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The Unemployment Cost of Canada's Inflation Target: A Phillips Curve Analysis

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Abstract

This study attempts to analyze Canada's inflation target with a specific focus on determining the unemployment cost of their inflation target. It is hypothesized that Canada's move towards decreased inflation results in an unemployment cost that potentially outstrips the benefits associated with price stability.

The Unemployment Cost of Canada's Inflation Target: A Phillips Curve Analysis

Robbie Gallagher

I. INTRODUCTION

In February of 1988, Canada announced its radical new approach to monetary policy - the push towards zero inflation. Three years later, it became just the second nation worldwide to institute a formalized inflation-targeting regime (Meyer, 2000). Since New Zealand (1990) and Canada (1991) implemented inflation targets, the global landscape has transformed into a collage of nations instituting similar inflation targeting regimes. From Spain to Finland and from the United Kingdom to Australia, each nation seeks to curb what many dub the "demon" of macroeconomic policy.

In 1988, John Crow, the Governor of the Bank of Canada, sought to tame inflation in Canada. His goal was simple: push towards absolute price stability now and reap the long-run rewards of economic growth and welfare gains later (Johnson, 1997). Crow offered a three-stage argument in support of targeting goals for Canadian monetary policy. He contends that a push towards zero inflation will: equalize expected and actual inflation, thus improving economic performance, stabilize economic costs due to 'fragile' expectations, and smooth 'fragile' inflation expectations (Johnson, 1997). This study will focus on Crow's first assertion; that inflation targeting equalizes expected and actual inflation measures, thus improving economic

performance. More specifically, this paper aims to explore the effects of inflation targeting in Canada on unemployment by testing the validity of the expectations-augmented Phillips curve.

Keynesian macroeconomic theory asserts that decreased inflation results in increased unemployment in the short-run. On the contrary, adaptive expectations and rational expectations theorists contend that a stringent commitment to decreased inflation curbs expectations thus negating the potential increase in unemployment (Abel, 2001). Hence, the ability to build a credible inflation target results in long-run stability and an elimination of the Phillips curve inflation-unemployment tradeoff.

The prospect of increasing unemployment looms large for inflation-targeting regimes, such as Canada. If inflation targets cause unemployment to spiral upwards out of control, then perhaps these targets are not the means to tame inflation. Contrarily, if Canada can reach the long-run without suffering tremendous unemployment hikes, then perhaps inflation targets are the answer. This study attempts to analyze Canada's inflation target with a specific focus on determining the unemployment cost of their inflation target. I hypothesize that Canada's move towards decreased inflation results in an unemployment cost that potentially

"Since New Zealand (1990) and Canada (1991) implemented inflation targets, the global landscape has transformed into a collage of nations instituting similar inflation targeting regimes."

outstrips the benefits associated with price stability.

Section II explores previous research on inflation targets and credibility while Section III focuses on the Phillips curve, adaptive expectations theory, and the rational expectations theory. Section IV contains my formalized empirical model. Section V describes the data, Section VI offers results, and Section VII draws conclusions and investigates potential policy implications.

II. LITERATURE REVIEW

Two main bodies of literature dominate this research study. I first present the relevant literature on inflation targets followed by the relevant literature on announcement credibility.

A. Inflation Targets

Inflation targeting is a relatively new phenomenon stemming back to the late 1980s. Hence, much of the literature available is still in its infancy stage. Nonetheless, a significant amount of past work delves into inflation targets, either directly or indirectly. Svensson (1997) explores the optimal inflation target among conservative central banks while McMahon (2000) explores the consequences of inflation targets while maintaining a specific focus on developing countries seeking to initiate greater fiscal and monetary discipline. Of particular importance in this study, however, are the works of Alesina and Summers (1993), Cornwall and Cornwall (1998), and Fortin (2003). Much of the early literature focused on the connections between increased central bank independence and low inflation. Hence, these early studies provide the initial framework for determining the relationship between inflation targets and unemployment costs. Later studies, such as Fortin's, investigate, with specific regard to Canada, the effects that an inflation target may have. Significantly lacking from this body of literature, however, is an empirical analysis that focuses directly on the unemployment costs of imple-

“. . . as central bank dominance moves upward, inflation rates tend to trickle downward.”

menting an inflation target in Canada and the potential ramifications of such a policy.

Alesina and Summers (1993) pioneered the relevant literature researching the benefits associated with inflation targets. Specifically, Alesina and Summers offer insights into the correlations between central bank independence and the rates of unemployment, inflation, and real GDP growth. They employ scatter plot diagrams to depict these correlations. Essentially, Alesina and Summers show that central bank independence is negatively related to inflation rates within a nation. Hence, as central bank dominance moves upward, inflation rates tend to trickle downward. Furthermore, they demonstrate that greater central bank independence, and hence lower inflation, does not have any effect on the real variables within their model. This includes the unemployment rate along with real GDP growth. This suggests that greater central bank independence leads to greater credibility. Their model builds directly on the indices used by Grilli et al. (1991) and Cukierman et al. (1993), who all reach a similar conclusion; that real variable changes need not accompany disinflation.

