Does the Phillip Curve Exist? An Econometrics Analysis Report

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Abstract
The Phillips' Curve is a theory that states inflation and unemployment have a stable and inverse relationship. Many scholars I have tested this theory and have found it to be true. In order to test the findings of previous scholars and to prove that this theory exists, the paper provided a set by set practical analysis. This was done by the systematic framing of traditional methodology of Econometrics to evaluate the concept of the Phillip's Curve. The eight (8) steps of : 1. Statement of theory or hypothesis, 2. Specification of the mathematical model of the theory, 3. Specification of the statistical, or econometric, model, 4. Obtaining the data, 5. Estimation of the parameters of the econometric model, 6. Hypothesis Testing , 7. Forecasting or prediction and 8. Using the model for control or policy purposes helped in concluding that the existence of the Phillips' Curve.

1. Introduction

Throughout the growth of academia there has been the development of a number of scholarly theories that have survived the test of time. These theories whether in the Medical and or Social Sciences fields have been used to guide the development of numerous policies that aided in better decision making. In the Social Sciences the area of Economics have been bombarded by many economic theories that gave some insight to the micro and macro operations of the economy. Respectively, these theories began with the inner operations of the business (microeconomics), then graduated to the wider economy (macroeconomic) of a country and to a larger extent the economic operations in the world. Although these theories have been useful, most economic theories make statements or hypotheses that are mostly qualitative, thus providing no numerical measure between the variables they may highlight. Since this is the case the Econometrician is tasked with the responsibility to provide the numerical estimates that the Economist did not provide (Gujarati, 2004).

For the purpose of this assignment, the economic theory of The Phillips Curve will be assessed under the realms of the Econometric portfolio. This theory was chosen because the author speculates that the numerical measures of this theory will give her a clearer understanding of how macroeconomics can affect the stability of human capital or human resource. For this paper, the author will follow the eight (8) Traditional Methodology of Econometrics to evaluate the concept of the Phillip's Curve. These eight (8) steps are as follows: 1. Statement of theory or hypothesis, 2. Specification of the mathematical model of the theory, 3. Specification of the statistical, or econometric, model, 4. Obtaining the data, 5. Estimation of the parameters of the econometric model, 6. Hypothesis Testing , 7. Forecasting or prediction and 8. Using the model for control or policy purposes (Gujarati, 2004). After completing the first to the seventh step in the Econometric Methodology the author will provide recommendation for the Canadian government in the eighth (8) step which focuses on using the model for control or for policy purposes.

2. Statement of Theory or Hypothesis

2.1. Canada

After Russia, the second largest country in the world is Canada. Canada occupies roughly the northern two-fifths of the continent of North America. Despite Canada's great size, it is one of the world's most sparsely populated countries. Although Canadians are comparatively few in number, they have crafted what many observers consider to be a model multicultural society, welcoming immigrant populations from every other continent. In addition, Canada harbours and exports a wealth of natural resources and intellectual capital equalled by few other countries. With such a sparsely populated country it will be good to assess 'The Phillips Curve' in this country as a means of giving those persons in Human Resource a better understanding of the macroeconomic effects on the rise or decrease in wage prices as it relates to unemployment (Britannia.com) (Nicholson, Krueger, Lewis, & Roger, 2019).

2.2. The Phillips Curve

The economic concept of the Phillips Curve was developed by A.W. Phillips. This theory stated that inflation and unemployment have a stable and inverse relationship. In so doing, the theory claimed that with economic growth there will be inflation. This in turn will lead to more jobs and less unemployment. The concept behind the Phillips Curve states the change in unemployment within an economy has a predictable effect on price inflation. The inverse relationship between unemployment and inflation is depicted as a downward sloping, concave curve, with inflation on the y-axis and unemployment on the x-axis. Increasing inflation decreases unemployment and vice versa. Alternatively, a focus on decreasing unemployment also increases inflation, and

vice versa (Al-zeaud & Al-hosban, 2015). Base on the information provided in this brief literature review the author wishes to test the following hypothesis.

2.3. Hypothesis

Null Hypothesis (Ho): There is an inverse relationship between unemployment and inflation.

Alternative Hypothesis: There is not an inverse relationship between unemployment and inflation

Guidelines: The p-value is a number between 0 and 1.

- If the p-value is ***(≤ 0.05)*** the null hypothesis will be rejected.
- If the p-value is ***(> 0.05)*** the null hypothesis will not be rejected.

1. Specification of the Mathematical Model of the Theory

The functional relationship between the variables posited by The Phillips Curve will be depicted through a simple Mathematical Equation that is linear.

