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Abstract

This paper reinvestigates the validity of the Okun's Law on its inverse relationship between unemployment rate and real GDP growth rate in Indonesia using annual data. The sample period spans from 1984 through 2019 with 36 observations. Data are obtained from the International Monetary Fund (www.imf.org). The time series data distributions of both variables are near-normal in their mean-to-median ratio, accompanied by relatively high standard deviations. To provide linear and unbiased estimates parameters, the Ordinary Least Squares (OLS) is utilized to estimate regressions (1) and (2). The slope-coefficients provide evidence of very weak inverse relationship between the variables in terms of the associated t-value and p-value.

Keywords

Unemployment Rate, Real GDP Growth, OLS, Inverse Relationship

Cover Page Footnote

I am deeply grateful to Professor Matiur Rahman of McNeese State University for his insightful guidance in my research work for this paper.

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Keywords: Unemployment Rate, Real GDP Growth, OLS, Inverse Relationship.
JEL Classifications: E10, E24, E30, E39.

I. Introduction

In 1962, Arthur Okun published a seminal paper on the negative relationship between real GDP growth and unemployment rates (known as Okun's Law). Okun's Law states that for 1% reduction in unemployment rate, there is requirement of 2-3% increase in real GDP growth rate. This is an empirical inquiry with no solid theoretical foundation, to note. Since then, many researchers have published a substantial number of papers on the validity of the Okun's Law in the context of many developed and developing countries with mixed evidences. Economies worldwide have gone through structural transformation for a variety of reasons in recent decades such as technological progress, and economic globalization, among others. The methods of calculating GDP and unemployment have also undergone changes across countries. So, there is renewed academic interest to reinvestigate this issue of profound macroeconomic policy importance.

According to Rahman & Mustafa (2015), there is weakening correlation over the decades since 1980 between real GDP growth and unemployment rates among selected developed countries. The evidence is attributed to differences in economic structures and labor market conditions among countries. Indonesia is considered as one of the developing countries going through structural transformation. According to an article of the World Bank dated April 5th, 2022, "Indonesia is the world's fourth most populous nation and the 10th largest economy in term of purchasing power parity." However, it is expected that in Indonesia weaker relationship between the above would likely be evidenced. Suryono et al. (2020) found that Okun's coefficient is -4.1 in Indonesia's economy for the sample period of 1986 – 2018. They used First-Difference Model on real GDP growth and open unemployment rates.

This paper re-examines the effect of real GDP growth on unemployment rates of Indonesia for the sample period of 1984 – 2019 using annual data. The period from 2020 to 2022 is excluded due to a lack of reliability of the data because of Covid-19 pandemic. The period being affected by the pandemic needs to be separately examined on its own to provide a more accurate picture, as adequate and more reliable data be available in the future. The rest of the paper is organized as follows. First, an overview of the history of Indonesian economy is provided to give a clear understanding of the key factors that drive the economy. Second, a brief review of the related literature is provided. Third, the paper outlines the empirical methodology and report results. Lastly, the paper offers conclusions.

II. Brief on Indonesia's Economy

Indonesia is a country comprising over 17,500 islands. The country's economy relies heavily on natural resources and fisheries. Since its independence in 1945, Indonesia has gone through several economic cycles starting from its lowest unemployment rates over the period of 1971 to 1980. These were due to

government investment in social infrastructures which used labor intensive model of production technology (Manning, 1994). This created employment for less educated workers in agricultural sector and its ancillaries such as transportation and manufacturing. During these periods, the unemployment rate was around 1.7 %. Before a series of crises facing Indonesia and East Asia, in general, GDP grew on average of 7.6% between 1967 and 1996 while poverty rate dropped by 22.5% in 1996. Indonesia was categorized as a newly industrialized economy together with Thailand and Malaysia (World Bank 1993). During the same period, the unemployment rate was 5%, considered as a full-employment state of the economy (Safrida, 1999).