Cornwall and Cornwall (1998), however, challenge the notion that greater central bank independence, and hence lower inflation rates, have no effect on real variables in the economy. They suggest that changing the nature of a central bank, in and of itself, does not lower inflation without cost. Furthermore, they contend that unemployment rates deviate in response to differences between actual and expected inflation rates.

Cornwall and Cornwall (1998) model the costs and benefits associated with central bank independence. To accomplish this, they employ an expectations-augmented Phillips curve to illustrate how greater central bank independence costs an economy in terms of unemployment. Ultimately, Cornwall and Cornwall conclude that a shift towards greater central bank independence, contrary to previous findings, results in greater unemployment. Thus, Cornwall and Cornwall indirectly find support for the notion

that inflation targets (movements towards disinflation) result in costs, namely in terms of unemployment.

Pierre Fortin (2003) takes the notion of central bank independence and extends it to Canada. Fortin argues using descriptive data that Canada's implementation of an inflation target is detrimental to the economy. Specifically, he asserts that the largely independent Bank of Canada instituted an inflation target without regard for the economic costs. Central bank independence reduces the policy adjustment time of an economy largely due to the ability of the bank to work as its own separate entity. Greater integration of banks and governments indicates a slower transition period, as coordination often becomes an issue. By laying out the Phillips curve framework, Fortin describes theoretically how inflation targets are likely to cause unemployment rates to swell inordinately high. However, this analysis is deficient in the respect that he ignores any empirical tests to measure the real magnitude of costs associated with inflation targets.

B. Credibility Issues

Numerous studies explore the effect of credibility on inflation target announcements, and hence the prospects for a long-run vertical Phillips curve relationship. Eliasson (2001) targets Australia, Sweden, and the United States in an attempt to determine whether it is appropriate to assume linearity in the short-run Phillips curve. Johnson (1990), on the other hand, analyzes the potential effects of inflation targets in Canada with a focus on the importance of attaining credibility. Similarly, Dodge (2002) focuses on the Canadian experience, but instead takes a backward looking approach to analyze the actual effects that establishing a credible anchor for inflation targets had in Canada. However, of particular importance to this study are the works of Koustas (1998) and Johnson (1997).

Koustas (1998) builds on the empirical model set forth by King and Watson (1992) to test the validity of three long-run propositions with specific regard to Canada. Theoretically, Koustas draws on the rational expectations theory developed by Lucas. In his study, Koustas explores the reasoning that per-

manent changes in nominal variables have no long-run effect on real variables. Specifically, he tests for long-run money neutrality, the vertical long-run Phillips curve, and the long-run Fisher relationship. His second empirical test is most relevant for this study. Drawing on data from Canada, Koustas constructs a bivariate vector to estimate his regression. He initially hypothesizes that the vertical long-run Phillips curve does not exist in Canada. His study finds support for this notion. Koustas' study provides a great deal of insight into the proposition that Canada has not yet reached the long-run where the Phillips relation disappears. However, the model seems somewhat deficient, as it does not concretely attack the expectations-augmented Phillips curve relationship. He uses a set of bivariate regressions to reach his conclusions. Theory suggests that the long-run Phillips curve is vertical resulting from expected inflation falling into line with actual inflation.

Johnson (1997), on the other hand, concentrates on the specific nature of three policy announcements in Canada to signal the implementation of inflation targets. He reasons that only credible policy announcements have any effect on expected inflation and hence the prospects for a long-run vertical Phillips curve. Thus, Johnson hypothesizes that credible announcements on inflation targets will put downward pressure on expected inflation. If the announcements follow other credible announcements, Johnson suggests that this magnifies the usefulness of the policy announcements, possibly to the point where expected inflation actually falls in line with actual inflation levels. To test this hypothesis, Johnson sets up a model where expected inflation serves as his dependent variable. He then includes inflation lagged, a recent forecast difference variable, a variable to capture the difference between U.S. and Canadian interest rates, the nominal bank rate over the past year, and a dummy variable to represent specific policy announcements. Johnson uses this last variable, the dummy variable, to estimate the effect that certain policy announcements had on expected inflation in Canada. His study provides support for the notion that the announcements in Canada decreased expected infla-

tion. This study will take Johnson's analysis one-step further. Johnson models expected inflation to flush out the relationship between announcements and expected inflation. This study uses a similar method to determine expected inflation, but places the Canadian experience into an expectations-augmented Phillips curve relationship in order to get at the unemployment effects of Canada's inflation target. Furthermore, this study looks solely at the initial policy announcement in Canada. I do this in order to determine the potential effect that Canada's initial policy announcement, a zero inflation target (i.e. absolute price stability), had on expectations.

