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The significance of real interest and real wages in the temporary inflation-unemployment trade-off: some evidence from Canadian data from 1935 through 2010

Abstract

This paper uses a different econometric model and more data compared to the first Canadian data paper published in 2007. This is also a different model from the UK data paper that was published in 2010. Other sections of the paper have also been updated. This article suggests that the real interest rate should be considered in the model for any empirical study on the inflation-unemployment trade-off. Two empirical models are developed to incorporate the real interest rate in addition to inflation rates and real wages, namely, New Keynesian Phillips Curve (NKPC) and triangle model. Both of them are estimated using annual data from Canada from 1935 through 2010. The finding shows that the interest rate plays a significant role in explaining the inflation/unemployment association. The authors maintain that all economists should at least consider the real rate of interest, in Phillips Curve Analysis.

Keywords: Phillips Curve, aggregate supply curve, Canada, short run, long run, economic history.
JEL Classification: E12, E24, E40, N12.

Introduction

Fisher (1926, 1973), was one of the earlier economists to graph the inverse relationship between the unemployment rate and inflation. Phillips' seminal work on this relationship in *Economica* (1958, 1961) resulted in the appellation "Phillips Curve", used by subsequent economists (Santoremo & Seater, 1978; Snowdon & Vane, 2005). Explanations about why short-run Phillips curves could exist have focused on misperceptions of both the real wage rate and the demand for goods and services. Herein, we show that any empirical test work on the unemployment-inflation trade-off using Phillips Curves should also include the real interest rate. Building on earlier works (Gentle, 1984; Gentle & Novak, 1995; Gentle et al., 2005, 2007; Chen et al., 2010, 2011), we test our hypothesis, using annual Canadian data over a period from 1935 to 2010, seventy-five years, more data and economic history examples than what we used for our previous Canadian paper (Gentle et al., 2007). In this paper, we are using a different econometric model and more data compared to the first Canadian paper we did. The empirical part, including both New Keynesian Phillips Curve (NKPC) and triangle models, their estimations and discussion of the findings are given in the third and fourth sections. The last section presents the summary and conclusion.

1. Theoretical background

New-Keynesians Mankiw (1989, 2006a), Gordon (1990, 2009a), and Taylor (1980) point out that wages and prices can adjust slowly, which affects macroeconomic fluctuations, including changes in the Phillips Curve. Noted by Mishkin (2010), the New Keynesians, Monetarists and New Classicals (Rational Expectationists), agree that unanticipated government policy would have the most significant impact on the economy. However, they also proclaim that anticipated policy may affect the economy. New-Keynesians Mankiw (2006a) and Gordon (2009a) describe the Phillips Curve as the short-run aggregate supply curve (SRAS). Gordon (2009a) explains that positive supply shocks cause the SRPC to shift downward and negative supply shocks cause the SRPC to shift upward. In this study, we are looking at a model where labor inputs are being used in a complementary way with capital. We include real wages (the real cost of labor) and real interest (the real cost of capital) in the model. Business and consumer confidence uncertainties may lead the economy to sometimes operate on the SRPC (Gentle, 1984; Gentle & Novak, 1995; Gentle et al. 2005, 2007; Mankiw, 2006a; Gordon, 2009a, Chen et al., 2010, 2011). The Marshallian Monetarist School advocates the partitioning of time into short-run and long-run periods; whereas, the Walrasian New Classicals do not (Santermo & Seater, 1978). New Classicals recreate the Phillips Curve, terming it as "Lucas short-run aggregate supply function" (Lucas, 1973; Sargent & Wallace, 1976). Classicals differ from New Classicals, who allow for short deviations from full employment, if economic agents have incorrect expectations (Dornbusch et al., 1998). A limited amount of monetary neutrality is inadequate to gain monetary neutrality for the whole economy (Barro, 1984). Our theory presented in this paper could be embraced by all: the Marshallian Neo-Keynesians, Marshallian Monetarists, or the Walrasian New Classicals, all of which have views concerning imperfect information and Phillips curves. The natural rate of unemployment (assumed in the LRPC) is "simply the market

rate, given frictions, mismatches, and institutional constraints, and serves as the base point from which to analyze cyclical unemployment" (Bellante & Garrison, 1988). Monetarists and New Classicals argue that an expansionary monetary policy can produce only a temporary decrease in the unemployment rate due to the misperception on the part of labor concerning their real wage rate once prices rise. Central to the existence of the Short Run Phillips Curve (SRPC) is the fact that the labor agents do not immediately realize a decrease in their real wage in comparison to government benefits for the unemployed. If inflation is correctly anticipated, the government can no longer use inflation to mask real economic variables (Friedman, 1968, 1970, 1976, 1977).

