iCBST 2014 International Conference on Business, Science and Technology which will be held at Hatyai, Thailand on the 25th and 26th of April 2014.

Australian Journal of Basic and Applied Sciences, 8(5) Special 2014, Pages: 91-98

AENSI Journals

Australian Journal of Basic and Applied Sciences

ISSN:1991-8178

Journal home page: www.ajbasweb.com

Output- Inflation, Output-Unemployment and Unemployment-Inflation Trade-Offs

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ARTICLE INFO

Article history:
Received 25 January 2014
Received in revised form 12 March 2014
Accepted 14 April 2014
Available online 25 April 2014

Keywords:
Okun's law, Co-integration, GDP, Unemployment, Inflation

ABSTRACT

This study aims to investigate the interdependence between the three macroeconomic phenomena: inflation, output and unemployment in Libyan economy during the period 1962-2009. According to this we utilize three different models to estimate the relationship in the long and short run. The relationships estimate through Co-integration, VECM and GMM methods. We performed the break point test and estimated the long-run and short-run for 1962 to 2009 and 1973 to 2009 separately. In addition, to get the robustness of our results; first we estimate the long-run and short run relationship between selected variables by applying Johansen co-integration and VECM. Then we estimate the gap model for the same relationship by applying two different methods covering two different periods of time: OLS and GMM. Furthermore, the results of the long-run and short-run denote to the policymaker or monetary policy must pay attention to the strategy that showed by Okun's law and Phillips curve.

To Cite This Article: Mohamed Fargani., Output- Inflation, Output-Unemployment and Unemployment-Inflation Trade-Offs. ***Aust. J. Basic & Appl. Sci.,*** *8(5): 91-98, 2014*

INTRODUCTION

Economic growth, unemployment and inflation are among the most difficult and politically sensitive economic issues that policymakers face, especially in developed and developing countries. Theories such as the neo-classical and Solow growth models, Phillips Curve and Okun's Law are empirically tested for some economies. Macroeconomic policies are implemented in order to achieve full employment and stable economy via low inflation. Many countries targeted inflation during 1990–1993 and showed success.

Okun's Law (Okun, 1962) describes the relationship between unemployment and output growth. According to Okun, an increase of 1% in unemployment leads to a fall of about 2% in RGDP growth. This law is often used in conjunction with the Philips curve for implementing certain economic and labour market policy. In 1958 the British economist A. W. Phillips described the relationship between inflation and unemployment. He established the relationship between the rate of unemployment and the change in wages in the UK using a data set from 1862 to 1957. This empirical study produced a reasonably smooth curve, now known as the Phillips Curve. It shows a trade-off between rate of inflation and unemployment rates.

It is often the case that suppressing inflation comes at the cost of greater unemployment, and that reduced unemployment comes at the cost of greater inflation. Every country desires to reduce unemployment and inflation, but none can do both.

To our knowledge there is no empirical study of the Phillips curve in Libya, particularly on testing its stability. This study investigates the long and short-run relationship between i) inflation and unemployment, ii) growth and inflation, and iii) growth and unemployment in Libya for the period 1962–2009. The study is organised as follows. Section 2 presents the literature review of the above three issues, section 3 develops the theoretical framework for the above mentioned relationships and Section 4 discusses the data and empirical findings. Finally, section 5 goes back to the main conclusion of this study and addresses some policy recommendations.

1. A Review of International Debate:

1.1 The relationship between inflation and unemployment:

The supposed trade-off between inflation and unemployment is usually demonstrated by the Phillips curve. Phillips (1958) was primarily concerned with the possibility of a negative relationship between the rate of

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unemployment and changes in nominal wage rates in the United Kingdom. This focus was modified by later economists to a relationship between unemployment and inflation rates. Friedman (1968)introduced the concept of the natural rate of unemployment, which led to the view that in the long run the Phillips curve is perfectly vertical and the unemployment rate is independent of inflation and monetary policy.