III. THEORETICAL FRAMEWORK

As mentioned previously, this study will focus on John Crow's assertion that inflation targets equalize expected and actual inflation thus improving economic conditions (Johnson, 1997). Adaptive expectations and rational expectations aid in explaining the change in expected inflation over time and hence the proposition of the long-run expectations-augmented Phillips curve. However, the Phillips curve relationship, which I present first, gets at the short-run effects of the difference between expected inflation and actual inflation on unemployment.

A. Phillips Curve

Developed in 1958 by A.W. Phillips, the Phillips curve originally proposed an inverse relationship between the rate of wage inflation and the rate of unemployment in the United Kingdom between 1861 and 1957, as shown by Figure 1 (Hoover 2002). Two years later, in 1960, Paul Samuelson and Robert Solow replicated Phillips' study using data spanning 1900 to 1960 in the United States (Blanchard, 2003). With the exception of the turbulent depression era, Samuelson and Solow's results supported Phillips' in that a negative relation exists between unemployment and inflation. By the 1970s, however, this relationship seemingly broke apart thus leading to the development of the expectations-augmented curve, which accounts for expected inflation. Hence, the Phillips curve relation-

ship posits that inflation depends on expected inflation, cyclical unemployment, and supply shocks, as depicted below (Abel, 2001):

$$\pi = \pi^e - \alpha(v - v^n) + \varepsilon$$

where π equals inflation, π^e equals expected inflation, $v - v^n$ equals cyclical unemployment, and ε equals the error term, or more specifically, supply shocks that disrupt cycle behavior.

Based on the theories of adaptive expectations and rational expectations, which I present next, people form their expectations based on the recently observed past and, on average, are correct in their expectations. Expected inflation, in the Phillips curve relationship, assumes past levels of actual inflation determine present expected inflation. Hence, expected inflation in this model is a backward looking variable, which depends on the assumption of adaptive expectations. By similar reasoning, expected inflation, which depends on the credibility of announcements, is a forward-looking variable. Hence, expected inflation, for any given year, depends on both backward and forward-looking variables in conjunction with supply shocks, which serve to disrupt normal cycle behavior. The next part of the Phillips relation captures cyclical unemployment, or alternatively, the deviation of actual unemployment from the natural level of unemployment. The α represents a positive number that measures the strength of the relationship between unanticipated inflation and cyclical unemployment. Hence, as actual unemployment moves further from the natural level of unemployment, inflation trends downward. As unemployment, or the deviation of actual from the natural rate, increases, inflation decreases. Similarly, as inflation hikes upward, unemployment levels shrink.

B. Adaptive Expectations

The adaptive expectations theory stems from the notion that individuals develop forecasts of future inflation based on past actual levels of inflation rates, adjusted for their own past expectations. Essentially, adaptive expectations indicate that people base their expectations in the future based on what occurred in

the past. For example, this “backward looking” theory suggests that if inflation was high in the past, people would tend to believe it will be high in the future (Ruby, 2003).

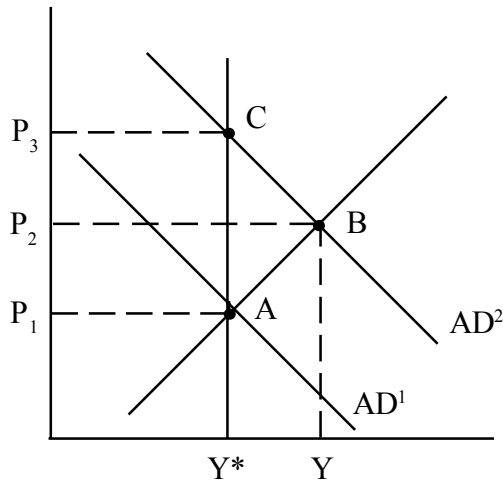
Adaptive expectations gained popularity in the 1980s, as a means to explain a significant amount of the crises that pervaded much of the world after the oil shocks of the 1970s (Adaptive, 2002). Following the oil shocks in the 1970s, many nations experienced sustained high levels of inflation. For some nations, this sustained inflation extended well into the 1990s. Adaptive expectations sought to explain these sustained levels of inflation solely on the basis of the past. The oil shocks in the 1970s caused inflation to spike upwards. The continued effect of these shocks created a situation where inflation levels remained high for some number of years. With continued high levels of inflation year after year, individuals within those nations began to expect high levels of inflation in the future. Adaptive expectations theorists contend that the best indication of the future is the past. Individuals in the 1970s, recognizing that past inflation levels were inordinately high, came to expect that future levels would be just as high (Adaptive, 2002). Hence, individuals adapt their expectations over time due to past indications about the economy (Abel, 2001).