According to Friedman (1969, 1976), anticipated inflation is reflected in interest rates so that only unanticipated inflation can affect real interest rates. Sargent (1973) has some econometric evidence to support Friedman's view. A Phillips Curve based on complete rational expectations would be vertical even in the shortrun, because only 'surprise' or unexpected inflation can have an impact on the economy. Otherwise there is money neutrality (Lucas, 1973; Barro, 1984; Sargent, 1979; Hertzel, 2005). New Classicals argue that the SRPC is attributable to short term imperfect information, which decomposes in the long run. Indexed wages, when allowed, result in a limited amount of monetary neutrality and are not enough to gain monetary neutrality for the whole economy (Barro, 1997).

2. Graphic analysis

Mankiw (2006a) describes the Phillips Curve as the Short-Run Aggregate Supply Curve (SRAC). Monetarists and New Classicals believe that the Short Run Phillips Curve can occur only with surprise amounts of inflation. The SRAC may provide a valid description of the supply side of the economy, until all input prices increase proportionately to the same level, as the output prices. Using labor inputs in a complementary way with capital, we include real wages and real interests in the model. Specifically, we use the Phillips Curves in Figure 1 (see Appendix) to develop our model and assume that the economy is initially operating at point A on $SRPC_0$. Then the difference between μ_2 and μ_1, an unanticipated inflation creates a money illusion, which leads the economy to move from point A to point B. When economic agents realize that they failed to accurately anticipate the inflation rate, the agents would make an adjustment. Hence the economy moves to point C on the LRPC. Both temporary misconceptions regarding employees' knowledge of the real wage and entrepreneurs' and managers' knowledge of the real net present value (NPV) allows the economy to operate on a SRPC. After a period of time, labor agents realize the increase in their cost of living compared to a decline in real wage. Concurrently entrepreneurs and managers realize the increase in the cost of capital and land, which causes a decrease in the real NPV for capital/labor complementary projects. Furthermore, labor, capital, and land may be used as complements as well. Meanwhile, managers and entrepreneurs are also aware that an increase in the demand for their products has not been sustained. At this time, the ability of policy makers to use money illusion to operate on $SRPC_0$ is lost. Therefore, the economy comes back to a natural unemployment rate on the LRPC, due to some workers opting for employment, some capital/labor complementary projects being curtailed, with attendant layoffs and a decrease in aggregate demand that characteristically happens when the real interest rate is increased (Phelps, 1967, 1968; Gentle, 1984; Gentle & Novak, 1995; Gentle et al., 2005, 2007; Gordon, 2009a; Chen et al., 2010, 2011). The isocost curves and isoquants in Figure 2 (see Appendix) show the effect of a change in the real interest rate on the capital and labor inputs used by a firm and its output. If the firm is initially operating at point A, the tangent point between the highest isoquant and highest isocost curves in the diagram, this is based upon a set of input costs. If the scenario is where the real wage is constant and the real interest rate increases, then the isocost line will shift inward leading to the firm to operate at point B, which produces a lower level of output.

An examination of Figure 2 reveals that the firm now reduces both the use of capital inputs due to the higher cost of capital and the use of labor input because of less complementary capital input resulted from the lower level of output. Thus the unemployment rate may increase. Furthermore, Lucas is pursuing his own research agenda (Golosov & Lucas, 2007). In addition, Sargent (1999) has outlined many models about Phillips Curves. From the beginning of our research publications, our argument has been that any and all schools of economic thought to consider the inclusion of the real interest rate, in Phillips Curve analysis. Dees et al. (2009) maintains that statistics and economic theory working together produce the best understanding of Phillips curves.