The natural rate of unemployment (NAIRU) occurs when the labour market is in equilibrium (supply side of unemployment, i.e., frictional and structural unemployment). If the actual rate of unemployment is reduced below the natural rate, there is an increased risk of inflation. Samuelson and Solow (1960) supported Phillips hypothesis and examined the relationship between inflation and unemployment in the US economy. Their results show an inverse relationship between the two macroeconomics variables in the short run. Hansen and Pancs (2001) examined the existence of the Phillips curve in Latvia. They also found a negative trade-off relationship between unemployment rate and actual inflation rate in the short run.

1.2 The relationship between RGDP and unemployment:

Several studies investigate the relationship between unemployment and RGDP, a relationship that has become known as Okun's Law. After the publication of Okun's seminal paper, numerous studies were carried out to test Okun's Law, mostly for the US but also for other developed countries. Those by Evans (1994) and Prachowny (1993)are some of the most important ones.Lee (2000) andMoosa (2008) examined Okun's Law and empirically estimated the relation between GDP and unemployment in different locations. These studies generally provide support for the empirical validity of the relationship, but the estimates have been found to vary substantially across countries and over time. Related data series are subject to structural breaks arising out of policy changes in the countries concerned: Lee (2000), for example, identifies structural changes caused by rising participation in the labour force by females, productivity and wage slowdowns, and corporate restructuring.

Evans (1994) uses data for the US economy from 1950 to 1989 to assess the relationship between RGDP growth and the unemployment rate, and finds 'substantial feedback' between the two variables, supported by the contemporaneous correlation between them. The study uses a non-restricted bivariate VAR which shows a long-run relationship between GDP growth and unemployment at 0.30, in line with Okun's findings. Keller and Nabli (2002) suggest that economic growth in the MENA region has been lagged behind growth in the region's labour force, and argue that high growth does not guarantee good labour market outcomes. They suggest that unemployment will persist during times of high economic growth if the growth is capital intensive rather than employment intensive, and point out that employment has strongly expanded despite low levels of growth.

Freeman (2001) has used new developments in trend/cycle decomposition to test Okun's Law in a panel of ten industrial countries. In Okun's original estimate for the USA, he finds that each one per cent reduction in the unemployment rate results in just less than two points of RGDP growth for the sample countries.

1.3 The relationship between inflation and output:

It follows from the above discussion that there is a relationship not just between inflation and unemployment but also between inflation and output. Lucas's (1973) classic paper on inflation–output trade-offs uses nominal GDP growth as the right-hand-side variable in a regression estimated with OLS. The implicit assumption is that supply shocks in the residual do not influence nominal GDP, but can influence both RGDP and the price level in opposite directions. Taking the relationship between economic growth and inflation, Mallik and Chowdhury (2001) examined the short- and long-run dynamics of the relationship between inflation and economic growth in four South Asian economies: Bangladesh, India, Pakistan and Sri Lanka. Applying VECM, they found two results: first, the relationship between inflation and economic growth is positive and statistically significant for all four countries; second, the sensitivity of growth to changes in inflation is smaller than that of inflation to changes in growth. These results have important policy implications; for although moderate inflation promotes economic growth, faster economic growth feeds into inflation by overheating the economy. These four countries are therefore on the turning point of an inflation–economic growth relationship. Their findings show a positive relationship between inflation and output gap. For MENA countries including Libya, few studies have analysed the relationship between inflation, unemployment and economic growth. Osama (2004) found a positive relationship between inflation and economic growth in Jordan using structural break point. He concluded that if the rate of inflation becomes low – up to 2% – the relationship between the two variables becomes negative.

2. Methodology and Data:

The models, data and methodology used to estimate the hypotheses are presented in this section to explain the relationship between RGDP and unemployment for the Libyan economy. Data and time frame used are explained, followed by a description of the background of the model and a discussion of model specifications.

2.1 Model specification:

As stated earlier, this chapter examines the relationship between i) inflation and unemployment, ii) growth and unemployment growth, and iii) growth and inflation in Libya for the period 1962 to 2009.

2.1.1 Co-integration and error correction mechanism:

Firstly we will analyse the three relationships using co-integration and error correction mechanism of the following forms:

$$f(\ln UNEMP_t, \ln CPI_t) = 0 \text{----------(4.1)}$$

$$f(\ln UNEMP_t, \ln RGDP_t) = 0 \text{----------(4.2)}$$

$$f(\ln RGDP_t, \ln CPI_t) = 0 \text{----------(4.3)}$$

Where lnUNEMP is a natural logarithm of number of unemployed persons at time t, RGDP is a natural logarithm of real gross domestic product at time t, and CPI is a natural logarithm of the consumer price index at time t.