As mentioned, adaptive expectations is particularly useful to explain one portion of expected inflation within the expectations-augmented Phillips curve. Based on adaptive expectations, expected inflation, or π^e , is a function of previous levels of inflation. Hence, π^e is appropriately written as π^e_{t-1} and π^e_{t-2} . Generally, adaptive expectations account for two periods, assuming that what the first lag fails to pick up, the second lag does. On occasion, expected inflation includes a third lag, most likely a lag of one year, in order to pick up what the other two lags fail to pick up. While actual inflation last year is the most accurate indicator for actual inflation this year, the inflation level from two years ago has some effect, though this effect diminishes the further back in time you go. Hence, an extremely low inflation level two years ago will serve to curb expectations for the future to some degree given that last year’s actual inflation level was significantly inflated.

C. Rational Expectations

Throughout the 1960s, several economists suggested that humans were able to adapt to their environment, and hence to economic conditions over time. Robert Lucas formalized this notion in 1972 (Ruby, 2003). Rational expectations, as Lucas coined it, essentially assumes that the beliefs of workers and firms are correct, on average. Developed as a response to apparent flaws in adaptive expectations theory, rational expectations seeks to explain how individuals, given constantly rising inflation, could come to rationally infer governmental policy (Rational, 2003). Essentially, “rational expectations” means that the expected price is chosen in such a way that, given shocks within the economy, sometimes the observed price is higher than the expected price and sometimes it is lower than the expected price. However, on average, people are correct in their expectations. Deviations from actual levels are possible, but as soon as this occurs, people’s expectations change to fall back in line. This suggests that beliefs depend on the course pursued by policy makers over time. In other words, the rational expectations theory predicts that people are forward-looking. According to the rational expectations theory, as soon as a government changes policy openly, people will change their expectations to offset any economic distortions, assuming, however, that the open policy announcements are credible. As Figure 1 demonstrates, rational expectations predict a shift from point A to point C under credible, open policy announcement scenarios. This represents the long-run Phillips curve, labeled line Y^* . Essentially, the shift from point A to point C indicates that the aggregate supply at Y^* is vertical, as it immediately shifts from point A to point C and theoretically skips point B. If people do not have rational expectations, then with a shift in aggregate demand to AD^2 equilibrium halts at point B in Figure 1, at least for some amount of time. If rational expectations do not exist, then the economy may rest at point B for some significant amount of time. Eventually, as time progressed, the economy would move from point B to point C, the new equilibrium.

FIGURE 1
Rational Expectations



Thus, according to rational expectations, if the government seeks to implement policy changes in order to affect the overall workings of the economy, the only way to accomplish this is through unanticipated alterations. Essentially, this indicates that a surprise policy is necessary to hurdle consumer expectations. However, according to the rational expectations theory put forth by Lucas, the government cannot surprise the general public. Public forecasts, on average, fall in line with actual policy guidelines. This explains how a nation, despite policy changes, can end up at the long-run Phillips curve.

IV. EMPIRICAL MODEL AND DATA

The empirical model utilizes two regressions: the first captures expected inflation based on both adaptive expectations and rational expectations while the second incorporates that measure of expected inflation into a Phillips curve relationship.

A. Expected Inflation

Based on adaptive expectations and rational expectations, expected inflation takes the following form:

$$\pi^e = \beta_1 + \beta_2\pi_{t-1} + \beta_3\pi_{t-2} + \beta_5\text{Announce} + \beta_6\text{US} + \epsilon$$

where π^e equals expected inflation, π_{t-1} equals actual inflation lagged one period, π_{t-2} equals actual inflation

lagged two periods, Announce is a dummy variable representing the initial policy announcement, and US represents a supply shock variable.

This equation indicates that expected inflation depends on certain adaptive expectations variables and a rational expectations variable, along with supply shocks. Each of the actual inflation lagged variables represents adaptive expectations variables, as they are backward looking components. The announcement dummy represents a rational expectation variable, as the effect of the policy announcement occurs in the future and hence, people adjust their expectations in a forward-looking manner. The supply shock variable attempts to account for any abnormal disruptions in the Canadian economy due to the United States economy.

As previously described, adaptive expectations contend that expected inflation is a function of past inflation levels. Several methods can adequately capture this. By far, the most simplistic way is to lag actual inflation one year. This indicates that expected inflation depends solely on the level of last year’s inflation. However, using one year as a proxy for expected inflation is insufficient because it completely ignores that inflation levels beyond one year ago have an impact on expectations. Hence, this model uses a two-year lag, assuming that two years is sufficient to capture the effect that past inflation levels have on current expectations. What the first lag variable fails to account for, the second lag should pick up. Based on theory, I hypothesize that each of the lagged variables carries a positive sign.

