed that asset prices deviate from their fundamental values and escalate—these periods are often described as bubbles. In the 1990s there existed a "dot.com" bubble which some believed began in 1995 with the Netscape Communications, Inc. initial public offering, others to Alan Greenspan's 1996 speech where he asked, "How do we know when irrational exuberance has unduly escalated asset values?" (taken from DeLong and Magin, 2006) but more analytical work has found that the bubble was actually in existence from around October 1998 and began to "burst" in March 2000 (DeLong and Magin, 2006). Volatility caused by this bubble in prices from the U.S. would spill-over to the Canadian markets according to the first argument that international correlation effects volatility. Furthermore, Canada experienced its share of the bubble, primarily due to Nortel, which surged in price in 1999 through 2000. Many professional investors have limits on the amount of a single company they can hold and struggled to maintain the pace of the TSE 300 due to Nortel's influence and asked for limits to be lifted so they could increase holdings of Nortel, or for the benchmark index to

become the TSE 299, by excluding Nortel (CBC News, 2000). These events may explain why 1999 and 2000 are the years with the highest annual standard deviation of daily stock market percentage returns (Table 1). Economists may struggle with the argument that irrational forces are used as an argument in this context, since economic agents are assumed rational. However, growing attention has been given to a field called Behavioural Finance, which attempts to understand cases such as the aforementioned without crying, "Irrational" but rather looking for how systematic psychological factors effect market behaviour (Olsen, 1998). In more cases than the bubble described above, Olsen (1998) believes behavioural finance describes a great deal of short-run volatility.

International correlation, market bubbles and behavioural finance as a whole are offered as examples of major impacts on the overall volatility of the stock market. Therefore, it is difficult to look at a statistic such as the standard deviation of the stock market and determine what an individual factor, such as monetary policy, has accomplished over a period of time. This is primarily why this study took the alternative route of identifying that monetary policy can do its part in reducing volatility by increasing the accuracy of investors' expectations of the variables it can control, which is tested through the announcement effect.

Hypothesis

This study examines whether or not there is evidence in the Canadian stock market to suggest inflation targeting is a clear, transparent and credible form of monetary policy. It was shown that clear, transparent and credible policy should increase the accuracy of investors' expectations of the Bank of Canada's actions and the economic

effects of those actions, which would reduce overall stock market volatility. The efficient market hypothesis suggests that testing for an announcement effect—which is whether markets react to interest rate announcements by the Bank of Canada, since only new information should move prices—will offer evidence of the accuracy of investors' expectations based on the existence and size of the announcement effect. Therefore, testing for the announcement effect during the inflation targeting regime in Canada and looking for a trend in the magnitude of the announcement effect will suggest whether or not inflation targeting increases the accuracy of investors' expectations due to its transparency and credibility and is therefore able to reduce overall stock market volatility.

There must first be evidence that an announcement effect does exist in Canada. Tests of the efficient market hypothesis at all three levels (weak, semi-strong and strong) support the theory that prices reflect all available information (Fama, 1970). Evidence of an announcement effect was found by Waud (1970), Jones, Lih and Masih (2005) and Bredin, Gavin and O'Reilly (2005) in the U.S. due to domestic announcements, the U.K. due to domestic announcements, and Ireland due to overseas (U.S.) announcements. Therefore, it is hypothesized that this study should find evidence of an announcement effect in Canada, since these aforementioned cases all conclude that there is news content within a central bank's interest rate announcements.

Furthermore, the magnitude of the announcement effect is hypothesized to trend downward over time due to the increasing transparency and credibility of monetary policy. It was previously mentioned in the *Abstract* and will be discussed further in the section *Sample Period Selection* that the sample range is from 1994-2006. I will stress

here that the reason the start date does not have to be the beginning of inflation targeting or a date before the implementation of inflation targeting is because this paper is testing for *increasing* transparency and credibility during the inflation targeting regime. This paper does not test for whether implementing inflation targeting caused an immediate impact on the market. The choice of 1994 was for a few reasons—most notably that the agreement between the Bank and the Government of Canada was extended in December 1993, which I believe acts as a signal that inflation targeting was well established by 1994. Johnson (1997) and Perrier and Amano (2000) both found financial market participants accuracy of inflation expectations has increased during the course of inflation targeting as measured by conducting a survey or analyzing the spread between Government of Canada long-term bonds and real return (inflation linked) bonds. This should suggest that the accuracy of expectations of key policy rate changes—the tool used to achieve inflation targeting as an objective—should also increase.

Finally, valuation of equity theory suggests that a stock is the sum of expected future cash flows divided by expected future discount rates (Equation 1). Since these expectations are largely dependent on expected key policy rates as well as expectations of variables affected by key policy rate changes, such as inflation, output growth and exchange rates, it is hypothesized that an increase in the accuracy of expectations of the Central Bank's actions will cause fewer changes to valuation and thus a more stable stock market.

Based on these arguments, it is hypothesized that an announcement effect will be found in the Canadian stock market, but that it will decline due to inflation targeting. This will offer evidence of the increasing accuracy of investors' expectations of the Central

Bank's actions which is evidence that the Bank's inflation targeting policy has reduced stock market volatility.

Research Methodology

Data Collection

For this study, daily price data for the Canadian stock market and data on interest rate announcements by the Bank of Canada are necessary. Since it is Canada's largest stock index, the Toronto Stock Exchange (TSE 300 prior to 2000 and renamed S&P/TSX Composite index in 2000, when the TSX Group Inc. made it a for-profit company) will be used to represent the Canadian stock market.

