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Non-Linear Analysis of Post Keynesian Phillips Curve in Canada Labor Market

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Abstract

This paper aims to analyze Post-Keynesian Phillips Curve by using non-linear ARDL approach and non-linear Granger causality method for the period from 1957 to 2015 in Canada. This study is differed from other empirical paper by using non-linear ARDL method which determined there is long-run asymmetric relationship between the selected macroeconomic variables for Canada. Canada exhibits bi-directional causality relationship between inflation-unemployment, unemployment-economic growth and inflation-economic growth which refers that the country has flexible labor market.

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Keywords: MURI, Non-linear ARDL, Augmented Non-linear Granger Causality,

1. Introduction

Phillips Curve is one of the most controversial issue among school of economic thought which is a considerable first approach to realizing the implications of that relationship for economic policy. Namely, it implies a fundamentally empirical relation between labor markets and monetary policy (Cooley and Qandrini, 1999).

Although it is commonly known that the structural composition of inflation and unemployment bases on Phillips (1958)'s study, the first statistical scatter diagram and downward-sloping convex trade-off curve of Phillips Curve, was presented by A. J. Brown (1955) and Paul Sultan (1957). The scatter diagrams plotted the relationship between annual wage inflation rates and unemployment rates for the United Kingdom from 1880 to 1914 and from 1920 to 1951 and additionally for the United States from 1921 to 1948. By these diagrams it is deduced that the two

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variables are inversely related and the relationship between these variables is nonlinear because wages change at a faster rate at low rates of unemployment than at high rates. Thus, it can be stated that the Sultan Schedule is the first diagrammatic representation of the Phillips Curve which represents a stable trade-off between inflation and unemployment (Humphrey, 1985).

The original Phillips Curve was constructed by Phillips (1958) and gained popularity by Samuelson and Solow (1960). He proposed a negative and stable relationship between the rates of unemployment and nominal wage changes in United Kingdom over the period 1861 and 1957 in his famous paper. This model was examined in industrialized countries and a stable long-run trade-off between the variables was obtained. Accordingly, there was a stable long-run trade-off between the variables and the economy could reach to higher level of productivity and employment rate only at the expense of a persistently higher rate of inflation (Wang, 2004).

By the oil crises in the 1970s, many countries have experienced an usual change in relation between inflation and unemployment such that inflation and unemployment positively correlated rather than negatively related. Stagflation leaded to controversion of Phillips Curve which became an unreasonable, most debated macroeconomic point and criticized severely by Friedman (1968), Phelps (1968), Lucas (1973), Fischer (1973), Taylor (1980) and among others asserting that the Phillips Curve relationship is only a short-run fact, in the long-run trade-off between inflation and unemployment does not occur. Instead, theory estimates that the trade-off between the variables vary with changes in agents' inflation expectations, and inflation expectation of agents covary with economic environment changes. Thus, theory predicts that the relationship between current unemployment and future inflation is expected to change as economic conditions alter and there is no stable relationship (Atkeson, Ohanian; 2001).

After 1970s, by Friedman-Phelps's (1968) model, consumers' inflation expectations have gained popularity and played a critical role in new interpretation of Phillips Curve. According to this theory, an upsurge in aggregate demand, reduces unemployment and enhances inflation. However, decreasing unemployment is not so possible since economic agents have adaptive expectations which means they generate forecasts of future expectations based on their former experience. In other words, workers realize that high inflation diminishes their real wages hence they demand higher wages to compensate for the reduction. This situation causes unemployment augmentation. As a result, the unemployment situation returns to its previous condition. At that point, the output impact also disappears.

In this model of the Phillips Curve, adaptive inflation expectation depiction points out that in the short run, real inflation is greater than expected inflation but in the long run, inflation expectations are fully realized and hence real inflation is equal to expected inflation. The short- run Phillips Curve is downwardly sloping yet, it becomes vertical in the long-run. The actual unemployment rate is the same as the natural rate of unemployment (which later became commonly known as NAIRU or non-accelerating inflation rate of unemployment). Thus, running up nominal demand as a means to lower the unemployment rate yields best results in the short-run but not in the long-run. In a similar manner, money could not be neutral in the short-run but is in the long-run. One of the major policy inferences is that the natural rate of unemployment (NAIRU) is independent of the inflation rate. Lucas (1972,1973) replaced "adaptive expectations" with "rational expectations" so it does not promote any trade-off between the variables not only in the long-run but also in the short-run (Pattanaik and Nadhanael, 2013).