From Equations (4.1), (4.2) and (4.3), if $ln UNEM_t$ and $ln RCPI_t$, $\ln UNEMP_t$ and $\ln RGDP_t$ and $\ln RGDP$ and $\ln CPI$ are co-integrated then the VECM model can be written as follows:

$$\Delta \ln UNEMP_t = \alpha_{11} + \sum_{i=1}^{p} \beta_{11i} \Delta \ln UNEMP_{t-i} + \sum_{j=1}^{p} \gamma_{11j} \Delta \ln CPI_{t-j} + \eta_{11} ECM_{t-1} + v_{11} DUM_{74t} + \theta_{11} DUM_{84t} + e_{11t} \text{--(4.4)}$$

$$\Delta \ln CPI_t = \alpha_{12} + \sum_{i=1}^{p} \beta_{12i} \Delta \ln UNEMP_{t-i} + \sum_{j=1}^{p} \gamma_{12j} \Delta \ln CPI_{t-j} + \eta_{12} ECM_{t-1} + v_{12} DUM_{74t} + \theta_{12} DUM_{84t} + e_{12t} \text{---(4.5)}$$

Similarly, from Equation (4.2) if $ln UNEM_t$ and $ln RGDP_t$ are co-integrated then the VECM model can be written as follows:

$$\Delta \ln UNEMP_t = \alpha_{21} + \sum_{i=1}^{p} \beta_{21i} \Delta \ln UNEMP_{t-i} + \sum_{j=1}^{p} \gamma_{21j} \Delta \ln RGDP_{t-j} + \eta_{21} ECM_{t-1} + v_{21} DUM_{74t} + \theta_{21} DUM_{84t} + e_{21t} \text{--(4.6)}$$

$$\Delta \ln RGDP_t = \alpha_{22} + \sum_{i=1}^{p} \beta_{22i} \Delta \ln UNEMP_{t-i} + \sum_{j=1}^{p} \gamma_{22j} \Delta \ln RGDP_{t-j} + \eta_{22} ECM_{t-1} + v_{22} DUM_{74t} + \theta_{22} DUM_{84t} + e_{22t} \text{--(4.7)}$$

Similarly, from Equation (4.3) if $\ln CPI_t$ and $ln RGDP_t$ are co-integrated then the VECM model can be written as follows:

$$\Delta \ln RGDP_t = \alpha_{31} + \sum_{i=1}^{p} \beta_{31i} \Delta \ln RGDP_{t-i} + \sum_{j=1}^{p} \gamma_{31j} \Delta \ln CPI_{t-j} + \eta_{31} ECM_{t-1} + v_{31} DUM_{74t} + \theta_{31} DUM_{84t} + e_{31t} \text{--(4.8)}$$

$$\Delta \ln CPI_t = \alpha_{32} + \sum_{i=1}^{p} \beta_{32i} \Delta \ln RGDP_{t-i} + \sum_{j=1}^{p} \gamma_{32j} \Delta \ln CPI_{t-j} + \eta_{32} ECM_{t-1} + v_{32} DUM_{74t} + \theta_{32} DUM_{84t} + e_{32t} \text{--(4.9)}$$

$ECM_{t-1} =$ Error correction term with a one year lag; it will measure the speed of adjustment of the return to co-integrated relationships.

As Libya has experienced fluctuations in oil price since 1973. The Chow test (Chow, 1960) has been employed to test the existence of endogenously determined structural breaks. We found two break points in 1973 and 1984. Therefore we considered two dummy variables (D_{73} *and* D_{84}).

2.1.2 Gap models:

The standard specification of the Phillips curve relates the inflation rate to the unemployment rate.

First model:

$$\pi_t = \pi_t^e - \beta_{01}(U_t - U_t^*) - \gamma_{01}\Delta(U_t - U^*_t) + \varepsilon_{01,t} \text{------(4.10)}$$

Where, $U_t - U_t^*$ is the unemployment gap, π_t is inflation and π_t^e is the expected inflation at time t, $\Delta(U_t - U^*_t)$ represents the change in unemployment gap over time to affect inflation.