3. Empirical framework

3.1. Some relevant highlights of Canadian economic history in 1935-2010. This analysis is based on Canadian annual data from 1935 through 2010, with four economic time periods examined during that period, rather than providing a complete historical review. Space considerations went into this

decision. We are aware that the real wage factor is important and present during these historical examples; however, we concentrate on the real interest rate factor to illustrate the point of our paper. Increases in Canadian investment expenditures, both from domestic and foreign sources, especially from the US and UK, have been especially important (Pomfret, 1993; Norrie et al., 2008).

Time Period 1. Prior to the Bank of Canada, the country's monetary policy operated via the Finance Act, which gave power to the Finance Department of the Canadian government. The Great Depression inspired some to create the Bank of Canada, which began operating in March, 1935. In 1926, Canada had returned to the gold standard. In 1929, Canada "imposed an unofficial embargo on gold exports and, in effect went off the gold standard." Though "officially she (Canada) remained on the gold standard until 1931" (Courchrene, 1969). From 1925 to 1929, there was an increase in the money supply, which ended with the stock market crash. "Immediately following the stock market crash of 1929", the money supply dropped (Couchrene, 1969). The drop came from the money multiplier, rather than a drop in high powered money. Indeed between 1931 and 1933, there was actually an increase in high powered money and a decrease in the money multiplier, resulting in a decrease in the money supply (Courchrene, 1969). During the easy credit times of part of the 1920s, personal and business debt had expanded. Yet people and businesses lacked such credit with advent of the Great Depression. "That currency should fall in a depression is not surprising, since the demand for it will fall, with falling incomes" (Courchrene, 1969). In terms of the Phillips Curve, such a drastic deflation would cause the Canadian economy to move to the right of the LRPC, with both a low inflation and low unemployment rate. The Great depression was worldwide and Canada, the UK and the USA, had similar experiences. Friedman & Schwartz (1963a, 1963b) and Meltzer (2003) state that the "Great Contraction" part of the Great Depression is the period from 1929 to 1933, when the US money supply was most severely reduced, a point agreed upon by the majority of economists (Gordon, 2009a; Stiglitz, 2010). Of course deflation creates enormous business and consumer uncertainty (Mankiw, 2006b; Mishkin, 2010; Gordon, 2009a). Furthermore, both Safarian (1959) and Pomfret (1993) have written on loss in business and consumer confidence in Canada. Being an exporter of many of its products, Canada was very vulnerable to a collapse of world trade. During the Great Depression, Canada increased regulation of agricultural markets (Norrie et al., 2008). In terms of the Phillips Curve, such a drastic deflation would cause an economy to move to the right of the LRPC, with both a low inflation and low unemployment rate. Creditors are the beneficiaries of deflation in an economy; whereas debtors benefit from inflation in an economy. As the theory in our paper indicates, the accuracy in estimating the real rate of interest and real wage rate can affect the behavior of economic agents, causing an influence on the unemployment rate.

Ottawa provided relief money, protected the provincial governments from bankruptcy, and through the Ottawa agreements sought to improve trade. The Smoot-Hawley Tariff had been passed in 1930 by the United States. The British crown promoted the Ottawa agreements of 1932, as a way to give Commonwealth countries an advantage in tariffs and trade agreements between each other. Canada raised tariffs on some non-Commonwealth goods. The year 1933 was the worst year for United States at 25.2% unemployment and for Canada at 30% unemployment. Also, the worst year for Canada's unemployment rate in 1933 at 30%. The UK unemployment rate peaked in 1932, at 22% (Pomfret, 1993; Gordon 2009a).

As the US had done, Canada used government programs to lessen the unemployment rate. In 1939 Canada entered World War 2 and its high unemployment problems subsided (Pomfret, 1939; Norrie et al., 2008). "War orders flowed to manufacturers, who began to gear up idle capacity for the work that was beginning to come their way" (Norrie et al., 2008). Additionally, more people were drafted into the armed forces. By 1941, the high unemployment rate of the Great Depression was over, due to a greater labor demand, resulting from World War 2. The United Kingdom became more dependent on Canadian exports, which increased by 50 percent from 1939 to 1940 (Norrie et al., 2008). Compared to peace time, Canada implemented strict controls on wages prices and production. World War 2 resulted in the UK, Canada and USA losing huge amounts of absolute wealth. It took some time to get the three economies reorganized for peaceful production (Ziemke, E.F., 2011).

