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Inflation-Unemployment in the Economy of UK– An Experimental Testing

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Abstract

This investigation analyzes the presence of connection between Unemployment Rate & Inflation in UK (1970-2017). Inflation (It) and Unemployment Rate (Ut) are observed to be stationary factors at first contrast and the arrangements are integrated at 1st difference. There is a long-run connection. The estimation of the VEC Model affirms the long-run association. But VAR does not support the result. The experimental discoveries supported the presence of a Phillips curve in UK economy.

Keywords: *VAR, Cointegration, VEC , Adaptive Expectation..*

INTRODUCTION

The Phillips curve was originally a diagram of the relationship between the rate of change of money wage rates – that is wage inflation – and unemployment.

The argue over the soundness of the 'Phillips curve' proved to be stimulus not only to further research in to the association between inflation & unemployment but also to the development of the modeling of expectations. Indeed influential papers by Lucas (1972) and Sargent (1973), which arose out of the inflation/unemployment debate, led to profound changes in how economists and econometricians perceived the formation and modeling of expectations more generally; they led to the dominant paradigm changing from one of adaptive expectations to rational expectations.

Consideration of the inflation/unemployment trade-off provides an interesting opportunity to illustrate the historical development of economic ideas as they relate to a particular body of empirical evidence, and how the same general phenomena are capable of

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different interpretations.

The experiential estimation of inflation and unemployment models is an enlarging research region, because of theoretical and technical thought. "Phillips curve models" is one type of those models.

The empirical issue of the connection amid Inflation & Unemployment Rate is important for UK because whether monetary policy is effectual or not. The estimation of such relationship may present an account of dynamic relations between these variables.

Hypothesis following the Phillips Curve

In an article that subsequently generated an extensive and sometimes quite hostile debate Phillips (1958) using nearly a century (1861-1957) of UK data, suggested that the rate of change of money wage rates can be made clear by the level of employment. Consequently the term 'Phillips Curve', describing a negative and nonlinear relationship between wage inflation & unemployment. Much earlier, using US data, Fisher (1926) had suggested a relationship between price (rather that wage) inflation and unemployment.

Friedman (1968) argued that Phillips had made a fundamental mistake in failing to discriminate real wages with nominal wages; and Friedman further distinguished between anticipated and unanticipated variables. The essence of Friedman's model, which leads to short run non vertical Phillips Curves, is because of money illusion. In Friedman's model only in the long-run, the unemployment at natural rate is sustainable since that is determined by real forces.

The development of empirical (rather that purely theoretical) attempts at improving Phillips' original approach centered on whether he had confused money wages with real wages and whether he had failed to distinguish the role of expected inflation. This led to the formulation of Phillips curve (expectation augmented) of the general form

$$\pi_w = a + f(u_t) + \delta\pi_{\text{ie}} + \eta_t .$$

A crucial role was attributed to the coefficient d. A d of 0 implied that there was total money delusion in the wage bargaining process - it was money wages rather than real wages that made an issue. A d of 1 implied that the appropriate dependent variable in the modified Phillips curve was $\pi_{wt} - \pi_t^e$. A value of d between 0 and 1 implied that the non-vertical long run Phillips curve.

The rational expectation of inflation, formed at t-1, to prevail at t is the conditional expectation of p_t given the information set W_{t-1} : $_{t-1}\pi_t^e = E_{t-1}\{\pi_t / \Omega_{t-1}\}$
The relation between the outturn and the rational expectation is $\pi_t = E_{t-1}\{\pi_t / \Omega_{t-1}\} + \varepsilon_t = {}_{t-1}\pi_t^e + \varepsilon_t$
where e_t a zero mean has and is orthogonal to W_{t-1} .

We now have a system of two equations comprising the Expectation Augmented Phillips Curve (EAPC) and the Rational Expectations Hypothesis, REH:

$$\pi_w = a + f(u_t) + \delta({}_{t-1}\pi_{\text{ie}}) + \eta_t$$

$$_{t-1}\pi_t^e = \pi_t - \varepsilon_t$$

Resulting in :

$$\pi_w = a + f(u_t) + \delta(\ \pi_t\ ) + v_{tt}$$

Where $v_t = \eta_t - \delta\varepsilon_t$

The above equation is the Rational Expectations description of the Amplified Phillips Curve. While AEH version of the Phillips curve appeared to be well specified it did not dominate the RE version using weakly rational information set. The comparison of models shows that while noise residuals but not by themselves sufficient conditions for a satisfactory empirical model. By the same logic the RE version of the EAPC is only tentatively adequate.