Second model :

$$Y_t - Y_t^* = \alpha_{02} + \beta_{02}(U_t - U_t^*) + e_{02,t} \text{------(4.11)}$$

Where $Y_t - Y_t^*$ is the RGDP gap at period t, $U_t - U_t^*$ is the unemployment gap at time t, and $\beta_{02} < 0$

Third model :

$$\pi_t = \alpha_{03} + \beta_{03}(Y_t - Y_t^*) + \gamma_{03}\pi^e{}_t + e_{03,t} \quad ----(4.12)$$

Where, $Y_t - Y_t^*$ is the RGDP gap at period *t* and π_t^e is the inflation expectation at time t.

First we estimate Equations (4.10), (4.11) and (4.12) using OLS. Then we use Generalised Method of Moments (GMM) to address possible endogeneity problems. GMM will provide us with better estimates of the coefficients.

2.2 Empirical results:

We analyse the effect of inflation on unemployment. We would expect that high rates of inflation will lead to a reduction in unemployment, and within this context, we investigate the empirical relationship between inflation and unemployment for both the short and long run in Libya. We go on to analyse the effect of RGDP on unemployment. We would expect that high rate of RGDP will lead to decrease the unemployment in both the short and long run. Lastly we analyse the effect of RGDP on inflation. We would expect that an inverse relationship exists between these variables.

2.2.1 Evaluating the long-run relationships between inflation, unemployment and RGDP:

Our empirical exercise is composed of three parts to test for the existence of unit roots for each series. The optimal lag lengths for unit root and Johansen's co-integration tests are decided by the AIC.

2.2.2 Unit root testing:

Table 1.1 presents the unit root test for the selected series, based on a total of 48 observations for the period 1962–2009. The results show that all the variables analysed are non-stationary at levels including intercept as well as trend and intercept, but the UNEMgap and GDPgap are stationary in level for both intercept and trend & intercept. Therefore the null hypothesis cannot be rejected for three variables: lnUNEMP, lnRGDP and lnCPI. We conclude that the two variables under study are not integrated.

Table 1.1: Augmented Dickey–Fuller, Phillips–Perron and Kwiatkowski–Phillips Schmidt–Shin Unit Root Test (C&T)#.

	ADF		PP		KPSS
	C	C&T	C	C&T	C
	Time period: 1962–2009				
lnUNEMP	-1.291	-2.428	1,264	-2.191	0.786
ΔlnUNEMP	-1.777	-0.908	-1.777	-1.494	0.600*
lnRGDP	-1.449	-1.750	-1.037	-1.702	0.778
ΔlnRGDP	-4.005***	-3.567**	-5.152***	-5.896***	0.381**
lnCPI	-1.859	-0.258	-1.518	-0.851	0.870
ΔlnCPI	-4.821***	-5.093***	-5.035***	-5.220***	0.257***
UNEMgap	-3.380***	-3.318***	-2.663*	-2.630	-0.051***
GDPgap	-4.039***	-3.979***	-4.469***	-4.409***	0.048***

Note: ***, ** and * imply significant at 1%, 5% and 10% level respectively.
(C) indicates the intercept and (T) indicates the trend

2.2.3 Long-run relationship between (Johansen Co-integration) CPI, UNEMP and RGDP:

Tables 1.2, 1.3 and 1.4, are based on Equations (4.1), (4.2) and (4.3) for the periods 1962–2009 and 1974–2009, applying Johansen's maximum likelihood technique.

Table 1.2 shows the results of the co-integration analysis for the long-run relationship between lnCPI and lnUNEMP for the both periods. From the first half of the table it is clear that the variables are co-integrated; therefore, there is drift in the long run. Moreover, the relationship between lnCPI and lnUNEMP is negative and significant for the period 1962–2009, meaning that an increase in unemployment of 1% will lead to a decrease in inflation of 3.6% per annum.

Table 1.2: Johansen's co-integration test for variables ln*CPI* and ln*UNEMP*.

