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Modeling the relationship between GDP and unemployment for Okun's law specific to Pakistan during 1976-2010

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Abstract. *Okun's law postulates a negative relationship between movements of the unemployment rate and the real gross domestic product (GDP). This article investigates the link between the real GDP growth and unemployment, as described by Okun's law. For this purpose we have used time series annual data during the period 1976 to 2010 and used unit root test, Hodrick–Prescott filter and least square method to find the relationship between GDP growth and unemployment in Pakistan. The empirical analysis shows that a rise of one percentage point of unemployment is associated with a decline of 0.36 percentage point of real GDP growth.*

Keywords: Okun Law; Gross Domestic Product; Hodrick–Prescott filter; Unit Root Test.

JEL Classification: E24; E31.
REL Classification: 8G; 8I.

1. Introduction

Okun has hypothesized that movements of the unemployment rate and the real gross domestic product (GDP) depicts a negative correlation. The Okun's law (1961) is named after Arthur Melvin Okun, the American economist who proposed that the unemployment rate and gross domestic product (GDP) are assocciated. He stated that there is inverse relationship between output and unemployment rate, and the ratio is 1:3. Apart from its significance, it is noted that in actual economical sphere the relationship chiefly depends upon the production, the increase in production causes a decrease in unemployment whereas it increases with the decrease in GDP growth. Okun's law is not the end word but it also requires amendments like any other pragmatic law or relationship. According to Samuelson and Nordhaus, Okun's ratio of three points decrease in GDP with one point increase in unemployment (3:1) is found to be inaccurate since two points to one point (2:1) are likely to be more precise recently.

Irfan et al. (2010) used co integration technique to figure out the short and long run dynamics between variable and error correction approach and concluded that Okun's law interpretation is not pertinent in few Asian developing countries including Pakistan. Quite a number of economists, or critics, observe that Okun's law is not appropriately applicable to every country. The difference between the expected and actual growth and change in unemployment rate and effect of distressing previous growth rate on prevailing unemployment give an outcome opposing to the Okun's law. The Okun ratio is also liable to vary from place to place, the same economical policies do not work effectively everywhere and they have to be combined with the specific area's policies to acquire the desired results. Knotek (2007) presents three ways of finding the Okun's law: to find out the difference between the unemployment rate from sector to sector, to find out the diversity between the expected and acquired yield and to identify the difference between the influence of present productivity on unemployment and the preceding output on unemployment. Noor et al. (2007) find that this law is present in Malaysia but with the proportion of -1.75: 1 ratio which is different than the actual Okun's law. Soegner (2002) concluded that the countries with definite system of labor hoarding experience low level ratio of employment-GDP relation while the unemployment factor is found to be strong in such countries. Okun's (1962) findings overlay an imperative background on the analysis of the relationship between output growth and unemployment Lee (2000) believes in the legitimacy of Okun's law but not in its absoluteness and sturdiness while Weber (1995) agrees with Okun's claim but finds smaller fractions.

Model specification

Okun's law is written as:

$$w (U^* - U) = (Y - Y^*) / Y^* \quad (1)$$

where U = unemployment rate

Y is the real GDP (* represents potential/natural rate)

This question interprets that for every percent point the unemployment is below the natural rate, GDP is w % above potential GDP.

Ast U* and Y* are difficult to estimate so by reducing form of the previous equation

Expanding equation 1:

$$wU^* - wU = Y / Y^* - Y^*/ Y^* \quad (2)$$

Now differentiating Eq (2) and considering Y* as a constant, assuming the potential GDP is not altering on the short term. Thus:

$$wdU^* - wdU - dY / Y^* - dY^*/ Y^* \quad (3)$$

As change of the natural rate of unemployment dU* = 0. Then the eq becomes

$$dY / Y^* = - wdU + dY^*/ Y^* \quad (4)$$

The natural real GDP growth rate is usually close to the real growth rate. Thus approximating dY*/Y with dY/Y

$$dY / Y = - wdU + dY^*/ Y^* \quad (5)$$

Using Ordinary Least Squares (OLS) Okun has obtained w = 2 and dY* / Y* = 3. Here, the potential GDP growth rate is about 3 percent points while with an elevation in unemployment by one percentage point, bring a decline in real GDP growth rate by 2 percentage points.

Testing the validity of Okun's law for Pakistan

In order to empirically test Okun's law for Pakistan, annual data for real GDP growth and unemployment in the period 1973-2010 has been employed. The source of the data is World Bank Dataset (WDI) and State Bank of Pakistan.