Literature review

Author	Country	Findings
William Phillips(1958)	United Kingdom 1861-1957	Solid negative connection among joblessness and expansion
Samuelson and Solow (1960)	United States	A converse connection among joblessness and expansion in the nation.
Solow (1970) & Gordon (1971)	U.S.	Presence of a non-positive exchange off connection among joblessness & swelling.
Friedman (1968) & Phelps (1967)	UK	There may be a pessimistic connection among joblessness and swelling in the short-period of time. Be that as it may, there would be no exchange off connection between them over the long haul.
Cashell (2004)		Over the long haul joblessness rates would go towards harmony level that is named as (NAIRU).
Lucas (1976)		There could be an exchange off connection among joblessness and swelling.
King and Watson (1994)	U.S.	The presence of an exchange off connection among joblessness and swelling in the nation. They contend that there could be a backwards connection among joblessness and expansion if clamors were expelled from the information.
Hogan (1998)	U.S.	There is a huge and negative connection among joblessness and expansion in spite of the fact that the conventional "Phillips bend" appears to over-anticipate the rate of swelling.
John DiNardo & Mark Moore (1999)	Nine OECD	Results demonstrate a striking powerful connection between variables concerned.
Turner & Seghezza (1999)	21 OECD countries	Solid help for the "normal" Phillips bend among 21 part nations of the OECD.
Tang & Lean (2007)	Malaysia	Stable exchange off connection was there.
Furuoka (2007)	Malaysia for the period 1973-2004	A tradeoff connection among swelling and joblessness.
Tang and Lean (2007)	Malaysia	Causal connection between the variables concerned.

Though in the above literature synthesis it has been found that the time series data analysis was used to fountain some light on the relationship, the empirical testing in this article looks ahead to contribute to the existing literature in UK. Hope it would provide better predictive performance.

Purpose of the Investigation:

Under this disputable hypothetical structure, we look to enquire experimentally into the connection among I_t and U_t in UK. Regardless of the way that the past research utilized time-arrangement information examination to inspect the presence of association between variables concerned. This paper would like to add to the current literature by utilizing time arrangement setback in UK.

Specific Issues Under Study:

The present examination looks to enquire into

(I) the presence of long-run harmony connection between I_t and U_t in UK

(ii) stable long-run relationship

(iii) the nature and course of causality between the variables concerned in the economy of UK.

The Data:

The connection among Inflation (I_t) and Unemployment (U_t) Rate in UK is being contemplated for the period 1970-2017. The examination includes the utilization of yearly dataset for Inflation and Unemployment Rate in UK. Discount Price Index (CPI) is utilized with 2000 as the base time frame. The information has been taken from different issues of IFS.

Organization of the paper:

Segment II is dedicated to the investigation of stationarity, cointegration. Segment III manages dynamic relationship through the estimation of Vector Autoregression Model. Segment IV covers Phillips Curve Analysis with Adaptive Expectation Hypothesis and Segment V presents Concluding Remarks.

Section II

Products of the tests are being presented through the Table-1 and the Table-2.

Table 1: Results of Unit Root Tests

					M C Value		
Variable	Exogenous	ADF Test Statistic	P-value	L-length	1%	5%	10%
Inflation (I_t)	none	-1.47	0.16	0	-3.61	-1.84	-1.71
Inflation at 1st difference	none	-6.90	0.00	0	-3.57	-1.82	-1.69
Unemployme-nt Rate ((U_t)	none	-0.80	0.50	0	-3.61	-1.84	-1.71
Unemployment at 1st difference	none	-6.95	0.00	0	-3.61	-1.82	-1.74

It is observed from the Table-1 that

The results hint at the stationarity of I_t series and of U_t series. These findings, therefore, call for the reexamination of the stationarity of the series concerned through the Phillips Perron Tests.

Table 2 : Phillips - Perron Tests in Inflation (I_t) and Unemployment Rate ((U_t)

					Mackinnon Critical Value		
Variable	Exogenous	P-P Test statistic	Prob.* value	Band with	1%	5%	10%
Inflation (I_t)	none	-1.24	0.32	21	-3.71	-1.74	-1.51
Inflation at 1st difference	none	-9.22	0.00	4	-3.71	-1.84	-1.51
Unemployment Rate ((U_t)	none	-0.66	0.60	6	-3.71	-1.84	-1.51
Unemployment at 1st difference	none	-5.90	0.00	9	-3.71	-1.84	-1.51

(I) the null hypothesis of Unit Roots in It series is accepted at 1% , 5% and even at 10% level but rejected at 1st difference level, and

(ii) the null hypothesis of unit root in Ut series has been also been rejected at 1% level of 1st difference.

Consequently, It is stationary and Ut is stationary at 1st difference level.