1962-2009	Hypothesis	Alternative	Eigenvalue	$\lambda - \max$	$\lambda - Trace$
Var(2)	r =0	r=1	0.316	15.581***	22.169***
	r≤1	r=2	0.148	6.589***	6.589***
LR estimates	ln*CPI* = 8.019 – 0.367** ln*UNEMP* exogenous : D73 and D84 (-2.030)				
1974–2009	Hypothesis	Alternative	Eigenvalue	$\lambda - \max$	$\lambda - Trace$
Var(2)	r =0	r=1	0.318	12.267*	15.938***

	r≤1	r=2	0.108	3.671**	3.671**
LR estimated	ln*CPI* = 18.950 – 1.298** ln*UNEMP* (-2.687) exogenous: D84				

Note: The analysis was performed including time tread, but this was not significant and was excluded from the analysis.

Table 1.3 shows the long-run relationship (LR) between lnUNEMP and lnRGDP for both periods. we can see the coefficient of UNEMP is negative and significant, indicating a long-run relationship between lnRGDP and lnUNEMP for the period 1962–2009. The finding for the next period shows the negative and significant effect UNEMP on RGDP.

Table 1.3: Johansen's co-integration test for variables ln*RGDP* and ln*UNEMP*.

1962–2009	Hypothesis	Alternative	Eigenvalue	$\lambda-\max$	$\lambda-Trace$
Var(3)	r =0	r=1	0.441	22.668***	33.683***
	r≤1	r=2	0.246	11.015	11.014*
LR estimates	ln*RGP* = 2.777-1.460***ln*UNEMP* +0.164*** *t* exogenous: D73 and D84 (-5.014) (5.559)				
1974–2009	Hypothesis	Alternative	Eigenvalue	$\lambda-\max$	$\lambda-Trace$
Var(3)	r =0	r=1	0.597	28.197***	37.939***
	r≤1	r=2	0.270	9.741	9.741
LR estimated	ln*RGDP* = 5.718 – 0.919*** ln*UNEMP* + 0.124***t (-4.576) (5.591)				

It is clear from Table 1.4 that the relationship between inflation and RGDP is negative and highly significant at 1%. For the next period we find the same relationship between inflation and RGDP.

Table 1.4: Johansen's co-integration test for variables ln*RGDP* and ln*CPI*.

1962–2009	Hypothesis	Alternative	Eigenvalue	$\lambda-\max$	$\lambda-Trace$
Var(2)	r =0	r=1	0.453	27.135***	32.219***
	r≤1	r=2	0.107	5.084	5.084
LR estimates	ln*RGP* = 11.00 -1.076***ln*CPI* + 0.088*** *t* exogenous : D73 and D84 (-4.999) (8.595)				
1974–2009	Hypothesis	Alternative	Eigenvalue	$\lambda-\max$	$\lambda-Trace$
Var(2)	r =0	r=1	0.438	20.764***	26.626**
	r≤1	r=2	0.150	5.861	5.861
LR estimated	lnRGDP = 10.241- 0.809*** ln*CPI* + 0.080*** t exogenous : D84 (-5.640) (11.734)				

2.2.4 Short-run Error correction mechanism (ECM)CPI, UNEMP and RGDP:

Table 1.5 presents the results of the error correction models for ΔlnCPI and ΔlnUNEMP for both periods. The estimated coefficients show the immediate impact of ΔlnCPI on ΔlnUNEMP; the ECM terms are negative and significant for both periods. For the period 1962–2009 the ECM term is -0.036, which suggests that ΔlnCPI is corrected by 3.6% per annum. The ΔlnUNEMP is corrected by 3.1% per annum in the same period. In the period 1974–2009, it is clear that the estimated ECM terms are negative and significant for ΔlnCPI, meaning that the speed of adjustment in Equation (4.4) is very small at 0.9% per annum. Similarly, ECM for ΔlnUNEMP has a correct negative sign and is significant at 1%, with a t-value of 3.274, and can be corrected by 1.3% per annum.