Time Period 2. In our second historical time period to examine, Canada and the US shared other macroeconomic fluctuations, such as, in part of 1957 and in part of 1958, the two countries experienced a recession that was short and that was also quelled with expansionary monetary policy. In Canada, "monetary policy was restrictive for the first three-quarters of 1957, before becoming appropriately expansionary for the last quarter and for most of 1958" (Norrie et al., 2008). Because of the recession that occurred around 1958, in Canada, the UK and in the US, those economies could be described as points on the three nation's individual SRPCs

and to the right of the three nations LRPCs. Wishing to spread payments forward, the Canadian government pursued the Conversion Loan of 1958, which doubled the average term to maturity of the federal government debt. Thus, the government refinanced the entire amount, by means of "increasing the average maturity of the debt significantly." Simultaneously the Bank of Canada adopted an extremely restrictive monetary policy, through the middle of 1961, which drove up interest rates and offset "attempts to expand the economy" (Christofides et al., 1976; Norrie et al., 2008). "Real GDP grew at 7.1 percent in 1962, compared with the average of 2.9 percent from 1957 to 1961" (Norrie et al., 2008). Something else must be mentioned in regard to how a special resource was used within Canada. The Organization of Petroleum Exporting Countries (OPEC) had two especially large price increases in 1973-74 and in 1979-80. The SRPC normally shifts up, when there is a supply shock (Gordon, 2009a). The Canadian federal government chose to try to balance the competing interests of oil net producing Canadian regions and oil net Canadian consuming regions (Merrill, 2007; Norrie et al., 2008). The Western provinces, especially Alberta, were producing oil, sold at a lower price than OPEC's, for the rest of Canada, which benefited heavily populated provinces, including Quebec and Ontario. The net result has been for the oil consuming and oil producing provinces to try to get their competing needs represented through the national elections and national government (Manning, 2002; Norrie et al., 2008).

Time Period 3. Our third historical time to be examined begins in the first part of the 1980s. At around that time, Canada, the US and the UK were all pursuing disinflation policies. A government policy may purposely put the country through a disinflation time and take the nation onto a SRPC to the right side of the LRPC temporarily, as in the direction of point D of Figure 1. Eventually the economy will settle back on the LRPC (Gordon, 2009a). Canada experienced the disinflation policy shown at point D on Figure 1. Eventually the economy was able to move to point A, a situation of tolerable inflation and a natural unemployment rate. Longworth (2002) describes the Canadian recession in the early 1980s, as resulting from disinflation policy. The United States, United Kingdom and Canada from our earlier studies have had similar results that could be shown on Phillips Curves (Gentle et al., 2005; Chen et al., 2010; 2011). After an election resulted in a new president taking office in 1981, the US Fed concentrated on using monetary policy to dampen inflation through high interest rates in the United States. It was successful and this also resulted in one of the highest unemployment rates since the Great Depression. The country operated on a Short Run Phillips Curve (SRPC) before coming back to a Long Run Phillips Curve (LRPC). Chen et al. (2011) and Dell (1996) and Carlin et al. (2006) describe the United Kingdom disinflation policy in part of the 1980s. We can use Figure 1, to explain the United Kingdom's economy returning to the Long Run Phillips Curve (LRPC), after temporarily going down the right side of the LRPC and down the downward sloping portion of an SRPC.

Time Period 4. The final chosen time period of history, is within the first decade of the 21st century. According to Bernanke (2010), the US economy experienced a recession between March and November 2001. One of three factors was the ending of the "dot.com boom," with its resultant great decline in stock prices. Secondly, 'geopolitical uncertainties' came to fruition, due to terrorist attacks against the US on September 11, 2001. Thirdly, corporate scandals, such as those that happened in Enron and Anderson hurt the economy (Graham et al., 2002). These factors led the US FED to pursue an expansionary monetary policy, without the Taylor Rule being observed. Optimally, central banks should keep inflation and GDP at reasonable levels. The Taylor Rule guides central banks to "move the real short interest rate away from its desired long-term vale in response to any deviation of actual inflation from desired inflation and in reaction to any deviation of real GDP from natural real GDP". Using the Taylor Rule as a guidepost for monetary policy, states that the US FED allowed the federal funds rate to be too low during a portion of the first half of the first decade of the 21st century (Gordon, 2009a).