Study of Cointegration Between Inflation and Unemployment:

Table 3 : Johansen Cointegration Test

Series: INFLATION UNEMPLOYMENT				
Hypothesized		**Trace**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	**0.283**	**21.511**	**16.484**	**0.013**
At most 1	**0.0860**	**4.898**	**4.8454**	**0.061**
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		**Max-Eigen**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	**0.287**	**16.622**	**15.264**	**0.020**
At most 1	**0.0860**	**4.7980**	**4.8514**	**0.041**
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level				

Johansen cointegration test showed that the variables are cointegrated i.e., a long-run association must exist between {I_t} and {U_t}. This means that It must have a long-run association with U_t. Similarly, U_t must uphold a long-run connection with I_t

VEC Model

There exists a long-run connection between Inflation (It)and Unemployment Rate (Ut) in the economy of UK. The security of such relationship should be inspected. This is done through the estimation of the Vector Error Correction (VEC) Model. The assessed model causes us comprehend if any short-run stun could destabilize the long-run connection between these factors.

The VEC Model:

In this study the Vector Error Correction Model is as follows:

$$\Delta I_t = \gamma_1 + \rho_1 Z_{t-1} + \alpha_1 \Delta I_{t-1} + \alpha_2 \Delta I_{t-2} + \alpha_4 \Delta U_{t-1} + \alpha_5 \Delta U_{t-2} + \varepsilon_{1t} \quad \text{------ (1)}$$

$$\Delta U_t = \gamma_2 + \rho_2 Z_{t-1} + \beta_1 \Delta I_{t-1} + \beta_2 \Delta I_{t-2} + \beta_4 \Delta U_{t-1} + \beta_5 \Delta U_{t-2} + \varepsilon_{2t} \quad \text{------ (2)}$$

where ΔU = first difference of U (unemployment), ΔI = first difference of I (inflation), Z_{t-1}= first lag of error term of the regression equation (serving as the virtual cointegrating equation), ε_{1t} , ε_{1t} are white noise error terms, $\alpha_1 \ldots \alpha_4$ are the coefficients of ΔU and ΔI in equation (1,) $\beta_1 \ldots \beta_4$ are the coefficients of ΔU and ΔI in equation (2), γ_1 and γ_2 are the intercept of the equations (1) and (2) respectively. In the estimation of VEC model at least one of ρ_1 and ρ_2 should be non-zero." (A Kundu, 2016, pp. 112-113)

Outcomes of Estimation:

Estimated VEC model depicted in the Table-4.

Table 4 : VEC Estimation

Dependent Variable	Independent Variable	Coefficients	Standard errors	**'t'Statistics**
ΔI_t	**Constant(β_1)**	**-0.122**	**0.251**	-0.48
	z_{t-1}	**0.016**	**-0.05**	[0.32]
	ΔI_{t-1}	**0.33**	**-0.707**	[0.46]
	ΔI_{t-2}	**-0.31**	**-0.45**	[-0.67]
	ΔU_{t-1}	**-0.251**	**-1.553**	[-0.46]
	ΔU_{t-2}	**-0.011**	**-0.966**	[-0.90]
	R^2 = 0.230, F-stat = 6.86, L likelihood = -55.93, AIC : 5.39, SC : 5.65			
ΔU_t	**Constant(β_2)**	**-0.008**	**0.12**	-0.07
	z_{t-1}	**-0.406**	**-0.03**	[3.15]
	ΔU_{t-1}	**-0.127**	**-0.248**	[0.51]
	ΔU_{t-2}	**0.053**	**-0.14**	[0.37]
	ΔI_{t-1}	**-0.227**	**-0.12**	[2.02]
	ΔI_{t-2}	**-0.138**	**-0.08**	[1.85]
	R^2 = 0.468, F-stat = 4.99, Log likelihood = -90.18546, AIC = 3.627, SC = 0.984			

Findings:

In UK over the period 1970-2017 the following result has been found

(i) the long-run association, that unemployment kept up with swelling, was steady. The stuns, spread through joblessness channel, had critical settling sway on the long-run association. Therefore, the short-run elements of joblessness characterized a 'balance' procedure.

Section IV

Phillips Curve Analysis with Adaptive Expectation Hypothesis

Building AR Model for Inflation and Forecasting:

Identification of The Model:
AR(p) Structure Identification:

It is further observed from the Figure-2 & 3 (given in the appendix) that
(i) the PACF restrains considerable spikes (at lag 6).
(ii) the ACF also restrains considerable spikes (at lag 6).
These indicate that at level Inflation series defines an AR(6) structure.
Consequently, the estimable AR (6) model is

$$I_t = \alpha + \beta_1 I_{t-6} + u_t \quad 3$$

Results of Estimation

The estimated equation is as follows:

$$I_t = 0.17 + (-1.33) I_{t-6} \quad 4$$

S.E. (0.29) (0.18)
t-Stats (0.57) (-7.68)
Prob. (0.57) (0.00)
R^2 =0.58, Adj R^2 = 0.57, DW=1.897, F=2.89

Findings:

The equation 2 shows that
(i) $\hat{\beta}_1$ is found to be statistically viable at 1% level,
(ii) $\hat{\alpha}$ is not statistically viable even at 10% level,
(iii) the equation is free from autocorrelation since DW=1.89.