Phillips Curve relation depends on NAIRU is widely accepted after 1970s has pointed out an inverse and stable relationship between the variables. This was a significant contribution because of being a prioneering and frame-breaking development of macroeconomic policy which was described as unemployment rate that would correspond to zero wage inflation.

Lucas's (1972, 1973) rational expectations approach substitute for adaptive expectations approach. Accordingly, economic agents consider their past information to predict future thus they do not make mistake in their future expectations. Thus, not only in the long-run but also in the short-run, inflation and unemployment have no trade-off relation which means short- and long-run Phillips Curve stays vertical. Only as a consequence of "surprise shocks" deviations from natural rate may occur.

By the Friedman-Phelps-Lucas remark on Phillips Curve, full employment was replaced the natural rate of unemployment and full employment policy was replaced by microeconomic labor market flexibility policy aimed at lowering the natural rate by weakening unions and worker protections (Palley, 2012). However, Tobin (1971) purported another approach that regardless of adaptive or rational expectations, his analysis stresses on nominal wage approach. The basic logic of backward bending Phillips Curve derives from Tobin's (1972) perception when there is downward nominal wage rigidity, inflation can help to grease the wheels of labor market adjustment by facilitating relative wage and price adaptation in sectors suffering from unemployment. A backward bending of the Curve emerges if workers in sectors with unemployment start to display downward real wage resistance once inflation passes a threshold level (Palley, 2008).

Akerlof et.al. (2000) established an alternative model to natural rate of unemployment. The most significant deduction of their study is that a low, but not zero inflation rate leads to the lowest sustainable rate of unemployment or minimum unemployment rate of inflation (MURI). Further, first, when inflation is low, a significant number of people may ignore inflation when setting their wages and prices. Second, even when they consider inflation, they do not treat as economists because they except inflation as increasing prices and reducing their real earnings and besides, they are near-rational. They fail to understand inflation as a general-equilibrium phenomenon (Akerlof et.al., 2000). Thus, when there is an increase in nominal wage, they cannot consider decline in real wages and this caused to less unemployment. Therefore, a low but positive rate of inflation minimalises sustainable rate of unemployment, leads to higher productivity and "greases" the wheels of the economy. As a result, economy is conducted by higher level of output and employment. When inflation reaches to a threshold inflation level (as inflation increases), economic agents take full account of inflation while inflation settings and their expectations are purely rational rather than near-rational which prompt to backward bending Phillips Curve (Malesevic: 2007).

While Tobin (1972) applied a multi-sector approach to the Phillips Curve, Akerlof et.al.(2000) developed a multi-agent approach in which economic agents have different rationality level and Palley (2003) brought a new perspective with his firm-based model.

Palley (2003) criticizes Akerlof et.al.(2000) at many points. Accordingly, Palley (2003) asserts that near-rationality approach is almost unreasonable because some workers disregard steady predictable low inflation and some workers fail to consider systematic predictable inflation even at fairly higher levels of it. Instead, Palley (1997, 2003) argues that workers are fully-rational and inflation pattern in an economy is in accord with downward nominal wage rigidity which rests on moral hazard. Because of moral hazard, employers opportunistically seeks to lower wages and workers already agree with downward adjustment to real wages because of inflation. This explains why inflation "greases the wheels of" labor market. However still, workers are reluctant to agree on too rapid real wage adjustments because if inflation ranges to a threshold level, they respond by demanding nominal wage increases. This response invalidates the grease effects of inflation and induce to increase in unemployment rate. If all workers have common knowledge about inflation threshold level, Phillips Curve performs a discrete break and becomes vertical at the point of backward shift. The backward bending Phillips Curve shows the Minimum Unemployment Rate of Inflation (MURI) coinciding with unemployment rate which Phillips Curve bends backward and becomes vertical only when all workers have their inflation resistance threshold level in common.

The structure of the Phillips Curve is substantial for economic policy. In linear Phillips Curve, the slope of the Curve is constant in each point of the Curve, thus sacrifice ratio between inflation and unemployment trade-off is stable. However in non-linear the Phillips Curve, the slope of the Phillips Curve depends on sacrifice ratio between inflation and unemployment trade-off. If the Phillips Curve is convex, disinflation policy will be less costly at higher levels of inflation. If the Phillips Curve is concave, the disinflation policy will be more costly for higher rates of inflation (Hasanov et.al.: 2010).