Data on key policy rate changes is collected from the Bank of Canada website, using the key interest rate lookup (Bank of Canada, 2006d). However, as will be explained in the section entitled *Sample Period Selection*, in December 2000 the Bank of Canada switched to fixed announcement dates. The data on which dates were announcement dates after December 2000 were collected from press releases issued by the Bank (Bank of Canada, 2006e).

TSE and S&P/TSX Composite index daily prices were collected from the CFMRC database (from June 1994 to December 2004) and from Yahoo! Finance (from December 2004 to May 2006). The CFMRC database is created by the TSX Group and made available through the Sprott computer labs at Carleton University. Yahoo! Finance is an online web-site with a historical price database that is publicly available (Yahoo! Canada Inc., 2006).

Sample Period Selection

Inflation targeting was first proposed in February, 1991 by the Finance Minister in the Government's budget (Crow, 2002). However, this study will examine the period from June 1994 to May 2006 because of the structure of the key policy rate. Historically, the key policy rate was the Bank Rate, but from March 1980 to February 1996 the Bank Rate floated at 25 basis points above the average yield on a 3-month treasury bill (Bank of Canada, 2006b). The difficulty in conducting this study during a period of a floating key policy rate is that investors have difficulty identifying which changes are key policy related. However, in June 1994 the Bank of Canada began to phase in the target for the overnight rate as the key policy instrument (Bank of Canada, 2006b). Then in February 1996, the Bank of Canada decided not to float the Bank Rate but to set it at the top of the overnight rate operating band (Bank of Canada, 2006b). In February 1999 the target for the overnight rate was defined as the mid-point of the operating band, making clear the link between the target for the overnight rate and the Bank Rate and finally in May 2001 the Bank of Canada formally identified the target for the overnight rate as the key policy instrument (Bank of Canada, 2006b). Furthermore, as has been previously mentioned, using 1994 is acceptable because the purpose of this study is to look for a decreasing trend in the announcement effect of a well-established policy. 1994 is a good candidate for when inflation targeting became a well-established policy, because in December 1993 the Government of Canada and the Bank of Canada extended the target agreement until 1998, signaling to the public the firm commitment to continuing this form of policy in the long-run in Canada.

These changes to the key policy rate are important points in identifying areas where the Central Bank's policy may increase in clarity and transparency and thus are

potential candidates for sub-periods to identify whether an announcement effect trends downwards as is hypothesized. From June 1994 to December 2000 the announcements studied are changes to the key policy rate at the time, which was the Bank Rate. After December 2000, the announcements are fixed announcements that may include the decision not to change the key policy rate. I believe that including all announcements is the best way to test the market's reaction to the Bank of Canada's actions, because announcements with no change can carry as much news content as an announcement with a change. For example, if investors expect no change and the Bank hikes rates, that would create a surprise and cause an announcement effect. Following this line of reasoning, if investors expect a rate hike and the Bank decides not to change rates on the announcement date, the public would still have to re-adjust their valuations due to this announcement.

The first sub-period will be from June 1994 to February 1996 and will look at the announcement effect of the Bank Rate. Although the phasing in of the target for the overnight rate had begun and should offer some insight as to which changes are key policy oriented and which are simply floating changes, it is expected that this policy will be the least transparent and clear. Next, the period from March 1996 to February 1999 is chosen since this is where the Bank Rate was fixed (set) as opposed to floating. Then, from March 1999 to November 2000 is the period where definition of the target for the overnight rate as the mid-point of the operating band makes a strong link between the Bank Rate and the target for the overnight rate; although, the Bank Rate is still the key policy rate, the dates at which they change are identical so either could be chosen. Finally, the period from December 2000 to May 2006 is where fixed announcement dates

were set to announce whether a change to the key policy rate will be made and if so what change.

To restate the sample period break down, there are four sub-periods chosen: June 1994 to February 1996, March 1996 to February 1999, March 1999 to November 2000, and December 2000 to May 2006. For the purposes of this paper, sub-periods are necessary to test the hypothesis that the announcement effect changes over time and trends downwards due to the increased transparency, clarity and credibility of inflation targeting. Rather than choosing random periods, choosing periods where the Central Bank modified the announcement was done to make the sub-periods more meaningful. In fact, these changes all impact the clarity and transparency of the method of achieving the monetary policy objective. When the Bank of Canada stopped floating the Bank Rate, they attempted to send a clearer indication of monetary policy intentions (Bank of Canada, 2006b). Furthermore, when the Bank issued a press release on October 20, 2000 entitled *A New System of Fixed Dates for Announcing Changes to the Bank Rate* it was stated that, "The new system will reduce the uncertainty in financial markets associated with not knowing exactly what day the Bank might announce a Bank Rate change, and it will permit market participants to prepare more fully for that possibility" (Bank of Canada, 2006e).

Model Selection

In the section *Announcement Effects on the Stock Market*, various models were discussed that previous researchers have used to test for an announcement effect. This study will use the following model:

$$\text{(Equation 8)} \quad \left|\ln p_t - \ln p_{t-1}\right| = \alpha + \beta D_t + \varepsilon_t$$

where ln p_t is the natural log of closing prices on day t[15], ln p_{t-1} is the natural log of closing prices on day t-1 (the difference between them is the one day percentage price change), D_t is a dummy variable which takes the value of 1 if an announcement is made on day t and 0 if no announcement is made on day t, α and β are the parameters of the model and ε_t is the stochastic error term.