Nevertheless, Indonesia was hit hard by economic crisis between 1980 and 1990. Unemployment rate almost doubled from 1.7% in 1980 to 3.2% in 1990 amid widespread political turmoils (Yaumidin, 2016). In particular, the Iranian revolution triggered disruptions in the global supply of crude oil. Consequently, the unemployment rate continuously rose approaching 7% in 1995 (Islam, 1998). The prolonged crisis set a deteriorating trend of energy prices and export volume making the economy more vulnerable to external shocks. The decade of 1980s represented “extended recession” and categorized as “malaise” (Kuntjoro-Jakti, 1986).

Knotek (2007) stated that “Okun’s Law has not been a stable relationship over time. Part of this variation is related to the state of the business cycle: the relationship between output and unemployment is different in recessions and expansions, and recent expansions have been longer than average.” “There have been many exceptions to the Okun’s Law, for instances, where growth slowdowns have not coincided with rising unemployment. This is true for both long- and short-terms. This is a reminder that the Okun’s Law is contrary to connotations of the word ‘law’—is only a rule of thumb, not a structural feature of the economy” (Knotek, 2007). As such, this explains the anomalies between output growth and unemployment rate between 1980 and 2019 in Indonesia due to a series of macroeconomic and political events, both internal and external.

A series of economic crises coupled with political instability occurred afterwards. This reversed the built-in progress of Indonesian economy, as stated earlier. The events are as follows: the crisis during 1980 – 1984, May 1998 riot marked by the stepping down of President Soeharto in the late 1990s (transition from dictatorship to democracy); financial crisis during 1997 – 1998 (Breuer et al., 2018), economic and financial reforms, global financial crisis from 2007 to 2009 that led to the devaluation of Indonesian rupiah by 80% (Ba, 2023), period of high inflation, financial pressure in 2013 due to the quantitative easing (QE) by the US Federal Reserve, known as *taper tantrum* that caused market panic hitting hard five emerging countries including Indonesia (Basri, 2017). Despite a series of crises, Indonesia finally was able to bounce back and experienced more stable economy

in 2019. Indonesia's macro-financial conditions made a solid recovery from the taper tantrum in 2013. The recovery included more stable exchange rate, energy prices, and inflation rate. The inflation was at the lowest since the fourth quarter of 2009 with an average of 2.6% in the first quarter of 2019 (Boediono, 2019). The period from 1980 to 2019 showed structural transformations transitioning from a predominantly agrarian economy to one with a more diverse economic base, with expansionary manufacturing and services sectors.

III. Brief Review of Related Literature

Knotek (2007) mentioned that there were so many potential issues related to the original Okun's Law due to its simplicity. Since the paper was published in 1962, many economists proposed several variations of Okun's original relationships. Although these relationships are also called Okun's Law, they differ substantially from the earlier equations—*difference-version* and *gap version*.

This is because *difference-version* relied heavily on changes in the unemployment rate with quarterly real GDP growth. On the other hand, *gap-version* seeks to close the gap between potential and actual output. In potential output, Okun (1962) sought to identify how much the economy would produce under "conditions of full employment" while the actual output associated with rates below its potential. The problem with both potential output and full employment is that they are not directly observable in macroeconomic data. Further, Burgen et al. (2012) found, "strong correlation between output growth and increase in unemployment rate when it is below potential but disappears when output is growing above potential". This means, even if output growth continues, unemployment rate will not necessarily be reduced until it reaches certain level.

Stemming from those limitations, many economists now use a dynamic version of Okun's Law. The *dynamic version* suggests that both past and current output can impact the current level of unemployment. This version of Okun's Law would have current real output growth, past real output growths, and past changes in the unemployment rate as explanatory variables. Additionally, economists also use another version of Okun's Law—*production-function version*—which combines a theoretical production function in which labor, capital, and technology are combined to produce output (Knotek, 2007). The basis of Okun's original law is output and production which depends on the labor involved creating direct relationship between output to employment and inverse relationship between output and unemployment. This explains why the UK unemployment (Chamberlin, 2011) continued to rise after 2008 - 2009 recession even as the economy was recovering and continued to grow.