By regards of the backward bending Phillips Curve, the slope of it and its inflexion point relies on how quickly workers return to real wage adjustments. If workers react to real wage adjustments at low inflation rates, the Curve will be vertical and bends back at a relatively lower rate of inflation and higher rate of unemployment. If real wage adjustments progresses slowly, the Phillips Curve will be flatter and bend back at a higher rate of inflation and lower rate of unemployment (Palley: 2006).

Although there is a considerable difference between the macroeconomic policy instruments, the MURI is considered as an alternative economic policy tool to NAIRU (non-accelerating inflation rate of unemployment). In the NAIRU framework, if inflation is in increase, this means the economy is overheating and monetary policy should be tightened or reverse. However in MURI framework, inflation is regarded as an "adjustment mechanism (grease)". If inflation is below the MURI point, an increase in inflation rate will cause to decrease in unemployment rate or reverse. Thus, inflation is an "adjustment mechanism" that "greases" the wheels of the economy (Palley: 2007).

This study aims to analyse the asymmetric relationship between unemployment-inflation and GDP-unemployment by using the asymmetric autoregressive distributed lag (NARDL) model for Canada. The MURI Curve is discussed in the first section. Econometric theory and methodology are examined in the second section while the third section consists of empirical results and the last section comprises the conclusions and policy implications.

2. *Data And Methodology*

2.1. Data

In this study, we aimed to analyze the relationship among unemployment, inflation and GDP by NARDL (non-linear ARDL) estimation for Canada with three variables which are inflation rate, unemployment rate and gross domestic product (GDP). Consumer price index was used to estimate inflation rate while per capita GDP was used to evaluate economic growth. The data covers 1957-2015 period quarterly were taken from OECD's Main Economic Indicators and IMF. The inflation rate (ip) was measured as ip=(consumer price indext /consumer price indext-1), unemployment was identified by un=unemployment rate and GDP(y) was calculated as y=(real per capita GDPt/ real per capita GDPt-1).

2.2. Methodology

In this paper initially, the asymmetric ARDL model was used as an extension of the linear ARDL approach. Firstly, the dynamic error correction sign is derived by the associated with the asymmetric long-run cointegrating regression, resulting in NARDL model. Secondly, it is employed a bounds-testing procedure for the existence of a long-run relationship that is valid regardless of whether the underlying regressors are I(0), I(1) or mutually cointegrated. When all variables are I(1), cointegration relationship is defined but if variables mix I(0) and I(1), it is accepted that there is a evidence of a long-run relationship. Thirdly, it is obtained asymmetric cumulative dynamic multipliers. Fourthly, NARDL model determines the long-run relation between the variables however, it doesn't inform about the direction of causality. That is determined by two non-linear Granger causality models.

2.2.1. Non-Linear ARDL Method

In recent years, there is great interest to non-linear cointegration models. The existing literature can be conducted by four subtitles. The first of them is generated by Balke and Fomby (1997). The second one is Markov-Switching ECM model of Krolzig (2006) and Psaradakis et.al. (2004). Thirdly, smooth transition regression ECM of Kapetanios et.al.(2006) and lastly, following Pesaran and Shin (1999) and Pesaran et.al (2001), Galeotti et.al (2003), Bachmeier and Griffin (2003), Van Treeck(2008), Shin et.al (2009), Bildirici and Özaksoy (2014) studied on asymmetric ARDL model. These models are applied in long-run asymmetric cases.

Shin et.al. (2013) used NARDL analysis to test the relation between economic growth and unemployment. Granger and Yoon (2002) established the term of "hidden cointegration". According to them, if positive and negative components of the series are cointegrated with each other, it means two time series have hidden cointegration. They suggested that standard linear (symmetric) cointegration is a special case of hidden cointegration and hidden cointegration is simple case of non-linear cointegration. Bivariate asymmetric cointegrated regression is proposed only for hidden cointegration analysis in cases where one component of each series appears in the cointegrating relationship.

It is possible to write ARDL model as follows:

$$y_t = c + \delta y_{t-1} + \beta x_{t-1} + \sum_{i=1}^{n-1} B_i\, y_{t-i} + \sum_{i=0}^{m} \gamma_i\, \Delta x_{t-i} + \varepsilon_t \quad (1)$$

$$\Delta y = y_t - y_{t-1} \quad (2)$$

Fpps test suggested by Pesaran and Shin (1999), Pesaran et al (2001) based on F-test on the joint null hypothesis. Null hypothesis is determined as $H_0\colon \delta = \beta = 0$.