Deterministic Relationship: $Y = \beta_1 + \beta_2 X$

Y = Inflation (Dependent Variable)

X = Unemployment (Independent Variable)

β_1 = Parameter 1- The Intercept, which is the value of Y when X=0

β_2 = Parameter 2- The Slope Coefficient

2. Specification of the Statistical, or Econometric, Model

Econometric Model

Linear Econometric Model $Y = \beta_1 + \beta_2 X + \mu$

Since the theory posits an inverse relationship between inflation and unemployment a nonlinear model is also provided (Al-zeaud & Al-hosban, 2015).

Nonlinear Econometric Model $Y_i = \beta_0 X_i \beta_1 \varepsilon_i$

To transform this equation to linear, the product law of logarithm.

Thus, $\ln Y_i = \ln \beta_0 + \beta_1 \ln X_i + \ln \varepsilon_i$

3. Obtaining the Data

Data for this assignment was collected from the website, Worldbank.com. This data was collected from the country Canada over a fifty year period which was 1969 to 2018. A snapshot is provided below of the dataset that was used for this assignment. The Eviews software was used to generate: 1. Log graph, 2. Regression Graph, 3. Inverse Graph, 4. Line Graph and finally, 5. Descriptive Statistics of the data.

	Year	Inflation	Unemployment
2	1969 [YR1969]	4.561558902	4.699999809
3	1970 [YR1970]	3.346039814	5.900000095
4	1971 [YR1971]	2.704918033	6.400000095
5	1972 [YR1972]	4.988028731	6.300000191
6	1973 [YR1973]	7.487647282	5.599999905
7	1974 [YR1974]	10.99717115	5.400000095
8	1975 [YR1975]	10.6721886	..
9	1976 [YR1976]	7.54173863	7.089600086
10	1977 [YR1977]	7.976445396	8.048700333
11	1978 [YR1978]	8.973723352	8.375800133
12	1979 [YR1979]	9.144676979	7.525300026
13	1980 [YR1980]	10.12922051	7.536799908
14	1981 [YR1981]	12.47161241	7.60710001
15	1982 [YR1982]	10.7689719	11.04030037
16	1983 [YR1983]	5.86358803	12.01840019
17	1984 [YR1984]	4.304778304	11.34440041
18	1985 [YR1985]	3.962030541	10.50249958
19	1986 [YR1986]	4.194786291	9.593000412
20	1987 [YR1987]	4.356108712	8.819999695
21	1988 [YR1988]	4.028234149	7.761899948
23	1990 [YR1990]	4.780476933	8.131099701
24	1991 [YR1991]	5.625864086	10.31610012
25	1992 [YR1992]	1.490132904	11.19699955
26	1993 [YR1993]	1.865079365	11.37689972
27	1994 [YR1994]	0.165562914	10.39519978
28	1995 [YR1995]	2.148760331	9.488900185
29	1996 [YR1996]	1.570531125	9.619700432
30	1997 [YR1997]	1.621216381	9.100500107
31	1998 [YR1998]	0.995942457	8.278499603
32	1999 [YR1999]	1.734842951	7.583099842
33	2000 [YR2000]	2.719439957	6.828700066
34	2001 [YR2001]	2.52512014	7.218599796
35	2002 [YR2002]	2.258394409	7.664800167
36	2003 [YR2003]	2.758563214	7.573800087
37	2004 [YR2004]	1.857258719	7.185299873
38	2005 [YR2005]	2.213552034	6.758100033
39	2006 [YR2006]	2.002025395	6.320300102
40	2007 [YR2007]	2.138383993	6.036099911
41	2008 [YR2008]	2.370270674	6.13710022
42	2009 [YR2009]	0.299466803	8.343999863
43	2010 [YR2010]	1.776871541	8.055500031

Table 1: Snapshot of World Bank's Dataset on Canada's Inflation & Unemployment from 1969 to 2010

3.4. Graphs (Log, Regression, Inverse & Line)

The four (4) graphs mentioned previously, showed some form of inverse relationship between inflation and unemployment when they were plotted in the Eviews software. Meaning, that with an increase in unemployment there was a decrease in inflation. In particular the line graph showed that there are points where unemployment and inflation were both high. This can be attributed to the concept known as Stagflation. Despite the many outliers depicted in the graphs as well as the issue of Stagflation, on average there seem to be merit for the Phillips Curve. Further discussion will be given for the Descriptive Statistic that is provided on this dataset.