Considering all four of Okun's Law variants in relation to their pros and cons as well as their data availability, this study implements the dynamic version. There are advantages and disadvantages of each variant. Both *Gap* and *difference versions*

provide simple concepts (Javeid, 2011). But the oversimplification makes these versions of lesser depth in analyzing the relationship between the real GDP growth and unemployment rates (Gyllo & Vieweg, 2021).

On the other hand, *production-function* version and *dynamic version* depict more accurate analyses. *Production-function* version links inputs to output. Thus, it solidifies a theoretical framework for the Okun's Law. Unfortunately, both capital and technology are difficult to measure (Alkraidees & Ayaz, 2020). As Rahman & Mustafa, (2015) explained, *production-function version* suggests that the unemployment rate is at best "a proxy variable" affected by unproductive resources. These resources come from different inputs such as a country's productions of goods and services, fraction of population in the labor force, and the number of hours that employed workers. On the contrary, *dynamic version* allows for time-sensitive analysis by accounting for time lags and provide implication of how economic growth influences job growth. Gyllo & Vieweg (2021) explain that the use of the *dynamic version* allows to capture the changes in unemployment rates which do not come only from the last period's change in real GDP growth, but from multiple periods. Omission of the above would result in information loss thereby inflating the error term. This allows more accurate depiction of the relationship between changes in output and employment over time. The downside of this version is that "it lacks the original concept of Okun's Law, which principally focuses on the contemporaneous impact of changes in real output growth on changes in the unemployment rate. However, it still has some similarities to the original version of the Okun's Law" (Alkraidees & Ayaz, 2020; Knotek, 2007).

Further, the dynamic version is also used in an attempt to limit the risk of endogeneity problem. The choice of using time lags in the independent variable would prevent "the possibility of a poorly chosen instrumental variable and is a more viable way of addressing potential biases" (Gyllo & Vieweg, 2021; Clemens et al. 2012).

IV. Brief Outline of the Empirical Methodology

As stated earlier, the Ordinary Least Squares (OLS) regression is specified in a dynamic setting. OLS is applied using the time series data for bivariate linear regressions. The dependent variable includes unemployment rate (in percentage), and the independent variable includes real GDP growth rate (in percentage). In the dynamic setting, the dependent variable is the unemployment rate, and independent variables are real GDP growth rate with two lags. As stated earlier, the sample period runs from 1984 through 2019 with 36 annual observations. The data source is the International Monetary Fund (www.imf.org).

Further, Durbin-Watson test is also used to detect the magnitude of the likely presence of autocorrelation in time series data. "Durbin-Watson always produces a test number range from 0 to 4. Values closer to 0 indicate a greater degree of

positive correlation, values closer to 4, indicate a greater degree of negative autocorrelation, while values closer to the middle suggest less autocorrelation” (Smith, 2023).

The data descriptors include mean, median, and standard deviation. The estimating OLS regressions are specified as follows:

$$U_t = \alpha_0 + \alpha_1 Y_t + e_t \text{----- (1)}$$

$$\alpha_0 \geq 0, \alpha_1 < 0$$

$$U_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 Y_{t-1} + \alpha_3 Y_{t-2} + v_t \text{----- (2)}$$

$$\alpha_0 \geq 0, \alpha_1 < 0, \alpha_2 \geq 0, \alpha_3 \geq 0$$

Where, U_t = unemployment rate, Y = real GDP growth rate, e = random error term of regression (1), v = random error term of regression (2), and t = time subscript. Conjecturally, expected mean of e and that of v are zero, expected covariance of U_t and $e_t = 0$ and respective expected variance is constant. Once these conditions are met, the applications of the OLS is appropriate for estimating linear and unbiased parameters.