The most recent economic crisis, which has spread throughout the world, had its origin in the United States, due to a housing bubble, occurring because of two reasons. The US FED provided low interest rates resulting in such low financing interest rates, that too many housing units were built. Houses were bought, not just to live in but also for speculative purposes, in the hope that the prices would go up in the future, as they had been doing. The Fed let the monetary policy stay relatively loose. Another factor is that in order to sell the surplus of houses, normal procedures were done away with. Unscrupulous agents sold houses to people, known as "subprime" buyers, who could not afford to make the payments. A balloon payment scheme was set up, whereby buyers paid smaller amounts at the beginning of the loan and the payments increased after a couple of years. The lowering of the interest rates occurred between 2001 and 2005. The housing bubble all came to a halt and housing prices no longer kept rising. During August 2007, trouble began for securities backed by the securities tied to ARMs (Adjustable Rate Mortgages). The "sub-

prime" buyers who were supposed to make housing payments, did not have the money to do so. Moreover, the value of their houses had not increased. So selling the houses would not recoup what the subprime buyers had paid for the houses. In 2001, there were 1.6 million housing starts; in 2005 there were 2.1 million housing starts; in 2007 there were 1.5 million housing starts. The USA stock market crash in October 2008 is attributable to the bubble in the housing market (Gordon, 2009a; Stiglitz, 2010; Mishkin, 2010). Furthermore, low interest rates have not proven sufficient to pull America out of the recession. Many economists believe the Glass Steagull Act of 1933, occurred in 1999, has enlarged the current woes, since some conflicts of interest came about with the repeal of that act (Stiglitz, 2010). Graham (2010) noted the United States has had a worsening measurement on the Corruption Perception Index, dropping out of the twenty least corrupt nations. Causes are the US financial institutions loss of credibility concerning lending practices in the subprime crises, exposure of Bernard Madoff's Ponzi scheme, and unethical contributions to political campaigns.

Hagerty (2010) states that Bank of Canada researcher Virginie Traclet, received one of the biggest rounds of applause for her presentation on the Canadian mortgage market, during a housing-policy conference sponsored by the Federal Reserve Bank of Cleveland. Firstly, the Canadian government does not create an incentive for people going into more debt, since interest on mortgages is not tax deductible. Due to conservative attitudes and regulation, sub-prime loans never account for more than 5% of the Canadian mortgage market. Secondly, if the loan defaults, the lender has recourse to the borrower's other assets, besides their mortgaged property (Hagerty, 2010; Kiff, 2009). In the US, there is a "mixed bag of recourse and non-recourse loans and many restrictions on banks' ability to go after other assets" (Hagerty, 2010). Consequently in the US, people who took out a mortgage are more likely to abandon their property, even if they could pay, with other assets. Thirdly, mortgage loan insurance must be maintained that covers 80 percent of the estimated property value. The Canadian government is the main seller of such insurance. Though this may be a subsidy to the market, at least the Canadian government is upfront about that, as opposed to some American politician's pretending like Fannie Mae and Freddie Mac, are not being bailed out by the US government. Fourthly, almost all US mortgages are paid monthly. Yet "Canadian borrowers can opt for weekly, biweekly, semimonthly, or monthly payment schedules, in order to smooth cash flows and reduce interest costs" (Kiff, 2009). Home ownership in the US, at the end of the fourth quarter of 2010 was 66.5% (U.S. Census, 2011). Canada was slightly higher, at 68%. This paper's Figure 3 (see Appendix) compares Canada to the United States, respectively in terms of mortgages in arrears. We can see that Canada has a less volatile housing market system (Perry, 2010). To keep the USA from getting into a similar situation in the future, necessitates constructive financial regulation on lending and less reliance on the US Fed to sustain credit booms, which inevitably end. Instead there should be more reliance on stability and long-term growth (Pomfret, 2010). Though Canada was affected by USA policy, in an adverse way at times, Canadian housing policies have been one of the ways Canada has partially offset it. The behavior of different agents is convoluted. As stated, we are cognizant of the real wage factor, affecting the Canadian economy. We have chosen to point out interest rate factors, in these four examples of Canadian economic history.