Table 1.5: Estimated co-efficient using VECM for $\Delta \ln CPI$ and $\Delta \ln UNEMP$

	1962–2009		1974–2009	
Variables	$\Delta \ln CPI$	$\Delta \ln UNEMP$	$\Delta \ln CPI$	$\Delta \ln UNEMP$
ECM_{t-1}	-0.036* (-1.805)	-0.031*** (-3.354)	-0.009* (-1.715)	-0.013*** (-3.247)
DUM_{73}	0.021 (0.495)	0.100*** (5.251)		
DUM_{84}	0.027 (0.600)	0.076*** (3.650)	0.017 (0.409)	0.073*** (3.248)
Constant	-0.014 (-0.362)	-0.088*** (-5.041)	0.009 (0.299)	-0.091*** (-3.999)
Adj. R^2	0.105	0.899	0.109	0.544
F-stat	1.674*	52.151***	4.608***	30.089***

Table 1.6 presents the results of for ΔlnRGDP and ΔlnUNEMP based on Equation (4.6). The estimated coefficient of ΔlnRGP does not show an impact on ΔlnUNEMP for the period 1962–2009. The ECM terms are positive and not significant for ΔlnRGDP, but are significant for ΔlnUNEMP at 1%. When we re-estimate the model and include dummy variable D84 for the next period (1974–2009), we find a significant result for both

variables. The ECM term is -0.25, which suggests that ΔlnRGP is corrected by 25% per annum. The ECM for ΔlnUNEMP is -0.16 and can be corrected by 16% per annum. These results are consistent with Okun's Law for the negative relationship between these two variables.

Table 1.6: Estimated co-efficient using VECM for $\Delta \ln RGDP and \Delta \ln UNEMP$.

	1962–2009		1974–2009	
Variables	$\Delta \ln RGDP$	$\Delta \ln UNEMP$	$\Delta \ln RGDP$	$\Delta \ln UNEMP$
ECM_{t-1}	0.022 (0.268)	-0.085*** (-4.730)	-0.252* (-1.783)	-0.163*** (-4.601)
DUM_{73}	0.011 (0.125)	0.068*** (3.396)		
DUM_{84}	0.128* (1.657)	0.042** (2.446)	0.112* (1.657)	0.005 (0.299)
Adj. R^2	0.031	0.915	0.103	0.640
Standard Error	0.104	0.023	0.100	0.025
F-stat	1.136	46.420***	1.430	7.667***

Table 1.7 presents the results of the ECM for ΔlnRGDP and ΔlnCPI. The ECM terms of ΔlnCPI are positive but not significant for both periods. We include two dummy variables, D73 and D84, for 1962–2009; the results show significance of ΔlnRGDP and D73 but not of ΔlnCPI. In the next period, the coefficient of ECM for ΔlnRGDP is found to be not significant even when we include a dummy variable. We conclude that a short-run relationship does not exist between ΔlnRGDP and ΔlnCPI.

In all short-run equations, R^2 is quite high and suggests the models have a fairly good fit. The models are statistically significant in terms of the standard F-test.

Table 1.7: Estimated co-efficient using VECM for $\Delta \ln RGDP and \Delta \ln CPI$.

	1962–2009		1974–2009	
Variables	$\Delta \ln RGDP$	$\Delta \ln CPI$	$\Delta \ln RGDP$	$\Delta \ln CPI$
ECM_{t-1}	-0.371*** (-4.726)	-0.052 (-0.915)	-0.616*** (-4.735)	0.071 (0.686)
DUM_{84}	-0.021 (-0.611)	-0.034 (-1.394)	-0.100** (-2.777)	-0.026 (-0.894)
Constant	-0.009 (-0.192)	-0.005 (-0.130)	0.078* (1.942)	0.057* (1.782)
Adj. R^2	0.387	0.085	0.417	0.078
F-stat	4.968***	1.586	5.174***	1.495

Notes: i) *, ** and *** indicate significant at 10%, 5% and 1% levels respectively.
ii) Figures in parentheses represent the t-statistics.

2.2.5 The relationship between inflation, output and UNEMP using GMM and OLS:

Table 1.8 shows the results for the relationship between expected inflation and unemployment gap. It shows the estimated coefficient using Equation 4.10 for both periods. GMM shows several estimations for the Libyan Phillips curve based on Equation 4.10. In column (1) where we present GMM, the inflation expectation and unemployment gap are significant at 5%. Inflation expectation has a positive effect on inflation and unemployment gap has a negative effect on inflation. The estimated coefficient of unemployment gap has a negative effect on inflation, indicating that there is a trade-off between inflation and unemployment.