This model was constructed taking into account the pros and cons of previous models which were used to test for an announcement effect—the model used by Waud (1970) and the model developed by Edderington and Lee (1993) to study intraday market volatility and used by Jones, Lih and Masih (2005) to test for an announcement effect. By choosing absolute value of the dependent variable used by Waud (1970) as opposed to the dependent variable in the Edderington and Lee (1993) model, the interpretation of the parameters become percentage price movement (absolute) rather than daily standard deviation.[16] However, the explanatory variable for the previous day's percentage price return used by Waud (1970) was not included since the efficient market hypothesis suggests that previous price data has no bearing on future price movements and the variable was also insignificant when tested by Waud (1970). Finally, a dummy variable was included to capture the announcement effect, which was the method conducted by Jones, Lih, and Masih (2005) rather than analysis of the residual which was conducted by Waud (1970) and Bredin, Gavin and O'Reilly (2005). This method is a simple, but still meaningful way of measuring the announcement effect.

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[15] Closing prices means the price level of the market at **4 p.m.** which is when the market officially closes.
[16] Waud's (1970) model did not use the absolute value so that the interpretation of the dependent variable was daily price return as opposed to daily price movement in equation 8. The Edderington and Lee (1993) model is interpreted as the standard deviation of the market.

This model (Equation 8) makes restrictive assumptions. It assumes that the magnitude in percentage price change should be the same for any non-announcement day with a random residual taking into account deviations from that average amount. To model daily percentage price changes would be extremely challenging due to the amount of factors that affect stock market movement. Kennedy (2003) explains that small and unsystematic factors can be included within the stochastic error term without committing specification error; however, omission of variables with a systematic influence is specification error. The nature of the specification error due to omission of variables with a systematic influence on the dependent variable is that "the nature of the economic relationship is not correctly specified" (Kennedy, 2003, pg. 3). Waud (1970) may have used the previous day percentage price movement for this reason (believing it has a systematic effect on the next day price movement), but as previously explained, this study does not believe there is a case for this relationship. In the model used by Jones, Lih and Masih (2005) they used many macroeconomic variable announcements (for example industrial production, output and inflation were found significant in determining equilibrium equity return by Chen, Roll and Ross {1986}); however, not all variables were found significant which lead to ambiguity in choosing appropriate variables. Theoretically, the mis-specification is probably because the efficient market hypothesis dictates that only surprise announcements should systematically affect the market price movements. It is difficult to distinguish which individual announcements are surprises and which are not; however, this study tests over a period of time whether aggregate announcements are surprises. In strong defense of the model in equation 8, however, is the fact that biased and inconsistent estimates of β only arise if a variable is omitted and

that variable is correlated with an explanatory variable, which in this model is just the announcement dates. As long as the estimates of β are unbiased and consistent, then I will be able to test my hypothesis.

Under the assumption made by this study that, with the exception of interest rate announcements, all other variables are part of numerous unsystematic influences and uncorrelated with the interest rate announcement dates, the model can be easily interpreted. The expected daily price movement for any non-announcement day is simply alpha:

(Equation 9) $E(|\ln p_t - \ln p_{t-1}| \mid D = 0) = \alpha$

Based on the ordinary least squares estimator, alpha will be the average of daily price percentage movement for non-announcement days. The expected daily price movement for any announcement day is alpha plus beta:

(Equation 10) $E(|\ln p_t - \ln p_{t-1}| \mid D = 1) = \alpha + \beta$

Similarly, due to the ordinary least squares estimator, alpha plus beta is the average daily price percentage movement for non-announcement days. Therefore, beta is the excess daily percentage price movement of announcement days over the daily percentage price movement of non-announcement days.

Analysis

After estimating the model, the results will be analyzed to test the hypothesis. Recall that the hypothesis is that during the course of inflation targeting, the accuracy of investors' expectations should increase, which will be reflected in a declining announcement effect. Within the framework of the model in equation 8:

$$H_0 : \frac{\beta_1}{\alpha_1} \geq \frac{\beta_2}{\alpha_2} \geq \frac{\beta_3}{\alpha_3} \geq \frac{\beta_4}{\alpha_4} \text{ with at least one strict inequality}$$
$$H_1 : otherwise$$

where 1,2,3,4 represents the parameter for the test period 1 through 4. Recall from the section *Sample Period Selection* that period 1 is June 1994 to February 1996, period 2 is March 1996 to February 1999, period 3 is March 1999 to November 2000 and period 4 is December 2000 to May 2006. In most research, the researcher states the null hypothesis in such a way that the researcher's study attempts to "reject" the null hypothesis. Since anything other than the null would not provide clear evidence as to a declining trend in the announcement effect, this is an unusual case where I am attempting to find enough evidence to "not reject" the null hypothesis.

By using the ratio of beta to alpha, the statistic determines the relative excess movement in percentage price changes rather than the absolute. For example, if the excess movement was 10 basis points in two separate periods but the average movement on non-announcement days was 100 basis points in the first and 10 basis points in the second, the magnitude of the announcement effect would by greater in the second. This also helps the analysis control for variations in volatility between sub-periods.

Also, the stipulation that there be at least one strict inequality is important. The time periods were chosen based on some change to the announcement type or structure; however, the purpose of this paper is to see a downward trend during the course of inflation targeting. The selection of time periods may make it so that two periods have an equal announcement effect, but at least one period should be lower than preceding periods, otherwise there would be no trend in the announcement effect over time, or an upward trend.

There is also the possibility that one inequality is reversed while the others are maintained. For example, if the announcement effect is less in period 3 than in period 1, and less in period 4 than in period 3, but larger in period 2 than in period 1. In this situation, it would be hard to determine whether the hypothesis that inflation targeting has increased the accuracy of investors' expectations over time can be proven.