3.2. Econometric model. Our use of the model in this paper, is the first time for us for any of our Phillips Curve analysis papers. In this paper, we employ both the New Keynesian Phillips Curve (NKPC) model and the mainstream triangle model (Gordon, 2009b) to explain the association between inflation and unemployment. The NKPC model is developed to derive an empirical description of inflation dynamics. A major difficulty to the NKPC model is to search for variables to proxy for the expected inflation rate. To overcome such challenge, we follow Roberts (2006) to use four lagged inflation to represent the expected inflation rate and, therefore, specify a reduced form NKPC model which includes the wage rate and interest rate as well.

$$p_t = \beta_0 + \sum_{i=1}^{4} \beta_i p_{t-i} + \beta_5 u_t + \beta_6 w_{t-1} + \beta_7 i_{t-1} + \varepsilon_t, \qquad (1)$$

where p_t is the inflation rate, u_t is the unemployment rate, w_t is the wage rate, and i_t is the interest rate. There are two basic assumptions that Roberts (2006) needs to set up the NKPC model: the non-accelerated inflation rate of unemployment (NAIRU) is constant, and the sum of coefficients on lagged inflation is unity. NAIRU can be estimated by β_0/β_5. We are always cognizant of the heterogeneity of capital. The lag effects in this model may help with the timely needs of different forms of capital.

A classical triangle model used in this study is almost the same as what Gordon (1982) developed 25 years ago. If the impact of demand is gauged by the unemployment rate, the general framework of the triangle model which incorporates the wage rate and interest rate can be specified as follows:

$$p_t = \beta_0 p_{t-1} + \beta_1 (u_t - u_t^n) + \beta_2 w_{t-1} + \beta_3 i_{t-1} + \eta_t. \qquad (2)$$

The notations in equation (2) are identical to that in equation (1) except that u_t^n denotes the non-accelerated inflation rate of unemployment (NAIRU). The NAIRU here is allowed to vary over time. Because this method can forecast steady inflation when the unemployment gap $(u_t - u_t^n)$ and the supply shock terms (w_{t-1}, i_{t-1}) are all zero, it is unnecessary to estimate a constant term in equation (2). To explicitly allow the NAIRU to vary over time, one more equation is needed to combine with the above equation (2).

$$u_t^n = u_{t-1}^n + \lambda_t \quad E(\lambda_t) = 0 \quad \text{var}(\lambda_t) = \sigma^2, \tag{3}$$

where the disturbance term λ_t is serially uncorrelated and independent of the disturbance term η_t in equation (2).

4. Empirical results

Before estimating the NKPC and triangle, we plot the Canada inflation and unemployment rates in annual data since 1935 in Figure 4 (see Appendix), and refer to it to assess their relationship within the period of 1935-2010. This figure verifies some historical fact discussed in subsection 3.1. In addition to inflation and unemployment, we also include the wage and interest into model. To get a sense of the distribution property of these variables, Table 1 below reports some general descriptive statistics such as number of observation, mean, standard deviation, minimum, 10 percentile, median, 90 percentile, and maximum. All of them are in the percentage term. The average inflation (unemployment) is 3.782 (6.802) with a standard deviation of 3.317 (2.774).

Moreover, a correlation matrix in Table 2 is estimated to examine the link between inflation, unemployment, wage and interest rates. To gain a reliable and robust result, we calculate both the Spearman and Pearson correlations to seek some preliminary evidences whether the association among key variable concerned is present or absent. The finding in Table 2 suggests that a statistically significant relation is detected between inflation and unemployment, regardless of which correlations are examined, consistent with the conventional pattern based on the traditional Phillips curve. On the other hand, both inflation and unemployment are found to be positively associated with interest under the one percent significant level. This is in line with our earlier discussion.