Table 1.8: Estimated co-efficient using Equation (4.10).

Dependent variable: Inflation				
	1962 – 2009		1974 – 2009	
Explanatory variables	(1) GMM	(2) OLS	(3) GMM	(4) OLS
π_t^e	0.548** (2.242)	0.465*** (3.442)	1.027* (1.734)	0.498*** (3.376)
$(U_t - U^*_t)$	-3.011** (-2.612)	-2.488* (-1.810)	-3.696 (-0.892)	-0.375 (-0.195)
$\Delta(U_t - U^*_t)$			-3.029*** (-3.453)	-2.829* (-1.983))
C	3.274* (1.758)	3.965*** (3.621)	-0.065* (-1.672)	3.798*** (3.073)
F-Statistic		6.382***		5.451***
J-Statistic	7.037		0.651	

Table 1.9 presents our econometric results for the relationship between RGDP gap and unemployment gap for Equation (4.11) by both methods. The results show that none of the estimated Okun's coefficients are statistically significant. We find similar results when we utilise OLS estimates.

Table 1.9: Estimated co-efficient using Equation (4.11).

Dependent variable: RGDP gap				
	1962 – 2009		1974 – 2009	
Explanatory Variables	(1) GMM	(2) OLS	(3) GMM	(4) OLS
$(U_t - U^*_t)$	-0.226 (-0.605)	-0.093 (-0.315)	-1.296** (-2.447)	-11.251 (-0.032)
C	1.335 (0.650)	0.066 (0.0419)	-2.691** (-2.665)	-0.317 (-0.238)
F-Statistic		0.099		3.671**
J-Statistic	10.554	2.84	3.556	

Finally, Table 1.10 shows the estimations for the relationship between expected inflation and RGDP gap for both periods by applying both methods for Equation (4.12). We can see that the coefficient of inflation expectation is significant at 5% but the GDP gap is not significant at any level, which means that inflation cannot be affected by the GDP gap in the case of the Libyan economy.

Table 1.10: Estimated co-efficient using Equation (4.12).

Dependent variable: Inflation				
	1962 – 2009		1974 – 2009	
Explanatory variables	(1) GMM	(2) OLS	(3) GMM	(4) OLS
π_t^e	2.342** (2.552)	0.396*** (2.914)	2.185** (2.397)	0.406** (2.568)
$(Y_t - Y^*_t)$	-0.047) (-0.208)	-0.022 (-0.421)	-0.166 (-0.519)	-0.057 (-0.738)
C	-9.601 (-1.449)	4.442*** (3.999)	-9.140 (-1.319)	4.437*** (3.325)
F-statistic		4.521***		3.985**
J-statistic	0.162		0.294	

2.3 Conclusion and policy recommendations:

This study attempts to provide an empirical analysis of the relationship between three macroeconomics variables, ΔlnCPI, ΔlnRGDP and ΔlnUNEMP, in the Libyan economy during the period 1962–2009. Results show that lnUNEM, lnRGDP and lnCPI were non-stationary at any level although stationary in the first difference. As there are structural breaks in the Libyan economy in 1973 and 1984, we performed the break point test and estimated the short and long run for both periods separately.

In the next estimation, our results support a negative relationship between unemployment and RGDP in the short and long run, conforming to Okun's Law indicating a negative relationship between GDP and unemployment. These results are very useful for policy developers in Libya to help them understand how a decrease in the change of unemployment will be associated with an increase of production level (increase in the aggregate supply) Therefore, an increase in the aggregate supply could lead to a possible increase in the aggregate demand.

Our empirical results for Libya support a negative relationship argument for GDP gap and unemployment gap; however, the impact of the GDP gap on the unemployment gap is not as strong as it is shown in Okun's Law context for the period 1962–2009.

For the relationship between inflation and output in the third model in the short and long run, our results report an important negative effect of output on inflation that will provide useful information to monetary and fiscal authorities. One basic approach aims to control inflation indirectly by stabilising the growth rate of GDP. Central banks may prefer to respond to expected inflation. However, when we apply OLS and GMM, the empirical findings for both methods do not confirm a relationship between expected inflation and output gap.

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