Results

There was evidence of an announcement effect on the Canadian stock market; however, this announcement effect was only present in the first period (June 1994-February 1996) and the second period (March 1996-February 1999). Furthermore, the announcement effect appears statistically significant in the first period at a 0.05 level of significance, while it does not in the second period. Table 2 offers summary results of the estimation.

Table 2: Summary Estimation Results

Time Period	Alpha	Beta	Beta/Alpha
June 1994 - February 1996	0.37018 (20.61)*	0.27883 (5.768)*	0.7532
March 1996 - February 1999	0.63560 (25.42)*	0.10461 (0.6973)	0.1646
March 1999 - November 2000	0.94394 (21.07)*	-0.13674 (-0.4066)	-0.1449
December 2000 - May 2006	0.6687 (38.09)*	-0.06127 (-0.6418)	-0.0916

t-statistics in parenthesis
*statistically significant at the 0.05 level of significance

Before the model was tested, the data on returns was multiplied by 100 so that absolute returns were stated as a percent. The alpha estimate shown in Table 2 is

estimated average percentage movement of prices during non-announcement days. From June 1994-February 1996, prices moved on average approximately 0.37 percent, or in financial jargon they moved 37 basis points. Similarly, the beta estimate is the estimated average excess percentage movement of prices on announcement days. Using June 1994 – February 1996 as an example once more, prices moved on average 0.27883 percent (or 27.8 basis points) more on announcement days then on non-announcement days. The total expected price movement on an announcement day during the June 1994 – February 1996 period (alpha plus beta) was 0.649 percent or approximately 65 basis points. However, I chose to use relative as opposed to absolute excess movement as a proxy for the size of the announcement effect, which is shown in the column "beta/alpha". The number shown in the column "beta/alpha" is stated as a ratio, but can be converted to a percentage figure simply by multiplying the column by 100.

In period 1, the relative announcement effect was approximately 75 percent meaning that prices moved 75 percent more on an announcement day then they do on a non-announcement day. In period 2, the relative announcement effect was approximately 16.5 percent. Periods 3 and 4 actually were found to have a negative relative announcement effect; however, since there is no theory for this finding and since the figures are small and not statistically different from zero, it will be interpreted as no announcement effect with a value of zero. Using the following equation of a confidence interval:

$$\text{(Equation 11)} \quad \text{Point Estimate} \pm \text{(Critical Value)(Standard Error)}$$

the lowest value for beta in period 1 is 0.1993107 and the lowest value for alpha in period 1 is 0.340638 using a 0.10 level of significance. Therefore, the relative

announcement effect could be as low as 58.5 percent in period 1 at a 0.10 level of significance. Similarly, the highest value for beta is 0.35136 and the highest value for alpha is 0.676725 in period 2, so that at a 0.10 level of significance the relative announcement effect could be as high as 51.9 percent. Therefore, at a 0.10 level of significance, there is enough evidence to suggest that the null hypothesis in the *Analysis* section should not be rejected.

From these results, there is evidence to support the hypothesis that the announcement effect has declined during the course of inflation targeting. In fact, the evidence suggests that inflation targeting has diminished the announcement effect so that it is no longer apparent in the Canadian stock market from approximately March 1999 onwards.

Surprise Announcements

By declaring that the announcement effect has diminished in periods 3 and 4 does not attempt to claim investors' expectations are 100 percent accurate for every interest rate announcement during that time period. This empirical result looks at the aggregate announcement during a particular time period and what is found is that on the aggregate level, investors are highly accurate with their expectations from approximately March 1999 to May 2006.

The reader should be careful to understand that the Canadian stock market may have still fluctuated greatly after a particular announcement during the period from March 1999 to May 2006. This does not disprove my hypothesis that inflation targeting has increased the accuracy of investors' expectations of the Bank's actions. The model in

Equation 8 tests the announcement effect during a period and takes into account that individual case where market participants were surprised. However, from March 1999 to May 2006 market participants were so highly accurate that individual surprise announcements did not change the result that on a majority of announcement days the market did not react in a significant way to the announcement.

To use an example to illustrate the argument, suppose an investor could find out exactly what the Bank will do on an announcement day, but at a great risk to himself (he may receive some punishment). As an announcement day arrives he must decide whether to attempt to gain that insider information. A rational investor will not take the risk, because in the aggregate, markets do not react to the Bank's interest rate announcements after March 1999, so he would be gambling that this one time would be an exception where the announcement was a surprise. However, in period 1, an investor may be willing to take the risk, because there is evidence that the Canadian stock market reacts to Bank of Canada interest rate announcements, so the risk is more likely to pay off.

Limitations and Extensions

Those who have conducted empirical research on the stock market will appreciate the difficulties in creating an adequate model. Many factors affect price movements in both systematic and unsystematic manners, which make it extremely difficult to create a model with a high measure of goodness-of-fit. In order to test my hypothesis—that investors have increased the accuracy of their expectations of the Bank's monetary policy actions over the course of inflation targeting—I have attempted to create a model to give

an unbiased and consistent estimate of the relationship between the Bank's key policy rate changes and stock price movement. With that unbiased estimate, I was able to test my hypothesis and reach a conclusion.

In the section entitled *Model Selection* I mentioned a few considerations that were taken into account to ensure my model was appropriate. First of all, it has been mentioned already that both systematic and unsystematic factors affect price movements. An example of a systematic factor would be exchange rate changes and an example of an unsystematic factor would be a natural disaster. Kennedy (2003) explains that unsystematic factors can be included in the error term, while systematic factors should be included in the model, otherwise a form of specification error arises—the economic relationship is inaccurately specified. However, there are a such a large number of factors that have been identified as having a systematic relationship with stock market price movements and probably many which are still being discovered; therefore, it would be extremely difficult to generate a perfect model. Feldstein (taken from Kennedy, 2003, pg. 81) once wrote, "The applied econometrician, like the theorist, soon discovers from experience that a useful model is not one that is 'true' or 'realistic' but one that is parsimonious, plausible and informative." This was what I kept in mind when analyzing my model.