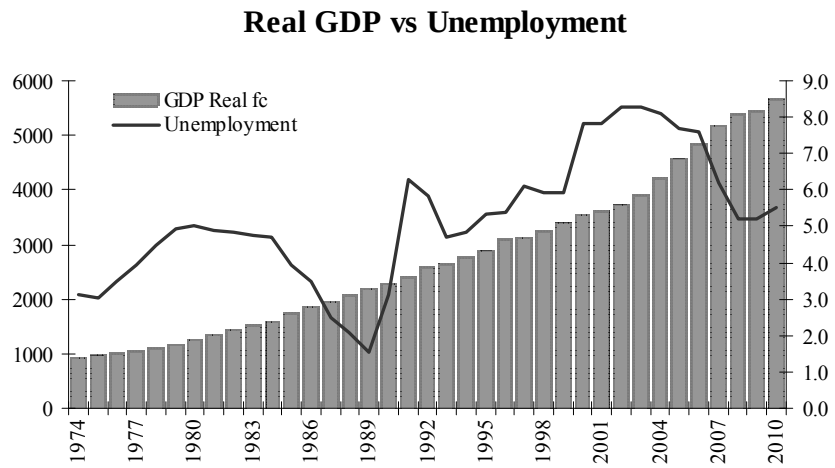


Figure 1. *Real GDP vs. unemployment*

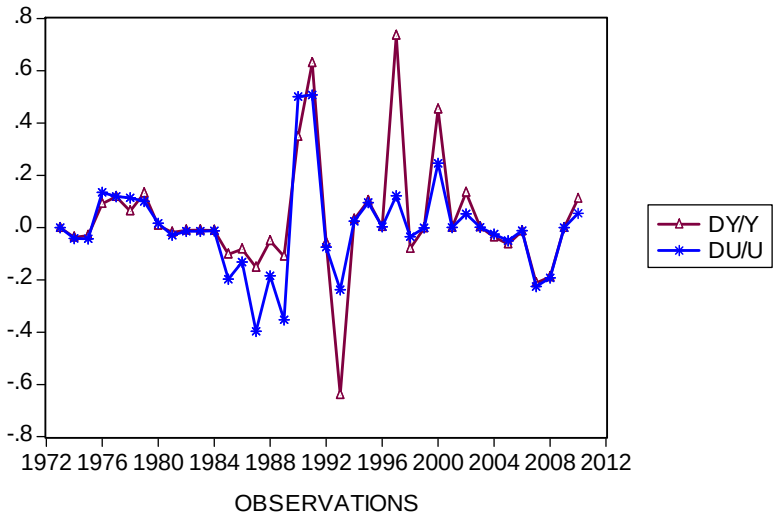


Figure 2. *DY/Y vs DU/U*

The chart shows the inverse nature as elevated values of growth rate can be coupled with lower values of unemployment growth rate.

The initial results obtained in order to get the fitted regression model to empirically estimate the association between unemployment and growth rate. First to check the stationary of the data by operating Augmented Dickey Fuller and Phillips-Perron (PP). The Results are mentioned in below table:

Table 1. GDP growth rate (dy/y) & unemployment growth rate (du/u)

Variable	*Test*	*t-statistic*	*p-value*
dy/y	ADF	-4.639434	0.0007
	PP	-4.65725	0.0006
du/u	ADF	-4.932097	0.0003
	PP	-3.841364	0.0058

Augmented Dickey-Fuller test (ADF) and **Phillips-Perron (PP)** tests clearly inveterate the fact that the variables are stationary in level.