In accordance with rational expectations is the announcement variable, which aims to capture the effect that the initial announcement in Canada in February of 1988 had on expected inflation levels. Theoretically, as time goes on, the announcement becomes more credible or it completely loses credibility. In order to decipher between the policy effects and the sole effect of the announcement, I include a measure of supply shocks as a variable, which I explain later. The announcement dummy accounts for the singular effect of that particular announcement on expected inflation over time. If the

announcement carries no effect at all, this variable will be insignificant. Theoretically, announcing an intended policy aim will have some effect, possibly a large effect, on expectations. If, as is the case in Canada, the announcement declares an intended target of zero inflation, then expectations, on the sole basis of this policy announcement, may change. Given that the policy announcement is for zero inflation, I *hypothesize* that this variable carries a negative sign. If the announcement carries any weight at all, then naturally people are going to believe the central bank and hence lower their expectations of what inflation will be in the future.

As previously mentioned, I include a measure of supply shocks to capture the effect that actual policy changes might have on expected inflation. This variable incorporates the Canadian producer price, along with the United States' producer price index for all goods. The Canadian economy, no doubt, depends significantly on the United States economy to provide raw inputs, as well as other significant economic support. This leads to the assumption that the Canadian economy moves in conjunction with the United States' economy. Specifically, this variable attempts to capture supply shocks within the Canadian economy. In order to do this, I subtract the Canadian producer price index from the U.S. producer price index. I then subtract this figure from the Canadian exchange rate. Essentially, the difference between the United States' producer price index and Canadian producer price index indicates a discrepancy between prices. Since Canadian firms depend on the U.S. market to supply vast amounts of raw inputs for manufacturing and other industries, any difference between the two values indicates a potential supply-side shock for the Canadian economy. Furthermore, it is essential to compare this value with the exchange rate for Canada in order to account for any changes in the value of money caused by exchange rate fluctuations, which could amplify or decrease any differences found between the U.S. producer price index and the Canadian producer price index. If the percentage change in the exchange rate is equal to the difference between the percentage change in the

United States producer price index and the Canadian producer price index, then there are no supply shocks. The inclusion of this variable is essential to capture any supply shocks that might disrupt normal cycle behavior. Since Canadian firms depend on U.S. inputs, I believe this represents a good proxy to get at potential supply shocks within the economy and I hypothesize that it shares a positive relationship with expected inflation. Table 1 presents each variable, a short description of each, and their predicted signs.

B. Expectations-Augmented Phillips Curve

The Phillips curve postulates that inflation and unemployment share an inverse relationship represented as the following:

$$\pi - \pi^e = \alpha(v - v^n) + \varepsilon$$

where π equals inflation, π^e equals expected inflation, $v - v^n$ equals cyclical unemployment, and ε equals the error term, or more specifically, supply shocks that disrupt normal cycle behavior. By manipulating the above equation, I obtain regression number two. The following depicts the transformation:

- (1) $\pi - \pi^e = \alpha(v - v^n) + \varepsilon$
- (2) $\pi = \pi^e - \alpha(v - v^n) + \varepsilon$
- (3) $\pi + \alpha(v - v^n) = \pi^e + \varepsilon$
- (4) $\alpha(v - v^n) = \pi^e - \pi + \varepsilon$
- (5) $v - v^n = 1/\alpha (\pi^e - \pi) + \varepsilon/\alpha$
- (6) $v = 1/\alpha (\pi^e - \pi) + \varepsilon/\alpha$

Equation (6) assumes that the natural rate of unemployment is zero, in order to get at the effects that a deviation of expected inflation from actual inflation has on the unemployment rate. From equation (6), I formulate regression model 2 as follows:

$$v = \alpha_1 + \alpha_2(\pi^e - \pi) + \varepsilon$$

where v equals unemployment and $(\pi^e - \pi)$ equals expected inflation obtained from Model 1 minus actual inflation, and ε represents the error term.

This regression equation incorporates a measure of the difference between expected inflation and

TABLE 1
Variable Descriptions and Predicted Effects

Variable	Name	Description	Predicted Effect
π^e	Expected Inflation	Expected inflation as a function of the following variables.	
π_{t-1}	Actual Inflation One-Year Lag	CPI measure from one year ago.	+
π_{t-2}	Actual Inflation Two-Year Lag	CPI measure from two years ago.	+
Announce	Announcement Dummy	Before February 1988 = 0, After February 1988 = 1	-
US	Supply Shocks	Difference between U.S. and Canadian PPI, adjusted for exchange rate	+

NOTE: Predicted Effect predicts the effect of an increase in each variable on the dependant variable.

actual inflation, as obtained in Model 1. Assuming that I adequately account for supply shocks in Model 1, this model predicts that the difference between expected and actual inflation accounts for the variation in unemployment. If expected inflation falls in line with actual inflation, then we have the long-run Phillips relation. This model suggests one hypothesis: The difference between expected inflation and actual inflation carries a positive sign. As the devia-

tion between expected inflation and actual inflation shoots upwards, the unemployment rate increases. Essentially, the deviation between expected values of inflation and actual values of inflation is what drives the Phillips curve relationship in the short-run. The greater the difference between the two, the greater the unemployment costs. Table 2 presents the variables, variable descriptions, and predicted signs.

