Unraveling the Impact of Unemployment on Inflation in Canada: An Analysis Using the Phillips Curve

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Abstract
This paper analyzes the validity of the Phillips curve for Canada from 1997 to 2018 by applying an extension of the New Keynesian Wage Phillips curve developed by Galí.

1 Introduction

The Phillips curve, first proposed by Phillips (1958), has served as a foundational concept in macroeconomic theory and inflation forecasting (Mankiw, 2012). This curve illustrates a trade-off between inflation and unemployment. To enhance the initial model, economists have developed their own estimations of the Phillips curve by incorporating additional relevant control variables. One such example is the New Keynesian Wage Phillips curve introduced by Galí (2011). This paper examines data from 1997 to 2018 in Canada to assess the applicability of this curve in the modern economy. Multiple tests will be conducted to ensure the robustness of the model.

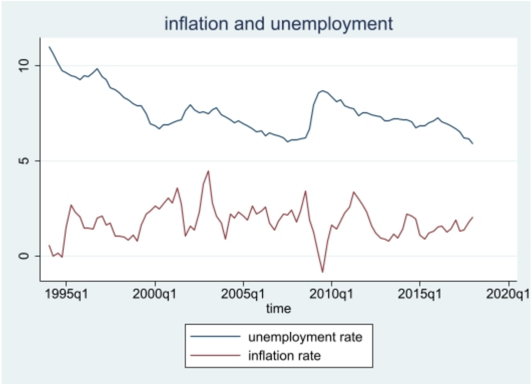
2 Theoretical background and method

The Phillips curve represents a relationship between unemployment and inflation. To reduce the rate of inflation, policymakers may need to temporarily increase unemployment, while to lower unemployment, they may need to accept higher inflation, as discussed by Mankiw (2012). In reality, the determinants of inflation are indeed highly complex, and there are various mechanisms that contribute to its occurrence. This paper specifically focuses on analyzing the variables that contribute to supply shocks. The objective is to gain a comprehensive understanding of their impact together with the unemployment rate on inflation and how they shape the overall dynamics of the economy.

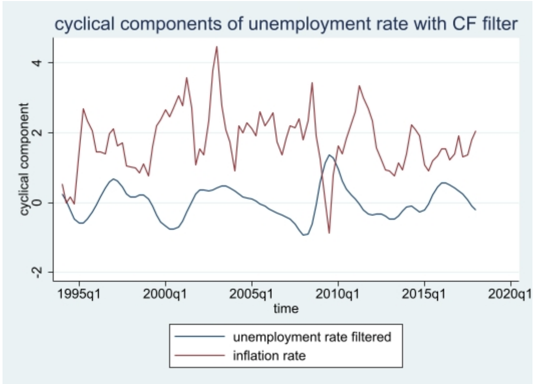
Since the dataset consists of time series data, where variables are observed sequentially over time, it is essential to address the presence of autocorrelation and heteroskedasticity (Heij et al., 2004). To accomplish this, I will employ the Breusch-Godfrey LM test and the Breusch-Pagan test, respectively.By conducting these tests, we can make appropriate adjustments to ensure the robustness of the analysis. Furthermore, it is important to consider the occurrence of a significant financial crisis between 1997 and 2018, with a notable recession in 2008. A structural break test will also be used to check if the Philips curve continues to hold under the presence of a structural change.

3 Data

The dataset utilized in this paper has been sourced from two primary databases: the Federal Reserve Economic Data (FRED) and the Organisation for Economic Co-operation and Development (OECD). The dataset encompasses a period from the first quarter of 1997 to the first quarter of 2018 in Canada, comprising a total of 97 observations. It is important to note that all the data utilized in this study have not undergone any seasonal adjustments and are recorded at a quarterly frequency.



(a) Figure 1



(b) Figure 2

The inflation variable utilized in the analysis is derived from the consumer price index, expressed as the growth rate compared to the same period in the previous year. The crude oil price is based on the West Texas Intermediate, considering the United States' position as the largest exporter during the given timeframe, and it is measured in U.S. dollars(Government of Canada, 2022). The current account balance is also measured in U.S. dollars to maintain consistency across the data. The exchange rate used is the real broad effective exchange rate. When examining the unemployment rate, individuals above 15 years old are taken into account. Figures 1 and 2 depict the quarterly inflation rate and unemployment rate data spanning from 1997 to 2018. In Figure 1, the data is presented in its raw form, revealing pronounced fluctuations in both parameters. These fluctuations can be attributed to the cyclical nature of business cycles within the economy(Christiano & Fitzgerald,2003). To address these fluctuations and achieve a smoother representation of the unemployment rate, the Cristiano-Fitzgerald filter is applied providing a more refined depiction of the unemployment rate over time.