Even without including the systematic factors in the model, the estimates of β are still unbiased and consistent on the condition that none of the excluded factors are correlated with the explanatory variable, which is the date of the key policy rate change. This leads to an area of further research in this area. After the change to fixed announcement dates, the events which are likely to have a correlation with key policy

rate announcements (the dates are announced in the fall of the previous year) are scheduled announcements of economic statistics by Statistics Canada and press releases by the Bank of Canada. Both of those factors are likely to have an effect on the market. Statistics reports by Statistics Canada change investors' expectations of future economic conditions, which change expectations of firms' ability to generate future cash flows as well as expectations of discount rates, which depend in part on risk and inflation. It is also plausible that press releases by the Bank of Canada change investors' expectations of various economic conditions and thus change their valuations. Even if those announcements systematically affect stock market prices, they would only make my estimates biased if the announcement dates are correlated with key policy rate announcements, which is an area of future research.

Prior to fixed announcement dates, there are many more factors which may be correlated with the announcement dates. For example, the Bank could choose to change the key policy rate after an event, such as a poor earnings announcement by a company with a large market capitalization or the announcement of a corporate scandal, in order to stabilize the market.

Another consideration is whether the relationship between announcement dates and stock market movements is correctly specified, based on the magnitude of the announcements. First of all, the frequency of announcements has changed over the sample period. From 1994 to the end of 1996 there were many announcements and the size of those announcements fluctuated so that many were small rate changes and some were large (sometimes more than 1 percent). From 1997 to the end of 2000 there were very few announcements (between 3 and 5) and they fluctuated between 25 basis points

(a quarter of a percent) to 100 basis points (one percent). After fixed announcements were implemented, the frequency of announcements was eight per year, and the rate changes could be from 0 percent to 75 basis points. However, the magnitude between years has not changed as much as it would seem (even though individual announcements may fluctuate). The average key rate change varied from approximately 18 basis points in 1996 to approximately 33 basis points in 2000.

A valid argument some might make is that including announcements when the Bank announces no change to the key policy rate affects the results. An argument for this might be that before fixed announcement dates every day was an announcement date—a no change announcement. However, I would argue that switching to fixed announcement dates draws market participants' attention to the announcement, because they are given the date in advance by the Bank of Canada and have no excuse to be unprepared for a policy action on that date. In that sense, investors focus their analysis on that particular date and an announcement of no change carries news content, because it either confirms their belief that no change in the rate would occur, or that they were wrong. However, prior to fixed announcement dates, having no change to the key policy rate did not carry the same news content, because there was no guarantee that the rate would not change the next day. Because of this, I decided that including fixed announcements where no rate change was announced was appropriate in the model. To appeal to any readers who may disagree on this argument, I ran the model again not including the "no change" dates, and the results changed slightly, but reached the same conclusion.[17]

As for an area of future research, recall earlier I mentioned that the relationship between statistics announcements by Statistics Canada and press releases by the Bank of

[17] Refer to Table 4

Canada should be studied to determine if a correlation exists between those dates and the dates that the Bank announces key policy rate changes. Even if there is little or no correlation between those variables, I feel it is an area of study which can build on to the conclusions of this paper. If investors are not reacting as much to key policy rate announcements due to a more transparent and credible policy, then it is plausible that they may react more to statistics announcements that are well known to affect the Bank's decision to change rates than they did when the policy was less transparent and credible. Conducting a study in this area would further strengthen (or weaken) the conclusions drawn in this paper.

Finally, a cross-country comparison would provide a great deal of information on monetary policy's influence on stock markets. First of all, determining if a diminishing announcement effect is consistent across various countries that practice inflation targeting would strengthen the conclusion that this form of monetary policy brings investors' expectations in line with central banks' actions. It would also be interesting to see what differences exist, since the framework of inflation targeting varies from country to country. Secondly, analysis of countries who do not practice inflation targeting would strengthen the case for inflation targeting if their announcement effect trends upwards or remains steady, but would provide separate conclusions if it trends downwards.

Although this model is far from ideal, I am confident that it appropriately tests this paper's hypothesis by giving an unbiased estimate of beta. However, research on possible correlations between statistical announcements and the Bank's key policy rate announcements as well as correlations between other factors that impact the stock market

and key policy rate announcements could bring into question the conclusions of this paper.

Implications for the Central Bank

Inflation targeting has been in practice for 15 years in Canada at the time of writing this paper. During such a long regime of monetary policy, every benefit and cost of the policy should certainly be taken into consideration, as the Bank determines the future path to best optimize financial welfare. This study offers evidence of the benefit of inflation targeting to the Canadian stock market, which is reduced volatility due to the increased accuracy of expectations.

However, it is important to remember that this benefit will only be realized if the Bank maintains transparency and credibility. Inflation targeting was certainly an improvement over targeting money aggregates due to the increased clarity of the policy (Crow, 2002) and over price stability without an explicit target, which was unclear in the sense that price stability implied to some a zero percent inflation level (Crow, 2002). On the other hand, inflation targeting in Canada is a framework, with a target range, as opposed to a rule. Fellner (1982) argued that targeting variables can work as a policy only if the central bank follows a strict rule and fails to deviate from that rule. However, Bernanke (1999) counters that following a strict rule could lead to poor economic outcomes, since employment, production levels, exchange rates and other variables are clearly important to the well-being of the economy. Furthermore, Bernanke (1999) suggests that a policy which only focuses on inflation would receive little support from the public.