The following ARDL model can be rewritten in the non-linear form as

$$\Delta y_t = c + \sum_{j=1}^{m-1} B_j\, \Delta y_{j-i} + \sum_{j=0}^{m} \left(\varphi_j^{+} \Delta x_{t-j}^{+} + \varphi_j^{-} \Delta x_{t-j}^{-}\right) + \delta y_{t-1} + \vartheta^{+} x_{t-1}^{+} + \vartheta^{-} x_{t-1}^{-} + \varepsilon_t \quad (3)$$

where Δ and ϵ_t are the first difference operator and the white noise term, respectively. Equation 3 represents the possibility of asymmetric effects over both short- and long-run, either only over long- or short- run. The second part of Equation 3 defines the long-run relationship and contains the lags of the asymmetric all variables in first differences.

$$\delta = \sum_{j=1}^{m} \emptyset_{j-1}\,, B_j = -\sum_{j=t+1}^{p} \emptyset_j \quad \text{for j= } 1, \ldots, n-1 \quad \varphi^{+} = \sum_{j=0}^{q} \varphi_j^{+}\,, \varphi^{-} = \sum_{j=0}^{q} \varphi_j^{-} \quad (4)$$

$\varphi_0^{+} = \vartheta_0^{+}, \varphi_j^{+} = -\sum_{t=j+1}^{q} \vartheta_i^{+}$ for $i = 1, \ldots, q-1$ $\varphi_0^{-} = \vartheta_0^{-}, \varphi_j^{-} = -\sum_{t=j+1}^{q} \vartheta_j^{-}$ for $i = 1, \ldots, q-1$ and $\varepsilon_t = y_t - \beta^{+1} x_t^{+} - \beta^{-} x_t$ is the nonlinear error correction term where $\beta^{+} = -\varphi^{+}/\delta$ and $\beta^{-} = -\varphi^{-}/\delta$ are the associated asymmetric long-run parameters

Following Shin et.al. (2013), if ρ=0, the equation reduces to the regression involving only first differences and then there is no long-run relationship among the levels at y_t, x_t^{+} and x_t^{-}. Following Pesaran et.al. (2001), F test was used. F test of the joint null is in $\delta = \vartheta^{+} = \vartheta^{-}$ eq.(3).

In this paper, it was used the pragmatic bounds-testing approach developed by Pesaran et.al. (2001). Shin et.al. (2013) determined two extreme cases can be identified one in which the level regressors x_t^{+} and x_t^{-} in eq.(3) are all I(1) and the other in which they all I(0).

In Equation 3, it is possible to test rigidities in the short- and/or long-run. The null hypothesis of no cointegration among the variables in Equation 3, are $H_0\colon \delta = \vartheta^{+} = \vartheta^{-} = 0$ against the alternative hypothesis $H_1\colon \delta \neq \vartheta^{+} \neq \vartheta^{-} \neq 0$ The null hypothesis of no long-run relationship $H_0\colon \delta = \vartheta^{+} = \vartheta^{-} = 0$ can be tested easily using the bounds-testing procedure advanced by Pesaran, Shin and Smith (2001), which remains valid regardless of whether the regressors are I(0), I(1) or mutually cointegrated. It follows three special cases:

(i) Long-run reaction symmetry where $\vartheta^{+} = \vartheta^{-} = \vartheta$; Long-run multipliers are determine as $L_{op}^{+} = \vartheta^{+}/-\delta\,, L_{op}^{-} = \vartheta^{-}/-\delta$ .When $\delta = 0$, there is no long-run asymmetric relationship. Long run symmetry is exaimed by Wald test with null hypothesis of $L_{op}^{+} = L_{op}^{-}$

(ii) Short-run adjustment symmetry in which $\varphi_i^+ = \varphi_i^-$ for all i = 0,...,q. Both types of restriction can be tested easily, using standard Wald tests;
(iii) The combination of long- and short-run symmetry in which the model became the standard symmetric ARDL model.

The asymmetric ARDL model is used to obtain the asymmetric dynamic multiplier effects of a unit change by

$$z_i^+ = \sum_{j=0}^{i} \frac{\kappa y_{t+j}}{\kappa x_j^+},\ z_i^- = \sum_{j=0}^{i} \frac{\kappa y_{t+j}}{\kappa x_j^-},\ \text{i=0,1,2,.........}$$
$$z \to \infty,\ z_i^+ \to \beta^+\ and\ z_i^- \to \beta^-\ where\ \beta^+ = -\vartheta^+/\delta\ and\ \beta^- = -\vartheta^-/\delta \qquad (5)$$

Symmetry over the short-run may be determined by standard Wald tests for the equality of the sum of the positive and negative dynamic coefficients:

$$\sum_{i=1}^{m-1} \vartheta_{t-i}^+ = \sum_{i=1}^{m-1} \vartheta_{t-i}^- \qquad (6)$$

Following Shin et.al. (2013), we used reduced form data generating process for Δx_t .