V. Empirical Results and Discussions

The descriptive statistics are reported as follows:

Table 1: Descriptive Statistics

	Mean	Median	Mean/Median	SD
U_t	5.461	5.75	1.00966184	3.6095
Y	5.806	5.65	0.96656834	2.5873

Further, Mean-to-median ratios of variables are within the proximity of one. They indicate that the time series data distributions of U and Y are near-normal and approximately symmetric. In term of standard deviations, Y has lower variability than U . However, their overall associated standard deviation of each variable also reveals no unusual highs and lows in returns, as calculated by taking percentage changes of the yearly real GDP growth and unemployment rates. Next, the simple correlation coefficient between them is reported as follows:

Table 2: Simple correlation*			
		U_t	Y
Pearson Correlation	U_t	1.000	-.179
	Y	-.179	1.000

*All variables are in % changes

As evidenced in Table 2, the pairwise simple correlation coefficient between U and Y is negative, as expected, and also very low. This shows weak inverse comovement between U and Y.

$$U_t = 6.912 - 0.235Y_t \text{--- (1)}$$

$$(t= 4.630, pv = 0.000) \quad (t=-1.061, pv = 0.296)$$

$$\overline{R}^2 = 0.032, F = 1.127, DW=1.345, \hat{\rho} = 0.3275$$

Note: $p < 0.005$, $t\text{-value} > 2$. The OLS estimates are based on the use of variables in % changes and the associated t- and p-values of the estimated coefficients are reported within the respective parenthesis.

In the case of the estimating bivariate linear regression (1), the hypothesis is that there is a negative relationship between unemployment rate and real GDP growth rate. The estimated value of α_1 shows that Y_t negatively influences U_t . The effect is statistically significant in terms of both associated t-value and p-value. The adjusted- R^2 is quite low at 0.032. The F-statistic is also quite low at 1.127.

Table 3: Descriptive Statistics with Lags

	Mean	Median	Mean/Median	SD
U_t	5.444	5.65	0.96353982	3.6886
Y_t	6.035	5.75	1.04956522	2.4730
Y_{t-1}	5.947	5.9	1.0079661	2.5558
Y_{t-2}	5.841	6	0.9735	2.6602

Mean-to-median ratios of the variables are within the proximity of 1. They indicate that the time series data of U_t , Y_t , Y_{t-1} , and Y_{t-2} are near-normal and approximately symmetric. In term of standard deviations, U_t has the highest variability as compared to all three independent variables (Y_t , Y_{t-1} , Y_{t-2}).

The simple correlation coefficients of the above are reported as follows.

Table 4: Simple Correlations

		U_t	Y_t	Y_{t-1}	Y_{t-2}
Pearson Correlation	U_t	1.000	-.183	-.118	-.143
	Y_t	-.183	1.000	.927	.848
	Y_{t-1}	-.118	.927	1.000	.932
	Y_{t-2}	-.143	.848	.932	1.000

As evidenced in Table 4, the pairwise simple correlation coefficients of U_t with Y_t , Y_{t-1} , Y_{t-2} are negative. This is also revealed in Figure 2.

The estimates of regression (2) are reported as follows:

$$U_t = 7.071 - 0.705Y_t + .0995Y_{t-1} - 0.678Y_{t-2} \text{ ---- (2)}$$

(t = 4.108, pv = 0.000)	(t = -1.167, pv = 0.252)	(t = 0.990, pv = 0.330)	(t = -0.635, pv = 0.530)
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$$\bar{R}^2 = 0.065, F = 0.690, DW=1.414, \hat{\rho} = 0.29$$

Note: $p < 0.005$, $t\text{-value} > 2$. The OLS estimates are based on the use of variables in % changes and the associated t-and p-values of the estimated coefficients are reported within the respective parenthesis.