This study suggests that transparency and credibility are crucial to stock market stability; however, a strict rule approach is not necessary. The Central Bank may still follow a framework which allows the Bank to focus on other economic variables, if the Bank is clear in its communications to the public. Recently, the governor of the Bank of Canada, David Dodge, has taken action to ensure communications to the public are clear. Dodge (2002) has recognized how inflation targeting has impacted market expectations and the importance of this phenomenon. Although the Central Bank gave clear indication that it had no intensions to raise interest rates at their next announcement, following the May 24, 2006 announcement, investors became skeptical due to a surge in new jobs in May, strong retail sales and first quarter growth data and an increase in core inflation (Thorpe and Silcoff, 2006). However, David Dodge addressed the public making clear once more his intention to maintain the target for the overnight rate despite the new data, since it was the belief of the Central Bank that as much as 4 indicators in 1 month was not evidence of a trend (Thorpe and Silcoff, 2006; Thorpe, 2006). This example shows the level of communication the Central Bank provides to the public so that they can maintain the accuracy in their expectations while following a framework policy as opposed to a rule.

Finally, should the Bank choose a new objective for monetary policy, this paper reinforces the importance of transparency and credibility in all future developments of policy, for the sake of maintaining a stable stock market. The stock market has many other factors which generate volatility, such as global risks, behavioural factors, and business risks. Reducing the volatility due to uncertainty of monetary policy and economic variables affected by monetary policy is beneficial.

Conclusion

There was evidence in the data to suggest that the announcement effect in Canada has declined over time and actually diminished. While this does not mean every announcement is accurately anticipated by stock market participants, it does suggest that in the aggregate, announcements are much more highly anticipated now than they were earlier in the inflation targeting regime.

This evidence supports the hypothesis of a downward trend in the announcement effect over the course of inflation targeting. What was not hypothesized was the diminishing of the announcement effect, which is stronger evidence of the ability of inflation targeting to bring investors' expectations in line with the Bank's actions. Because investors' expectations of monetary policy actions have become more accurate, the Bank has succeeded in reducing stock market volatility due to monetary policy.

Although the Bank follows a framework as opposed to rule based approach to implementing inflation targeting, the announcement effect has still diminished. This offers evidence that the Bank can still follow the framework approach if they determine that it is beneficial in maximizing economic welfare; however, to continue to keep investors' expectations accurate, the Bank should communicate regularly and clearly its intensions.

Certainly 15 years is a long term for a policy regime. As the Bank of Canada makes decisions as to the future course of monetary policy, this analysis leads me to believe that continuing inflation targeting as the objective of monetary policy would be beneficial to the Canadian stock market.

Appendices

Table 4: Full Estimation Results (including standard errors)

June 1994 – February 1996
Sample: 419
R-Squared = 0.0737

```
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
```

```
   NAME    COEFFICIENT   ERROR     418 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
 D         0.27883    0.4834E-01    5.768     0.000 0.272     0.2715    0.0942
CONSTANT   0.37018    0.1796E-01    20.61     0.000 0.710     0.0000     0.9058
```

March 1996 – February 1999
Sample: 755
R-Squared = 0.0006

```
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR     754 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
 D         0.10461     0.1500       0.697     0.486 0.025     0.0254     0.0046
 CONSTANT  0.63560     0.2500E-01   25.42     0.000 0.679     0.0000     0.9954
```

March 1999 – November 2000
Sample: 338
R-Squared = 0.0005

```
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR     336 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
 D        -0.13674     0.3363     -0.4066     0.685-0.022    -0.0222    -0.0026
 CONSTANT  0.94394     0.4481E-01   21.07     0.000 0.754     0.0000     1.0026
```

December 2000 – May 2006 (Including no-change announcements)
Sample: 1331
R-Squared = 0.0003

```
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR    1329 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
 D        -0.61270E-01 0.9547E-01  -0.6418    0.521-0.018    -0.0176    -0.0031
 CONSTANT  0.66870     0.1755E-01   38.09     0.000 0.722     0.0000     1.0031
```

December 2000 – May 2006 (Excluding no-change announcements)
Sample: 1 1331
R-Squared = 0.0002

```
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR    1329 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
 D     -0.61126E-01    0.1149     -0.5322     0.595-0.015    -0.0147    -0.0021
 CONSTANT  0.65831     0.1708E-01   38.55     0.000 0.729     0.0000     1.0021
```

Table 5: Core and Total Annual Inflation in Canada, 1971-2004

Year	Core Inflation	All Items Inflation
1971	3.82%	4.84%
1972	5.11%	4.99%
1973	8.20%	8.95%
1974	11.74%	11.63%
1975	8.92%	9.03%

1976	5.70%	5.68%
1977	8.91%	9.05%
1978	9.24%	8.08%
1979	9.22%	9.31%
1980	9.50%	10.54%
1981	9.15%	11.50%
1982	7.80%	8.84%
1983	4.18%	4.50%
1984	3.60%	3.62%
1985	3.74%	4.28%
1986	5.73%	4.11%
1987	3.53%	4.07%
1988	5.01%	3.91%
1989	4.01%	5.09%
1990	3.22%	4.85%
1991	4.14%	3.72%
1992	2.40%	2.11%
1993	2.35%	1.67%
1994	1.63%	0.19%
1995	1.79%	1.74%
1996	2.13%	2.18%
1997	1.27%	0.75%
1998	1.35%	1.02%
1999	1.42%	2.54%
2000	1.74%	3.18%
2001	1.63%	0.69%
2002	2.68%	3.81%
2003	2.13%	1.97%
2004	1.69%	2.10%