Adaptive Expectation for Inflation:

AR (1) model as given by the equation 1 has been used for generating six period ahead forecast for It .

VAR Model:

VAR model forms:

$$i_t = \alpha_1 + \delta_{11} i_{t-1} + \delta_{12} i_{t-2} + \lambda_{11} U_{t-1} + \lambda_{12} U_{t-2} + u_{1t} \quad (5)$$

$$U_t = \alpha_2 + \lambda_{21} U_{t-1} + \lambda_{22} U_{t-2} + \delta_{21} i_{t-1} + \delta_{22} i_{t-2} + u_{2t} \quad (6)$$

Results of Estimation of the Model:

Table 5 : Estimated results of Equations (5) and (6)

Dependent Variable	Independent Variable	Coefficients	Standard errors	't'Statistics
i_t	Constant(α)	-0.04	(0.35)	[-0.12]
	i_{t-1}	0.423	(0.37)	[1.20]
	i_{t-2}	-0.012	(0.34)	[-0.04]
	U_{t-1}	-0.239	(0.68)	[-0.31]
	U_{t-2}	0.008	(0.67)	[0.02]
R^2 = 0.075, F-stat = 0.70, Log likelihood = -90.85, AIC = 5.598				
U_t	Constant(α')	20.12	(4.99)	[4.21]
	U_{t-1}	0.675	(0.19)	[1.57]
	U_{t-2}	0.014	(0.18)	[0.08]
	i_{t-1}	0.004	(0.008)	[0.387]
	i_{t-2}	0.005	(0.008)	[0.48]
R^2 = 0.38, F-stat = 4.53, Log likelihood = 30.85, AIC = -2.28				

Stability check of VAR Model:
The roots of the Characteristic Polynomials B(L) and A(L) are given by the Table-5

Table 6 : VAR Stability Condition Check

Roots of Characteristic Polynomial	
Endogenous variables	
Root	Modulus
0.218 - 0.429i	0.481553
0.214 + 0.428i	0.481553
0.095 - 0.126i	0.158189
0.095 + 0.126i	0.158189

Figure 5

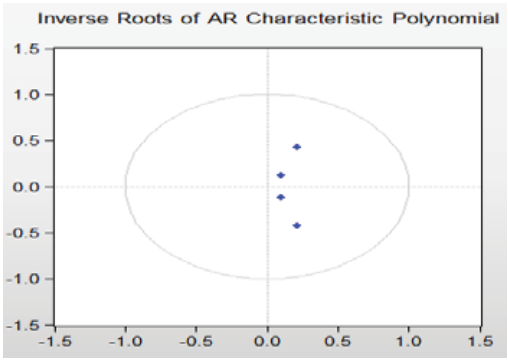

Table - 6 depicts that

(i) there is one characteristic root (eigen values) for A(L),

(ii) there is one characteristic roots (eigen values) for B(L),

(iii) absolute value (modulus) of the roots are less than unity,

Table-6 and figure-5 shows the stability of the model.

Understanding from economics point of view:

(I) $\hat{\lambda}_{11}$ being insignificant indicates that U_{t-1} did not affect it even in the presence of i_{t-1} in the vector of regressors. Consequently, U_t, the unemployment did not Granger cause i_t, inflation in UK.

(ii) $\hat{\lambda}_{11}$ being insignificant indicates that variation in unemployment did not lead to an immediate variation in inflation.

(iii) $\hat{\delta}_{21}$ being insignificant indicates that current unemployment did not significantly affect by inflation in last one period.

Overview:

The findings in this part point to that in the economy of UK

(I) inflation did not Granger Caused unemployment,

(ii) unemployment did not Granger Caused inflation.

Consequently, the economy of UK was marked by the absence of association between inflation & unemployment rate.

Section V
Concluding Remarks

The experimental consequence of cointegration test shows cointegration among It and Ut for the nation, which infers that there is a long-run connection. No causality running in short-run.

The study affirms 'Uni-directional Causality' running from It to Ut in the economies over the period 1970-2017. Since Inflation granger caused unemployment, money related approach is substantially more fitting to diminish unemployment.

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