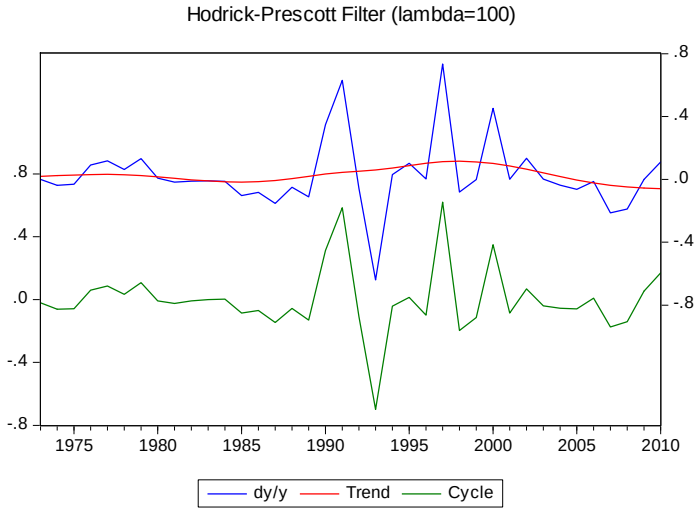
The Hodrick-Prescott filter

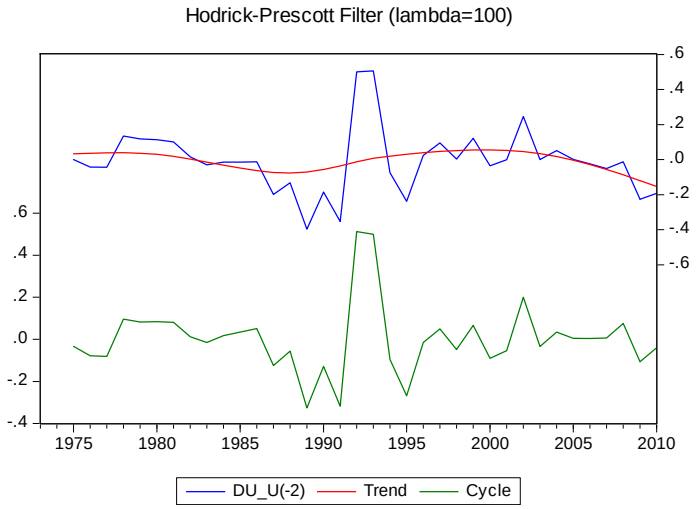
The Hodrick-Prescott filter is a statistical tool used to figure out business pattern strategy to split the cyclical component of a time period from raw data. Usually this filter is checked to obtain a smoothed-curve reflection of a time period sequence of any raw data, that is more delicate to long-term than to short-term variations. The modification of the kindliness of the trend to short-term variations is obtained by changing a multiplier ƛ.

The general equation for Hodrick-Prescott filter (Hodrick, 1997)

$$\min_{\tau}\left(\sum_{t=1}^{T}(y_t-\tau_t)^2+\lambda\sum_{t=2}^{T-1}\left[(\tau_{t+1}-\tau_t)-(\tau_t-\tau_{t-1})\right]^2\right).$$

There are usually two terms in this filter. Firstly sum of squared deviations that penalizes the cyclical movement and secondly the multiple ƛ which penalizes the rate of the trend component.





As can be seen in the graph the lower the value of ƛ, lower is the penalty and vice versa.

The dependent variable (dy/y) illustrates that partial autocorrelation function exhibits dependency in the first two lags; in order to overcome this we incorporated the first two Auto Regressor (AR) terms to attain the significant regression results. After incorporating different lags by running and manipulating a number of regression equations for unemployment growth rate (du/u) the best one based on the statistically significance criterion is du/u (-2).

Hence the equation after modification and manipulation based on statistically significance criterion was:

$$dy / y = c + \beta_1 AR(1) + \beta_2 AR(2) + \beta_3 du / u(-2) + \varepsilon$$

Dependent Variable: DY/Y
Method: Least Squares
Sample (adjusted): 1977 2010
Included observations: 34 after adjustments
Convergence achieved after 12 iterations

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
C	0.028361	0.041737	0.679532	0.5020
DU/U(-2)	-0.361528	0.381952	-0.946526	0.3514
AR(1)	0.130541	0.198787	0.656685	0.5164
AR(2)	-0.092076	0.289812	-0.317709	0.7529

R-squared	0.124168	Mean dependent var	0.030317
Adjusted R-squared	0.036585	S.D. dependent var	0.237916
S.E. of regression	0.233523	Akaike info criterion	0.039058
Sum squared resid	1.635989	Schwarz criterion	0.218630
Log likelihood	3.336009	F-statistic	1.417717
Durbin-Watson stat	1.987754	Prob(F-statistic)	0.256955

As seen in the results the coefficient of dU is statistically significant, around -0.36. An increase in one point of unemployment will reduce real GDP growth by 0.36 fractions. The variation can be taken as potential GDP growth; the level of economic growth which will not cause the rising in the prices of gross products is below 2.83 percentage points. The test to check the autocorrelation i.e. Durbin-Watson statistic clearly shows there is no autocorrelation in the residuals and its value is around 2.

The correlogram of residuals also confirmed the nonexistence of autocorrelation.

Conclusions

The importance of Okun's law is based on the fact that it can be implicated well for economic policy. For sustainable improvement in living standards, the relationship between real GDP growth and unemployment is of great significance to policy makers. In case, if the GDP growth is elevated as compared to its natural level, the policy makers will come to a decision that they will not promote the creation of new jobs intensively, in order to maintain a sustainable growth rate which will not generate inflation.

The gradient of unemployment in Okun's law in around -0.36 and potential GDP growth is around 2.8 percentage points and the variables are negatively correlated as predicted by the theory. The Okun's law helps the policy makers to create new job ideas for the purpose of improving the living standards of a country, the connection between GDP growth and unemployment plays a fundamental role in instigating the policy makers in generating novel thoughts to perk up the GDP growth rate. This paper facilitates the understanding of unemployment and its effects on national output, it enables us to analyze and calculate the economical sequence which will furthermore lend us a hand in controlling the deviation in GDP growth and rising rate of unemployment, kindling the progress in production.

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