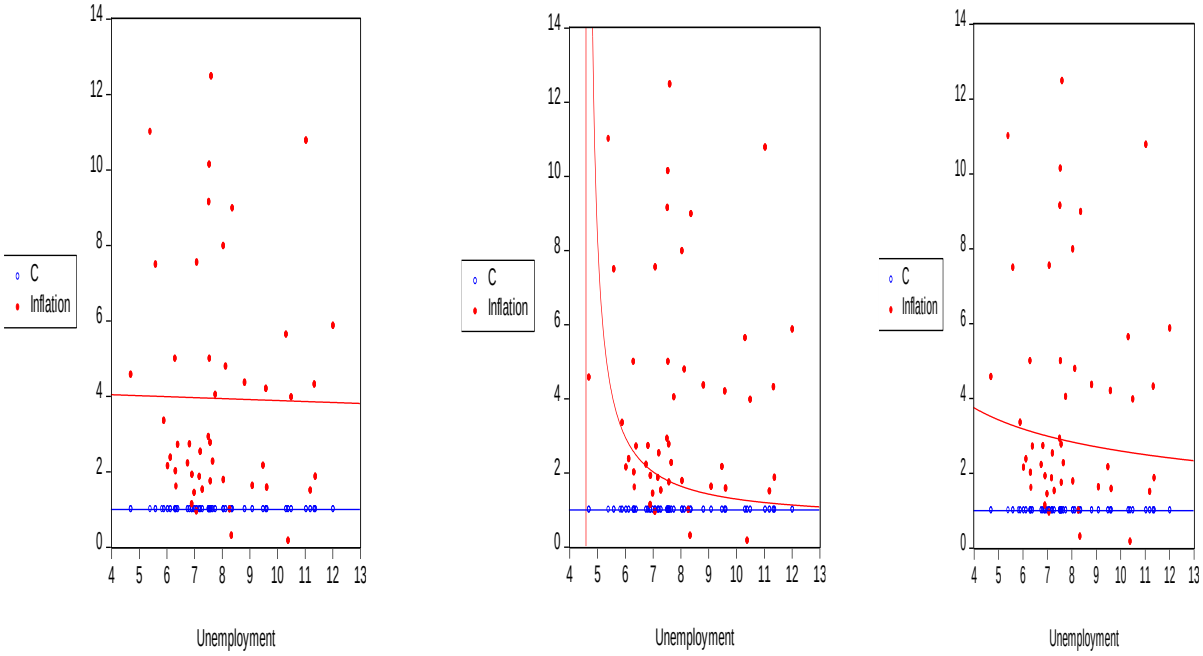

Figure 1: Graphs Showing Regression, Inverse Relationship and Log Relationship Respectively

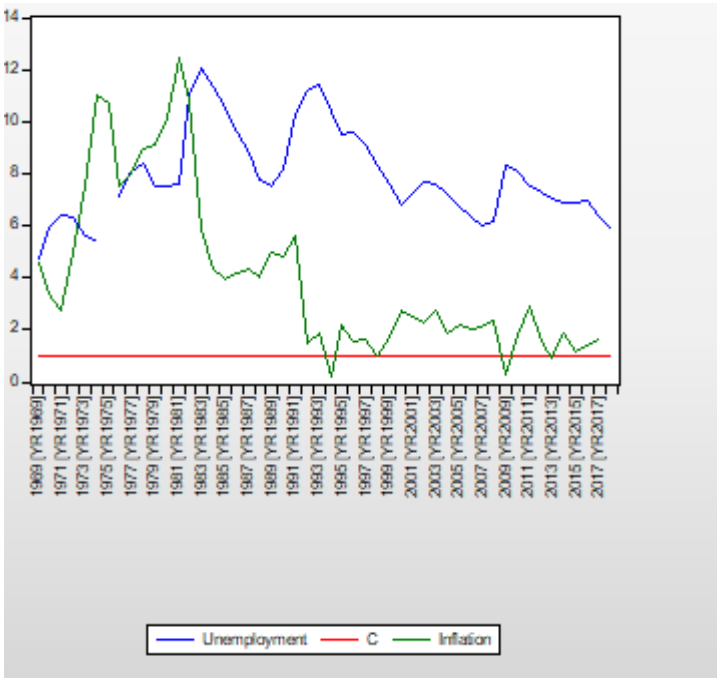

Figure 3: Line Graph Showing the Association Among Inflation and

3.5. Descriptive Statistic

The table below gives a number of descriptive statistic on the dataset assessed. As is depicted the dependent variable was inflation; whereas unemployment was independent. There was a sample adjustment from forty nine (49) observations to forty eight (48) observations. The forty eight (8) adjusted observations were used to calculate the estimates depicted in the table. The coefficient measurement shows that with every 1 unit rise in unemployment there is 3.9 unit decrease in inflation.