Next, we turn to the estimated results of the NKPC and triangle model. Tables 3 and 4 show the estimated coefficients and their corresponding standard errors for the NKPC (triangle) specification for equation where the dependent variable is the inflation rate. By examining the finding in Table 3 and Table 4, we can observe that the interest rate and wage rate do matter to the inflation rate. In terms of the sign, the interest rate persistently has a positive impact in both specifications. However, the wage rate displays negative and positive influence on the inflation rate in the NKPC and triangle model, respectively, which seems to conflict with each other. In spite of this inconsistent effect from the wage rate, the relation between inflation and unemployment maintains significantly negative, which re-confirms the shape of the traditional Phillips Curve.

Summary and conclusion

This paper suggests that any analysis of a Phillips Curve should at least consider including the real interest rate, as well as the real wage. This is because any changes in the real interest rate changes the labor input mix in the production process, which ultimately affects the level of employment in the economy. In order to find evidence in favor of this argument, two empirical models are used, which include the interest rate as one of the explanatory variables in addition to the wage rate. These models are estimated based on the annual data in Canada from 1935 to 2010. These models are different from the first Canadian study, published in 2007. Our findings imply that the interest rate is an important variable when describing the Phillips Churve. Gentle (2005; 2007) and Chen (2010; 2011), have similar results. This Canadian study provides an especially interesting study, in view of the fact that it over a period of seventy-five years. Furthermore, we see the consequences of American politicians in recent time, not pursing the optimal regulation of financial markets, especially in housing finance. Canada presents a more responsible policy, in housing finance.

Table 1. Descriptive statistics

	p	*u*	*w*	*i*
#	76	76	76	76
Mean	3.782	6.802	0.054	5.247
S.D.	3.317	2.774	0.039	3.616
Min	-1.408	2.200	-0.051	0.650
10 percentile	0.714	3.000	0.014	1.580
Median	2.697	6.972	0.043	4.310

Table 1 (cont.). Descriptive statistics

	p	*u*	*w*	*i*
90 percentile	9.574	10.636	0.118	9.690
Max	14.563	14.000	0.155	17.930

Note: This table presents the basic descriptive statistics for inflation rate (*p*), unemployment rate (*u*), wage rate (*w*), and interest rate (*i*). These statistics include number of observation (#), mean, standard deviation (S.D.), minimum (Min), 10 percentile, median, 90 percentile, and maximum (Max).

Table 2. Correlations matrix

	p	*u*	*w*	*i*
p		-0.046**	0.756***	0.504***
u	-0.087**		-0.346***	0.465***
w	0.812***	-0.295***		0.228**
i	0.539***	0.401***	0.356***	

Note: This table presents the Spearman (Pearson) correlation among inflation rate (*p*), unemployment rate (*u*), wage rate (*w*), and interest rate (*i*) in the upper (lower) triangle. ***, ** and * indicate the values are significant at 1%, 5% and 10% levels.

Table 3. Estimation of the NKPC models

	Coef.	S.E.	*t*-stat.
Constant	2.949***	1.000	2.950
p^{-1}	0.973***	0.124	7.820
p^{-2}	-0.399***	0.144	-2.770
p^{-3}	0.553***	0.142	3.890
p^{-4}	-0.127	0.118	-1.070
u	-0.453**	0.171	-2.650
w^{-1}	-21.805**	9.445	-2.310
i^{-1}	0.225*	0.128	1.760

Note: This table reports the estimated coefficients (Coef.), standard errors (S.E.), and *t*-stat (*t*-statistics) for the NKPC model. ***, ** and * indicate the values are significant at 1%, 5% and 10% levels.

Table 4. Estimation of triangle model

	Coef.	S.E.	*z*-stat.
p^{-1}	0.380**	0.159	2.400
$u\text{-}u_n$	-0.070***	0.028	-2.489
i^{-1}	0.265**	0.116	2.290
w^{-1}	22.679**	11.226	2.020

Note: This table reports the estimated coefficients (Coef.), standard errors (S.E.), and *z*-stat (z-statistics) for the NKPC model. ***,** and * indicate the values are significant at 1%, 5% and 10% level of significance.