$\Delta x_t = \sum_{i=1}^{q=1} \Lambda_i \Delta x_{t-j} + e_t$ where $e_t \sim iid(0, \Sigma_e)$ with Σ_e being a kxk positive define covariance matrix.

Conditional nonlinear ECM is

$$\Delta y_t = \delta \xi_{t-1} + \sum_{j=1}^{m-1} B_j \Delta y_{t-j} + \sum_{j=0}^{q-1} (\mu_j^{+`} \Delta x_{t-j}^+ + \mu_j^{-`} \Delta x_{t-j}^-) + \nu_t$$
$$\mu_0^+ = \nu_0^+ + w;\ \mu_0^- = \nu_0^- + w;\ \mu_j^+ = \varphi_j^+ - w' \Lambda j\, and\, \mu_j^- = \varphi_j^- - w' \Lambda j \qquad (7)$$

2.3. Non-linear Causality Analysis

Although non-linear ARDL approach determines whether or not existence of long-run relationship between variables, it doesn't show the direction of causality. The direction of causality is important for policy makers and governments. The linear causality tests have some shortcomings. Hiemstra and Jones (1994) who pointed out that one of the shortcomings of the linear causality tests show their inability to detect the nonlinear relationships between macroeconomic variables. Baek and Brock (1992), Hiemstra and Jones (1994) suggested the non-linear Granger Causality test approach. In pursuit of pioneering papers, some papers have found it favorable and used it in macroeconomic perspectives. For example, Ma and Kanas (2000), Kyrtsou and Terraza (2003), Kyrtsou and Labys (2006), Rashid (2007), Bildirici (2013), Bildirici and Özaksoy (2014) used non-linear Granger causality.

3. Augmented Non-linear Granger Causality Model

The Asymmetric Error Correction (AEC) model was constructed as follows:

$$\Delta y = A_{10} + \sum_{i=1}^{m} B_{1i}\, \Delta y_{t-i} + \sum_{i=0}^{m} (\varphi_i^+ \Delta x_{t-i}^+ + \varphi_i^- \Delta x_{t-i}^-) + \zeta ECM_{t-1} + \varepsilon_{1t} \qquad (8)$$

$$\Delta x = \alpha + \sum_{j=1}^{m} \lambda\, \Delta x_{t-i} + \sum_{i=0}^{n} (\beta_i^+ \Delta y_{t-i}^+ + \beta_i^- \Delta y_{t-i}^-) + \zeta_2 ECM_{t-1} + \varepsilon_{2t} \qquad (9)$$

$\varepsilon_t = y_t - \gamma^{+'} x_t^+ - \gamma^{-'} x_t^-$ is the non-linear error correction term where $\gamma^{+'}$ and $\gamma^{-'}$ are the associated asymmetric long-run parameters. To deal with the possibility of non-zero contemporaneous correlation between the regressors and the residuals eq. (8) and (9), it was considered the following reduced form data generating process for $\Delta x_t = \sum_{i=1}^{q=1} \Lambda_i \Delta x_{t-j} + e_t$, $u_t \sim iid(0, \Sigma_0)$ and it was analysed ε_t conditionally in terms of

$$\varepsilon_t = \omega_{0_t} + e_t = \omega' (\Delta x_t - \sum_{j=1}^{q-1} \Lambda_i \Delta x_{t-j}) + e_t \tag{10}$$

$$\Delta y_t = p\xi_{t-j} + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=1}^{q-1} (\Pi_j^+ \Delta x_{t-j}^+ + \Pi_j^- \Delta x_{t-j}^-) + e_t \tag{11}$$

$$\Pi_0^+ = \vartheta_0^+ + \omega, \Pi_0^- = \vartheta_0^- + \omega, \Pi_j^+ = \vartheta_j^+ - \omega'\Lambda j \; and \; \Pi_j^- = \vartheta_j^- - \omega'\Lambda j \; for \; j = 1, \ldots\ldots, q-1 \tag{12}$$

ζ and ζ_2 are parameters indicating the speed of adjustment to the equilibrium level after a shock. They show how quickly variables converge to equilibrium and it must have a statistically significant coefficient with a negative sign.