Dependent Variable: LOG(INFLATION)
Method: Least Squares
Date: 06/28/19 Time: 22:39
Sample (adjusted): 1 49
Included observations: 48 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.361990	0.600941	2.266428	0.0282
UNEMPLOYMENT	-0.038715	0.073845	-0.524269	0.6026

R-squared	0.005940	Mean dependent var	1.054082
Adjusted R-squared	-0.015670	S.D. dependent var	0.874916
S.E. of regression	0.881744	Akaike info criterion	2.626944
Sum squared resid	35.76375	Schwarz criterion	2.704911
Log likelihood	-61.04666	Hannan-Quinn criter.	2.656408
F-statistic	0.274858	Durbin-Watson stat	0.727576
Prob(F-statistic)	0.602609		

Table 2: Table Showing the Descriptive Results for Canada's Dataset

The P-value generated for this dataset was 0.6026 which is greater than the limits of 0.05. For the coefficient of determination or r- squared the results shows that the sample regression line provided fits the data 0.005940, falling within the limits of this measurement; however, it is considerably low. In other words, the total variation in y is explained by the regression model 0.005940. As for the Standard Error (SE), the mean of the sample estimates the mean of the population 0.073845.

4. Estimation of the Parameters of the Econometric Model

$$Y = \beta_1 + \beta_2 \bar{X} + \mu$$

Where $\boldsymbol{\beta_1}$ stands for the intercept term, and $\boldsymbol{\beta_2}$ is the slope of the regression line **computed as follows;**

The model's parameters are estimated as follows:

$\hat{\beta}_1 = \bar{y} - \hat{\beta}_2 \bar{X}$ And $\hat{\beta}_2 = \frac{\sum_{i=1}^{n}(X-\bar{X})(Y-\bar{Y})}{\sum_{i=1}^{n}(X-\bar{X})^2}$

Where;

$\bar{X}$ =7.751722012 And $\bar{y}$ =3.995969442

After computations we get,

$\hat{\beta}_1$ = 5.99 And $\hat{\beta}_2$ = -0.26

Based on the parameters derived, it is determined that at an intercept of 5.99 when the X-axis is at 0, there will be a slope coefficient or rise and run of -0.26 on the Y- axis.

5. Hypothesis Testing

From section (1) of this assignment the following hypotheses and guidelines were provided:

- ✓ ***Null Hypothesis (Ho):*** There is an inverse relationship between unemployment and inflation.
- ✓ ***Alternative Hypothesis:*** There is not an inverse relationship between unemployment and inflation
- ✓ ***Guidelines:*** The p-value is a number between 0 and 1.
  - If the p-value for is ***(≤ 0.05)*** the null hypothesis will be rejected.
  - If the p-value is ***(> 0.05)*** the null hypothesis will not be rejected.

From the guidelines provided above the Null Hypothesis will not be rejected since the Pvalue is > *0.05*

6. Forecasting or Prediction

Using the listed 2018 figure of 5.830800056 for unemployment, the ($\dot{y}$) or inflation will be forecasted for that year since it was missing from the dataset.

$$Y = \beta_1 + \beta_2 X$$

$$Y_{2018} = 5.99 - 0.26(5.8308)$$
$$= 4.77$$

Based on the calculations presented the inflation rate for 2018 as a trade-off from unemployment on average will be 4.47.

7. Using the Model for Control or Policy Purposes

With the forecasted inflation rate for 2018 the Canadian government can apply a mix of the appropriate fiscal and monetary policies to manipulate the control variable X to produce the desired level of the target variable Y. Such policies can also help to guide Human Resource in setting and accepting wage prices.

Conclusion

In conclusion, the eight (8) steps of traditional Econometric Methodology have provided an efficient way to sufficiently test theories and hypotheses.

Traditional Econometric Methodology

1. Statement of theory or hypothesis
2. Specification of the mathematical model of the theory
3. Specification of the statistical, or econometric, model
4. Obtaining the data
5. Estimation of the parameters of the econometric model
6. Hypothesis Testing
7. Forecasting or prediction
8. Using the model for control or policy purposes

After applying the eight (8) steps listed above, the author can sufficiently state that the hypothesis stated should be accepted as well as The Phillips Curve does exist.

References

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