Source: Statistics Canada
Collected from CANSIM (E-STAT) database
Measured as ln CPI_t - ln CPI_{t-1}

Table 6: Select Interest Rates in Canada, 1970-2004

Year	Bank Rate	Government of Canada long-term bonds: average yield	Government of Canada 3 month T-Bill auction: average yield	Target for the Overnight Rate

1970	7.13	7.91	5.99	0.00
1971	5.19	6.95	3.56	0.00
1972	4.75	7.23	3.56	0.00
1973	6.13	7.56	5.47	0.00
1974	8.50	8.90	7.82	0.00
1975	8.50	9.04	7.40	0.00
1976	9.29	9.18	8.87	0.00
1977	7.71	8.70	7.33	0.00
1978	8.98	9.27	8.68	0.00
1979	12.11	10.21	11.69	0.00
1980	13.08	12.49	12.79	0.00
1981	17.97	15.22	17.72	0.00
1982	13.91	14.26	13.66	0.00
1983	9.56	11.79	9.31	0.00
1984	11.31	12.75	11.06	0.00
1985	9.68	11.05	9.43	0.00
1986	9.22	9.52	8.97	0.00
1987	8.40	9.95	8.15	0.00
1988	9.73	10.23	9.48	0.00
1989	12.31	9.92	12.05	0.00
1990	13.06	10.85	12.81	0.00
1991	8.98	9.77	8.73	0.00
1992	6.84	8.77	6.58	1.14
1993	5.10	7.85	4.84	3.03
1994	5.79	8.63	5.54	3.15
1995	7.14	8.28	6.89	4.62
1996	4.53	7.51	4.21	2.86
1997	3.52	6.42	3.26	1.99
1998	5.10	5.47	4.73	3.18
1999	4.94	5.69	4.72	2.98
2000	5.77	5.89	5.49	3.51
2001	4.31	5.78	3.77	2.95
2002	2.71	5.66	2.59	1.75
2003	3.19	5.28	2.87	2.10
2004	2.50	5.08	2.22	1.61

Table 7: GDP Growth Year over Year

Year	End of Year Seasonally Adjusted GDP at Market Prices	Natural log of GDP	Year over Year GDP Growth
1970	91,840	11.4278032	
1971	103,036	11.5428337	11.50%

1972	115,488	11.6569219	11.41%
1973	138,260	11.8368912	18.00%
1974	161,940	11.9949812	15.81%
1975	182,924	12.116826	12.18%
1976	206,696	12.2390044	12.22%
1977	229,116	12.3419837	10.30%
1978	255,680	12.4516819	10.97%
1979	293,480	12.5895648	13.79%
1980	330,392	12.7080351	11.85%
1981	368,844	12.8181291	11.01%
1982	384,984	12.8609571	4.28%
1983	426,496	12.9633583	10.24%
1984	461,872	13.0430431	7.97%
1985	500,768	13.1238982	8.09%
1986	520,888	13.1632903	3.94%
1987	580,300	13.2713005	10.80%
1988	630,924	13.3549407	8.36%
1989	667,876	13.4118578	5.69%
1990	680,140	13.4300539	1.82%
1991	690,296	13.4448758	1.48%
1992	707,740	13.4698321	2.50%
1993	739,048	13.5131182	4.33%
1994	790,216	13.5800616	6.69%
1995	818,760	13.6155463	3.55%
1996	855,800	13.659792	4.42%
1997	898,248	13.7082015	4.84%
1998	928,824	13.7416745	3.35%
1999	1,014,480	13.8298867	8.82%
2000	1,102,676	13.9132505	8.34%
2001	1,098,204	13.9091867	-0.41%
2002	1,185,368	13.9855638	7.64%
2003	1,232,380	14.0244578	3.89%
2004	1,318,608	14.0920872	6.76%