4 Result

The analysis is based on the model proposed by Gali (2011), which suggests expressing the inflation rate as a linear function of several variables. These variables include the lagged inflation rate, the filtered unemployment rate, the lagged filtered unemployment rate, and other economic factors that may contribute to supply shocks. By incorporating these variables into the model, it is aimed to understand the relationship between inflation and its determinants.

$$\pi_t = \alpha + \delta\pi_{t-1} + \beta_1 U_t + \beta_2 U_{t-1} + \gamma' X + \epsilon_t \quad (1)$$

After conducting extensive tests on various combinations of lags for the inflation rate and filtered unemployment rate, it was found that the most ideal result is obtained with a mixture of one lag for the inflation rate and one lag for the filtered unemployment rate.

Table 1: OLS estimation

VARIABLES	OLS Inflation rate(π)
Inflation rate = L,	0.675***
	(0.0696)
Unemployment rateCF(U)	-1.031***
	(0.326)
Unemployment rateCF = L,	1.093***
	(0.337)
Crude oil price	0.0255***
	(0.00594)
NBCABIS	-0.0518***
	(0.0134)
Current account balance	1.85e-05**
	(8.77e-06)
Constant	4.621***
	(1.081)
Observations	96
AIC	154.3399
BIC	172.2904
R-squared	0.652
Adj R squared	0.628
Log Likelihood	-70.17

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The Ordinary Least Squares (OLS) estimation results, presented in Table 1, indicate that the coefficient for the inflation rate lagged one period shows a positive relationship with inflation. A one percent increase in lagged inflation from the previous year corresponds to a 0.675 percent increase in inflation for the current year. This relationship is highly significant, with a significance level of 0.01, as indicated by the p-value. On the other hand, the unemployment rate and lagged unemployment rate have opposite effects on inflation. A one percent increase in the unemployment rate leads to a -1.031 percent decrease in inflation, while a one percent increase in the lagged unemployment rate results in a 1.093 percent increase in inflation. These findings are consistent with previous research (Galí, 2011) and are not surprising. Additionally, all the variables that can cause a supply shock show a significant effect on the inflation rate.

Table 2 presents the results of the Breusch-Godfrey LM test, which does not reject the null hypothesis of no serial correlation. The p-values for the first three lags are relatively high, with the smallest p-value being 0.1060. In Table 3, the Breusch-Pagan test does not reject the null hypothesis of constant variance, with a p-value of 0.2199. Although the estimated break date is the fourth quarter of 2009, the p-value suggests that there is no structural break between 1997 and 2018. One possible explanation for this finding is the healthy financial condition of Canadian households, which contributed to a rapid recovery from the recession(Boivin, 2011).

5 Conclusion

This study employs Galí's linear model to examine the impact of the unemployment rate on the inflation rate within the Canadian economy during the period 1997-2018. By incorporating one lag for the inflation rate and one lag for the unemployment rate, the model successfully fulfills all necessary assumptions. Consequently, the findings indicate that the unemployment rate exhibits a negative effect, whereas the first lag of the unemployment rate demonstrates a positive effect. Despite being introduced in 1958, the Phillips curve continues to hold relevance in contemporary economic developments. The investigation into the impact of the natural rate of unemployment presents an intriguing avenue for future research.

6 Appendix

Table 2: Breusch-Godfrey LM test for autocorrelation

lags(p)	chi2	df	Prob > chi2
1	2.613	1	0.1060
2	2.638	2	0.2674
3	2.648	3	0.4492
4	14.396	4	0.0061
5	16.971	5	0.0046
6	17.184	6	0.0086

Table 3:Breusch-pagan-cook-weisberg-test

Test	Chi2	df	Prob > Chi2
Breusch-Pagan/Cook-Weisberg	8.26	6	0.2199

Table 4: Structural Break Analysis

Sample	**Full**	**Trimmed**
Period	1994q2 – 2018q1	1998q1 – 2014q3
Estimated Break Date	2009q4	
H0	No structural break	
Number of obs	96	

Test	Statistic	p-value
Supremum Wald	19.0683	0.1210

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