TABLE 2
Variable Descriptions and Predicted Effects

Variable	Name	Description	Predicted Effect
u	Unemployment Rate	Unemployment Rate (as a percentage)	
$(\pi^e - \pi)$	Inflation	Deviation between expected inflation and actual inflation	+

NOTE: Predicted Effect predicts the effect of an increase in each variable on the dependant variable.

V. DATA

The data used in these two models comes from Source OECD, an Internet database that houses economic statistics for nearly every nation around the world dating back to 1960. I use monthly data stemming from June 1973 to December 2002. I do this to provide an adequate balance of data both before and after the February 1988 zero inflation policy announcement in Canada. Source OECD provides all three variable sets including unemployment rates, CPI values, and PPI values. I convert the CPI values into inflation levels, as a percentage, by calculating the increase in CPI from year to year.

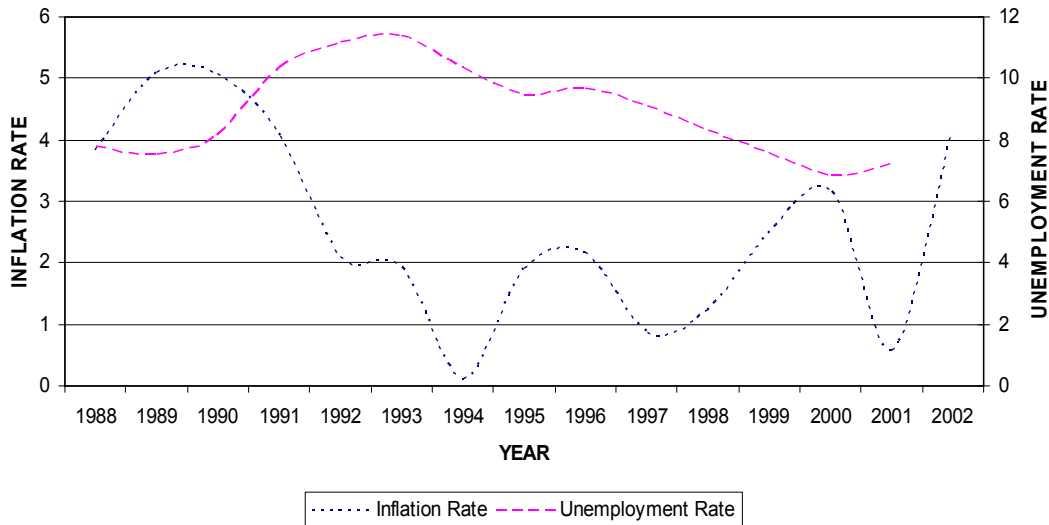
Throughout the post-announcement period, the Canadian inflation rate has fluctuated quite dramatically. Immediately following the announcement, inflation tailed upwards, which goes contrary to what theory suggests. However, I postulate that this occurred due to the uncertainty surrounding the inflation target at the time and due in large part to the fact that Canada did not actually institute their inflation target until 1991. Following 1991 and even for a short time before 1991, inflation rates trended downwards in Canada, which is in accord with what theory suggests. Furthermore, the unemployment rate within Canada spanning this period shows a relatively stable path of between 7 percent and 11 percent. Figure 2 depicts the relationship between the inflation rate and the unemployment rate in Canada, beginning in 1988. As Figure 2 clearly shows, inflation rates within Canada fluctuate quite drastically throughout the period, ranging anywhere from just over five percent in 1989 to nearly a zero inflation rate in 1994. Of particular importance to this study, however, are not the absolute values of the unemployment rate or the inflation rate, but rather the relationship between the two rates.

Following the initial announcement of a zero inflation target by Canada in February 1988, the country experienced a sharp increase in inflation that moved from roughly three and a half percent in 1988 to just over five percent in 1989. However, beginning in 1991, Canada's inflation rate began to steadily decline, eventually reaching a low in 1994 at just over zero percent inflation for the year. Following 1994,

the inflation rate picked up somewhat and currently hovers somewhere between one and four percent. These inflation trends are not surprising, however. Canada did not actually institute their inflation-targeting regime until 1991, which might explain the jump in inflation from 1988 until 1991. Following 1991, inflation rates declined and, on the whole, are considerably lower than in years prior to 1988. This suggests that the inflation target is working to curb inflation rates within the country. Unemployment rates in Canada follow a different pattern than inflation rates, but show an overall decline throughout the period. Specifically, immediately following the announcement in 1988, unemployment rates dipped slightly only to rise and peak at just over eleven percent in 1993. From 1993 on, unemployment rates show a constant decline, indicating that perhaps the credibility of Canada's announcement is creating a situation where expected inflation is slowly falling in line with actual inflation. In other words, this suggests increasing credibility over time.