Non-linear Granger Causality can be examined as follows: short-run or weak Granger causalities are detected by testing $H_0: \varphi_i^+ = \varphi_i^- = 0$ and $H_0: \beta_i^+ = \beta_i^- = 0$ for all i and j in Equations (10) and (11).

4. Econometric Results

Table 1 shows short and long-run non-linear ARDL results for Canada. According to the results, Wald test statistics is above the critical value. Wald tests determine to reject the null hypothesis of long-run symmetry for Canada. This shows that there is long-run asymmetric relationship among inflation, unemployment and economic growth in Canada.

The estimated long-run coefficients of y+ and y- are 4.028 and 15.46, respectively. An economic upturn of 24.8% is necessary to reduce unemployment by %1 while economic downturn of 6.4% leads to increase in unemployment for Canada. Shin et.al.(2013) supports our results with the ratios of 5.8% and 3.5% for economic upturn and economic downturn, respectively.

Table 1 Econometric Results for Canada

	Canada		
C_{t-1}	-0.0426 (2.339)	Δy^-	-1.64 (8.55)
un_{t-1}	0.388 (5.730)	Δy_{t-1}^-	-0.176 (2.81)
y^+_{t-1}	0.186234 (2.616)	Ly^+	4.028
y^-_{t-1}	-0.64077 (3.222)	Ly^-	15.46
Δun_{t-1}	0.478 (3.63)	F	58.79
ΔC_{t-1}	-0.1428 (5.17)	R^2	0.604
Δy^+	-0.195 (2.486)	W_{LR}	12.25
Δy_{t-1}^+	-0.334 (4.277)	W_{SR}	30.383

Note: W_{LR} refers to the Wald test of long-run symmetry while W_{SR} signifies the Wald test of the additive short-run symmetry condition.

The non-linear ARDL method does not indicate the direction of causality, however, according to non-linear ARDL results, at least a single direction causality relationship must exist. Therefore, we used non-linear Granger Causality model to determine the direction of the causality.

Table 2. Nonlinear Granger Causality Results

Canada			
	Symmetric Case	Asymmetric(P) Case	Asymmetric(N) Case
Δip→Δun	2.300	0.046	8.527*
Δun→Δip	25.61*	1.971	4.801*
Δun→Δy	0.5991	3.74*	5.1515*
Δy→Δun	0.2012	1.503	5.990*
Δip→Δy	5.56*	2.153	4.653*
Δy→Δip	51.359	5.641*	4.0699*

Notes: we consider the null hypothesis that *A* does not cause *B*. ***, ** and * indicate the rejection of the hypothesis of no causality at the 1%, 5% and 10%, respectively. Asymmetric(P) and Asymmetric(N) indicate asymmetric case for positive and negative changes in the causing variables, respectively.*SM* designates stock markets

Non-linear Granger Causality specifies the evidence of bi-directional causality between inflation and unemployment in negative asymmetric case for Canada. However, there is uni-directional causality from unemployment to inflation only in symmetric case. According to our empirical test results, there is bi-directional causality between unemployment and economic growth in negative asymmetric case and uni-directional causality from unemployment to economic growth only in positive asymmetric case for Canada. Further, for Canada, the evidence of bi-directional causality is demonstrated between inflation and economic growth for Canada and uni-directional causality from inflation to economic growth in symmetric case and from economic growth to inflation in positive asymmetric case for Canada.

5. Conclusion

Phillips Curve is regarded as a substantial macroeconomic instrument which holds empirical relation between monetary policy and labor market. The non-linear structure of the Phillips Curve is essential for designate non-linear economic policy implications according to sacrifice ration between inflation and unemployment.

In this paper, Post-Keynesian Phillips Curve was investigated by non-linear ARDL model and non-linear Granger Causality test for Canada. By using non-linear ARDL model, the short- and long-run asymmetric relationship is evaluated by selected macro economic variables for Canada. MURI offers an alternative policy guide to NAIRU. Thus, backward-bending Phillips Curve is so essential especially for policy makers who direct economy on the basis of macroeconomic variables.

Our empirical results suggest that bi-directional causality relationship indicates flexible or semi-flexible labor market structures while uni-directional causality relationship offers rigid labor market characteristics. Accordingly, Canada has flexible labor market designation which has bi-directional relationship between inflation-unemployment, unemployment-economic growth and inflation-economic growth. Besides, the empirical results show the there is enough evidence to reject the null hypothesis of long-run symmetric relationship between the variables. Thus, it can be stated that Canada has asymmetric labor market structure which supports Shin et.al. (2013)'s findings.

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