Source: Statistics Canada

Figure 2: Various Canadian Interest Rates

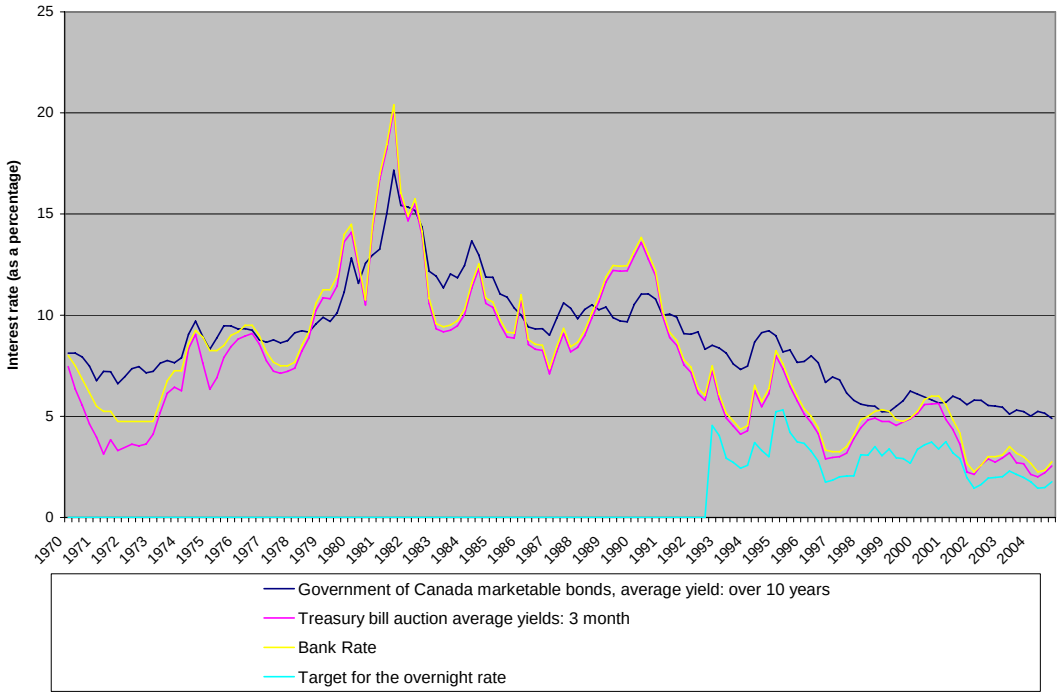


Figure 3: GDP Growth, Year over Year

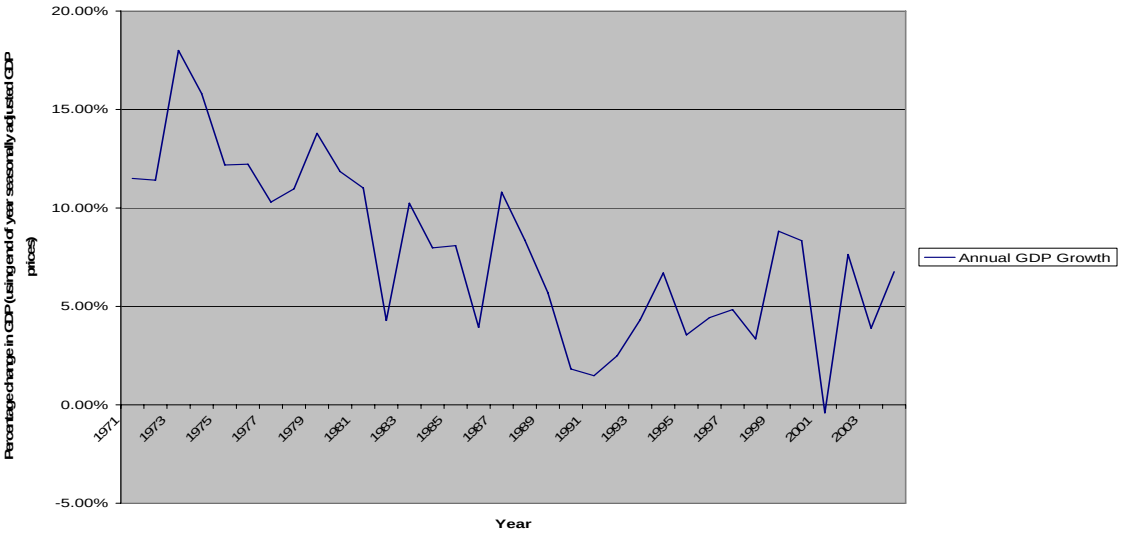
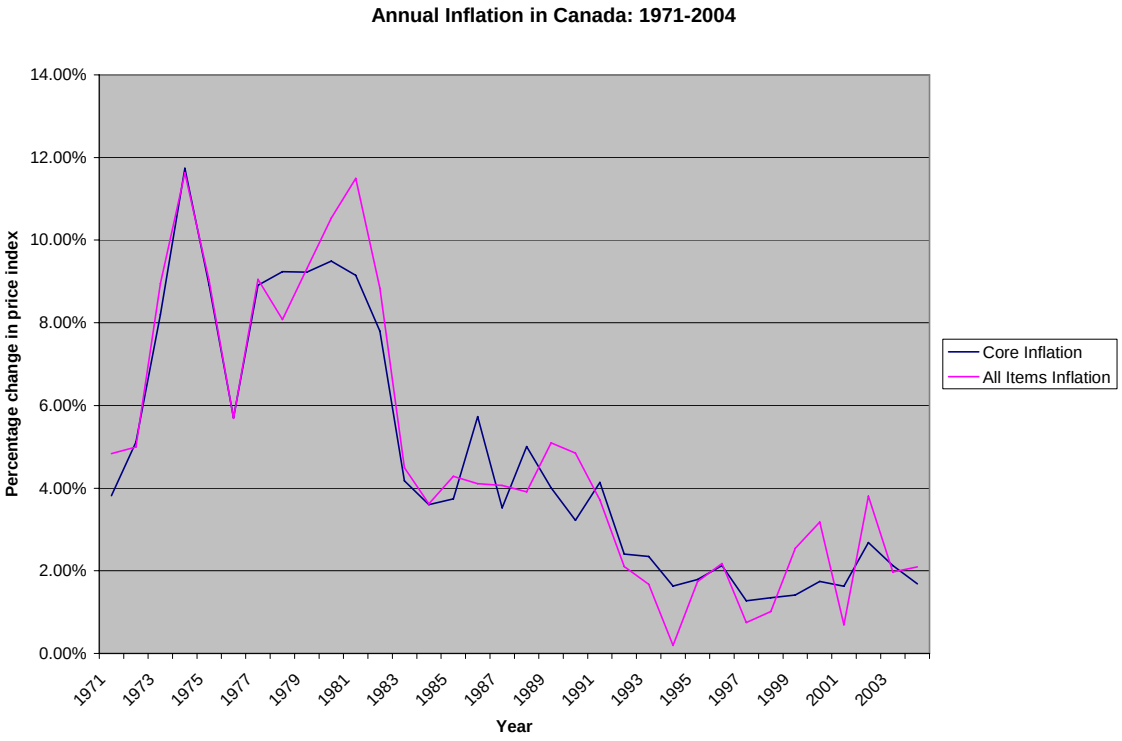


Figure 4: Annual Inflation, Core and Total



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