Comparing these trends in inflation and unemployment, it is apparent that perhaps an unemployment-inflation tradeoff does exist in Canada following the initial announcement in 1988. From 1991 until 2002, inflation rates remained low, on the average, while unemployment rates remained relatively constant, with a slight decline from year to year, which suggests increasing credibility. Figure 2 clearly demonstrates that inflation targets quite possibly result in unemployment costs, as indicated by the jump in unemployment and the associated drop in inflation beginning in 1991. Furthermore, Figure 2 demonstrates the possibility that the Bank of Canada is slowly gaining credibility with their inflation target announcements. This suggests, as indicated by the expectations-augmented Phillips curve, that Canada is slowly reaching the long-run stage where expected inflation falls in line with actual inflation. If this is indeed the case, then the unemployment costs of Canada's inflation target are diminishing over time. This is essentially John Crow's long run utopia of price stability and minimal unemployment costs. Based solely on the trends in inflation and unemployment over time, however, it appears as though

FIGURE 2
Post-Announcement Trends



the inflation target set forth by John Crow created significant unemployment costs initially, as unemployment rates shot up from nearly seven percent to just over eleven percent. My empirical analysis supports this notion.

VI. RESULTS

Both models use ordinary least squares (OLS). I first present results for Model 1, the expected inflation model. Subsequently, I present results for Model 2, which aims to test the validity of the expectations-augmented Phillips curve with respect to Canada.

A. Expected Inflation

As mentioned, I use OLS to approximate the empirical model. I present the results of Model 1 in Table 3.

Model 1 incorporates two adaptive expectations variables, a rational expectations variable, and a supply shock variable. As a whole, Model 1 accounts for 32.7% of the variation in expected inflation, according to the R^2 value. Furthermore, all of the coefficients within the model have the expected sign and proper magnitudes. Moreover, each of these variables is highly significant. In particular, π_{t-1} , or

actual inflation lagged one period, demonstrates a positive relationship with expected inflation, as it should. A one percent increase in actual inflation lagged one year indicates a .111 percent increase in expected inflation this year. This figure falls within an acceptable range, as the effect of a one percent increase in actual inflation lagged one year should not have more than a one percent increase effect on actual inflation this year. Furthermore, this effect should be above zero. Hence, since this coefficient is between zero and one, it is within the acceptable range. Actual inflation lagged one year, π_{t-1} , is significant to the .05 level. This demonstrates a highly significant relationship.

Similar to actual inflation lagged one year, actual inflation lagged two years, or π_{t-2} , is highly significant. This particular variable is significant to the .01 level, meaning it is slightly more significant. The coefficient indicates that a one percent increase in actual inflation lagged two years results in a 0.146 percentage increase in actual inflation this year. In accord with actual inflation lagged one year, this coefficient must fall between zero and one. Hence, it is within the acceptable range. The worrisome aspect of this coefficient, however, is that it is higher than actual inflation lagged one year, which goes

against theory. Theory suggests that the level of inflation one period ago has a larger effect than inflation from two periods ago on this year's inflation. The results suggest that inflation from two periods ago has the larger effect. Though this goes against theory, perhaps my use of monthly data provides an adequate explanation. Perhaps if I had used yearly data, then this would hold true because people have more time to adjust. Nonetheless, this coefficient is highly significant and falls within the acceptable range.

The announcement dummy coefficient suggests that the announcement effect decreases expected inflation by 0.001782 percent. Hence, there is some credibility associated with Canada's initial zero inflation announcement. If the announcement lacked all credibility, then I would expect this coefficient to equal zero. Theoretically, if the announcement carried no credibility then it would have no effect on expected inflation. This coefficient falls within an acceptable range, but the small coefficient suggests that the credibility of the announcement is minimal. The announcement dummy is significant to the .001 level, thus indicating that it is highly significant.

The supply shock coefficient is also highly significant. It is significant to the .001 level, as well. This coefficient suggests that a one percent deviation in the difference between the United States' PPI and the Canadian PPI adjusted using the Canadian exchange rate results in a 0.01524 percent increase in expected inflation. Along with all other variables in this model, this coefficient carries the expected sign and falls within

an acceptable magnitude. Supply shocks, or events that disrupt the normal workings of the economy, should theoretically increase expected inflation. Assuming that the variable used to represent supply shocks provides an adequate proxy this coefficient predicts what theory suggests.

B. Expectations-Augmented Phillips Curve

As mentioned, I use OLS to approximate the empirical model. I present the results of Model 2 in Table 4.