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Appendix

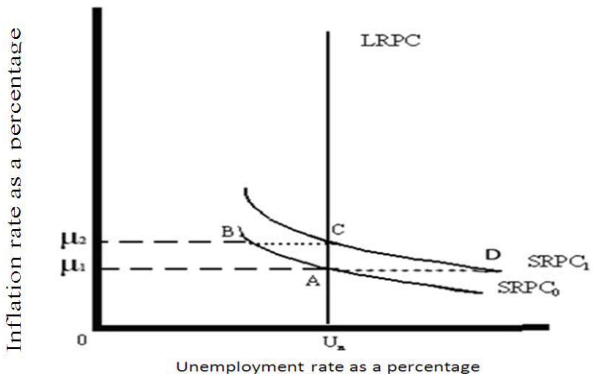


Fig. 1. Phillips Curves

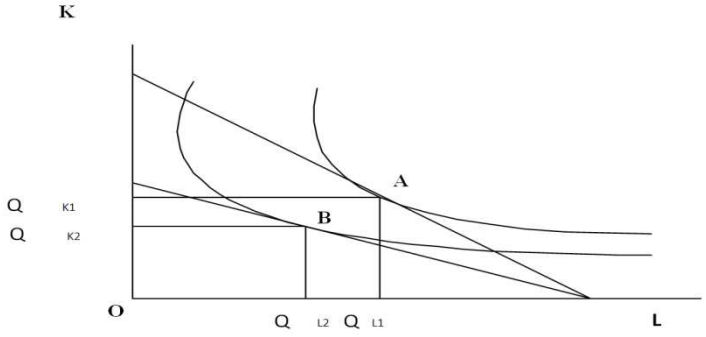
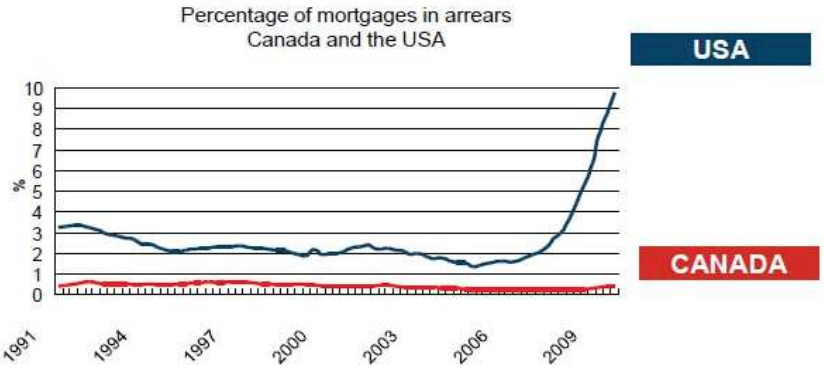


Fig. 2. Effects of real interest rate change on capital (K) and labor (L) use



Sources: Canadian Bankers Association, Federal Reserve.

Fig 3. Canadian and US percentage of mortgages in arrears perry (2010)

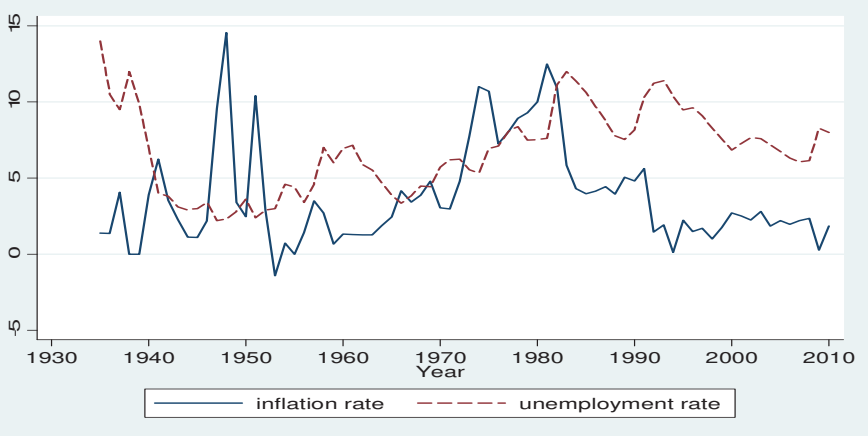


Fig 4. The Canada unemployment and inflation rates, 1935-2010