In the equation (2), the estimated negative coefficient of α_1 is magnitudinally higher than that of α_1 in the equation (1). The comparison between equations (2) and (1) in terms of \bar{R}^2 and F-value are as follows. In equation (2), $\text{adj-}R^2$ is 0.065 which is higher than 0.032 in equation (1) and F-value at 0.690 is lower than that of equation (1). The $DW = 1.414$ and thus, $\hat{\rho} = 0.29$ ($\hat{\rho} = 1 - \frac{DW}{2}$). They suggest the presence of very mild autocorrelation in time series data posing no discernible statistical problem. The associated t-and p-values of each slope coefficient are statistically insignificant. The net effect is -0.393 in term of the sum of the estimated slope coefficients meaning real GDP has to grow by 3.93% for 1% reduction in unemployment rate in Indonesia, as evidenced from the estimated regression (2).

VI. Conclusions

This empirical study shows that Okun's Law still exists in the Indonesian economy with very weak inverse relationship between real GDP growth and unemployment rate. Thus, promotion of real GDP growth alone is not sufficient enough to reduce unemployment rate. In addition to fiscal and monetary stimuli, there is a need for targeted policies and programs for improved wages, better work conditions and upskilling of workers to address deficient demand for employability. Finally, this study shows that the Okun's Law is valid in Indonesia, but not to the extent, as originally proposed in the Okun's Law.

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Appendix A
Figure 1

Scatterplot

Dependent Variable: uemplrate

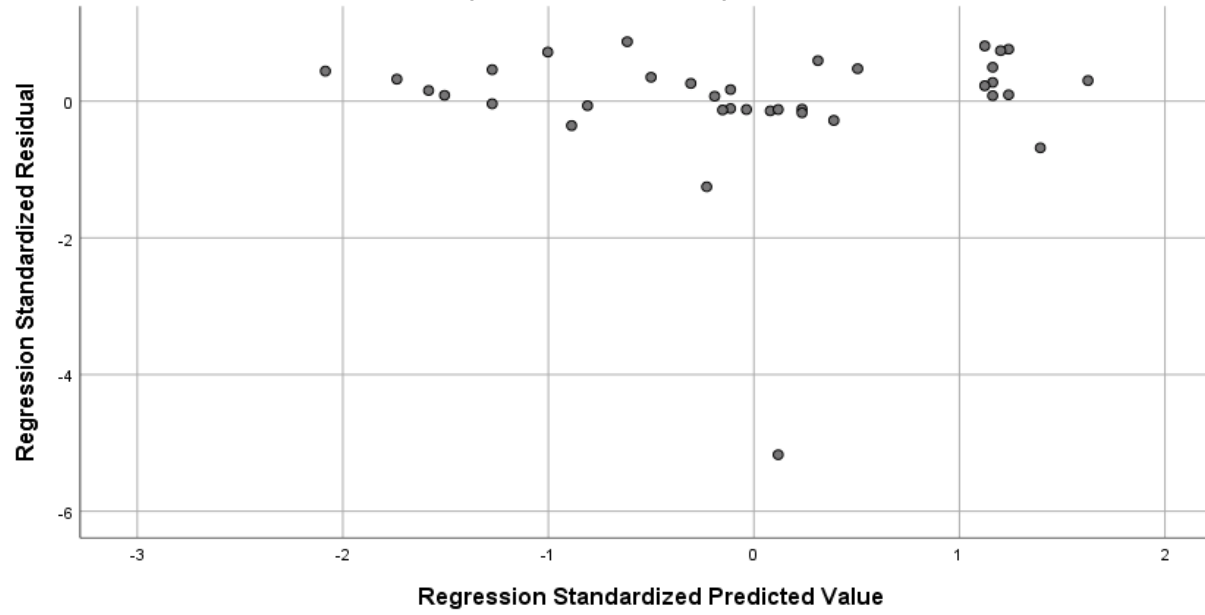


Figure 2