Model 2 attempts to test the validity of the expectations-augmented Phillips curve with respect to Canada following their initial zero inflation target. As a whole, this model accounts for 2.1% of the variation in unemployment, according to the adjusted R^2 value. Though this value appears excessively low, it is nonetheless acceptable. This model does not attempt to control for any other variables. A large

multitude of variables affects unemployment rates. In order to test the validity of the expectations-augmented Phillips curve, however, I exclude these ceteris paribus variables. The Phillips curve framework suggests that unemployment and inflation share an inverse relationship. As applied to an expectations-augmented framework, the larger the difference between expected inflation and actual inflation, the larger the unemployment cost. Therefore, despite the disappointing adjusted R^2 value, the model does what it sets out to do. Hence, this R^2 value, taking into account that I exclude all ceteris paribus variables, is appropriate.

TABLE 3
Regression Results for Expected Inflation

Variables	Model 1
Constant	.002818*** (4.988)
π_{t-1}	.111* (2.114)
π_{t-2}	.146** (2.773)
Announce	-.001782*** (-3.505)
US	.01524*** (4.204)
Adjusted $R^2 = .327$ $n = 354$	
* indicates significance to .05 level	
** indicates significance to .01 level	
*** indicates significance to .001 level	

NOTE: t-statistic appears in parentheses.

TABLE 4
Regression Results for Unemployment

Variables	Model 2
Constant	.08687** (87.846)
$(\pi^e - \pi)$.836* (2.924)

Adjusted R² = .021 n = 354

* indicates significance to .01 level
** indicates significance to .001 level

NOTES: t-statistic appears in parentheses.

Perhaps even more important than the R² value, however, is that the coefficient associated with the deviation between expected inflation and actual inflation carries the correct sign and is highly significant.

Model 2 predicts that a one percent increase in the deviation between expected and actual inflation results in a .836 percent increase in the unemployment rate. This falls within an acceptable range. The farther away expectations are from actual values of inflation, the higher are the associated unemployment costs, according to theory. Hence, this value should be small with minor deviations and large with significant deviations. As it stands, a 0.836 percent increase in the unemployment rate is reasonable. The coefficient is significant to the .01 level, meaning that it is highly significant. Though this model has little predicting power in terms of an R² value, the correct signs and high significance values indicate it is a good predictor. Since the aim is to test the validity of the expectations-augmented Phillips curve, these results have significant meaning and successfully predict what theory suggests.

VII. CONCLUSIONS

This study persuasively supports the notion that inflation targets result in unemployment costs,

which are possibly significant in magnitude. Undoubtedly, moves towards disinflation, such as an inflation target, result in higher unemployment levels. The Phillips curve predicts this relationship and my results also support this notion. Perhaps the most significant conclusion of this study, therefore, is that instituting inflation targets can result in unemployment costs. The deviation between expected inflation and actual inflation magnifies these costs. If expected inflation is five percentage points higher than actual inflation as compared to only one percent higher, then surely this indicates a more significant unemployment cost. This reasoning leads to the conclusion that announcement credibility is crucial to successfully implementing an inflation target, as hinted at by previous research on the topic. A credible announcement, theoretically, should decrease expected inflation possibly to the point where expected inflation falls in line with actual inflation. This study supports the notion that announcements can alter expected inflation.

Hence, with specific regard to the Canadian situation, my results suggest that they have yet to reach the long-run, where expected inflation falls in line with actual inflation and the unemployment costs disappear. Initially, this is what John Crow hoped for – suffer the consequences of disinflation policy in the short-run and reap the rewards of long-run growth and welfare increases as expected inflation falls in line with actual inflation due to credibility over time. Unfortunately, for Canada, expected inflation and actual inflation have yet to equalize meaning that the unemployment costs of their inflation target will continue to accumulate. These findings suggest that inflation targets may not be the answer to taming inflation due to the potentially excessive unemployment costs. Canada instituted their inflation target nearly sixteen years ago and has yet to reach the long-run utopia that John Crow dreamed of. The unemployment costs of implementing this policy continue to grow. Perhaps the length of Canada’s “short-run” in regards to this inflation target suggests that the costs of such a policy outweigh the benefits associated with price stability.

The conclusions set forth above suggest possible policy implications. First, if inflation targets are

to work without unemployment costs, then announcement credibility is of utmost importance. If a nation seeks to implement a target and aims to avoid the subsequent increase in unemployment, then they must strive to build credibility before instituting such a policy. If announcement credibility is such that expected inflation falls in line with actual inflation then disinflation through an inflation target is possible without the unemployment costs experienced by Canada. Furthermore, another policy implication is that inflation targets may not be the best way to attack inflation. The results of this study support the notion that the unemployment costs of inflation targets are significant and hence nations should seek to implement policies other than inflation targets, unless they can build credibility such that expected inflation falls in line with actual inflation. Canada's inability to reach John Crow's long run utopia after nearly sixteen years provides convincing evidence to support this notion.

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