# Test of Okun's Law in Some Asian Countries Co-Integration Approach

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1 January 2012

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## Abstract

*The objective of this paper is to estimate the Okun's coefficient, and to check the validity of Okun's law in some Asian countries whether it is valid or not, for this purpose we have used the time series annual data during the period 1980-2006. Engle Granger (1987) co integration technique is employed to find out long run association between variables and error correction mechanism (ECM) is used for short run dynamic. After getting empirical evidences it can be said that Okun's law interpretation may not be applicable and also the principle of NAIRU does not hold its validity in some Asian developing countries. Our results have also supported to Noble Prize awarded Austrian economist Paul Krugman.*

Key words: Okun's law, Validity, cointegration
Jell classification; R11; R15

## Introduction:

Okun's Law defines an inverse association between cyclical fluctuations in output and the change in unemployment rates, where the values of rate of change vary from country to country and time to time. It is the feature of supply side economics, as output increases in a recovery phase resulting unemployed workers are hired and as output falls in recession phase consequently workers are laid off from their jobs. In our investigation the Okun's Law coefficients in case of some Asian countries i.e. Pakistan, India, China, Sri Lanka and Bangladesh have been clearly shown that the magnitude of Okun's coefficients are far from being uniform.

"At earlier studies, Okun found that the relationship was about 3 to 1: that is 1 point of unemployment for every 3 points of GDP gap. However, modern data and advanced econometrics techniques found that the 2 to 1 (or perhaps 2.5) ratio between output and the unemployment rate is more representative for recent periods". [Samuelson and Nordhaus, 15th Ed.]

LEOPOLD SOEGNER and ALFRED STIASSNY (2002) tested Okun's law and claim a negative association between the unemployment rate and the real output (GDP). CHRISTIAN E. WEBER (1996) investigated Okun's law and stated that it is traditionally associated measure of output gap to the unemployment rate which has been one of the fact of the business cycle. José Villaverde, Adolfo Maza (2008) argued that the values of Okun's coefficients are dissimilar; a result is partially clarified by regional inequalities in productivity growth. These differences imply the policy issues; aggregate demand/supply management policies should be collaborated with region-specific policies. Dany Lang et.al (2009) enlightened the connection between fluctuations in unemployment and growth, the most primary lag growth shock impacts the current unemployment rate. Christian Pierdzioch et.al (2009) found a significant negative relationship between the anticipated change in unemployment rate and the projected growth rate of real output. Roger Perman and Christophe Tavera (2005) observed the Okun's Law coefficient forms a main macroeconomic measure under the deviations of unemployment to the fluctuations in economic activity. Ho-Chuan Huanga, and Shu-Chin Lin (2006) found an inverse

association between cyclical unemployment and cyclical output and confirm the validity of Okun's law. Another interesting observation is also found that the fluctuations between output and unemployment is small when the output gap is small and unemployment is large when the output gap is large. NICHOLAS APERGIS and ANTHONY REZITIS (2003) investigate the Okun's relationship and explore that a structural change, unemployment are less responsive with output changes. Moreover, policy makers must emphasis on deregulating the selected sectors in the economy. This would enhance the labor productivity and competition, which in turn consequently the overall economic productivity will be increased and reduce unemployment.

HUBERT GABRISCH & HERBERT BUSCHER (2006) suggested that the evolution of labor markets can be completed till unemployment responses to output changes, not the institutional and environment changing which distort the jobs in the public sector. While technological progress leads to reduce the jobs in industry. The objective of reducing unemployment can be achieved by more output growth rate than the growth rate of productivity. This would an important element of aggregate demand growth. ENGELBERT STOCKHAMMER (2004) pointed out that the equilibrium rate of unemployment find out the expected inflation in short run, unemployment and output in t long run. The real balance plays the essential role in the changeover from short run to the long run.

Paramsothy Silvapulle, Imad A. Moosa, Mervyn J. Silvapulle (2004) found the asymmetric association between output and unemployment in Okun's law case. Additionally, Okun's coefficients are explained on the basis of a dynamic model which permits for asymmetry in the link between unemployment and cyclical output.

RICHARD G. SHEEHAN, FRANK ZAHN (1980) observed that the change in labor productivity is one of the most significant factor and changes in weekly average hours, changes rates in labor force participation impact significantly. Jim Malley, Hassan Molana (2008) demonstrated that the labor and goods market imperfections can affect the labor productivity which reflect the fluctuations in unemployment. Moreover, it is possible to

anticipate that an economy can move between a boom and a trough levels which reflects that the change of demand side macroeconomic policies can reduce unemployment level depends on which policies are to be adopted to overcome the expected results of an economy. CLIFFORD, ATTFIELD, BRIAN SILVERSTONE (1998) found that the Okun's coefficient, output gap to the unemployment gap can be easily anticipated as the cointegration exists between the these variables.

DONALD G. FREEMAN (2000) explored it as a rule of thumb he explains that a Okun's law provides rough guideline to the policy makers with the employment effects on the output growth. While Okun's originally estimates that three-points increase in real output results one-point decrease in unemployment but it has been reduced to 2.0-2.5. Masanao Aoki1 and Hiroshi Yoshikawa (2003) found that the GDP is varied by variation in demand among the sectors. Moreover, a relationship between unemployment and GDP similar to the Okuns' law in its business cycle oscillation ultimately the Okun's coefficient rises as the average GDP rises. Martin F. J. Prachowny (1991) concluded that the marginal contribution of a one point cutback in unemployment is only about 2/3% enhance in output, while changes in weekly hours have independently impacts on the output gap in U.S economy. Clifford L. F. Attfield and Brian Silverstone (1997) found the strong evidence of long run equilibrium relationship between output and unemployment gap with an estimate of Okun's coefficient approximately to -2.25 in U.S economy. FARROKH NOURZAD et.al (1996) analyzed that when expectations are not included in a model of Okun's Law, the growth rate of output required to decrease the rate of unemployment by one percent point is undervalued.

Unemployment is a prominent matter in rest of the world. Every year thousands of students have passed out from colleges and universities, therefore it is one of the key responsibilities of every government to grant jobs to all passed out students but governments have failed to fulfill the job requirements. Generally, some jobless graduates have been appointed by government sector offices and private enterprises but a majority of the passed out students remain unemployed. Various Asian developing countries are prominent example in the World who successfully removed the unemployment problem e.g. Korea, Malaysia,

Singapore and China are most recent of them. Additionally, they are growing swiftly because of political stability and if the political, law and order conditions are stable consequently the foreign investors from different countries e.g. America, Europe and Japan may invest in these regions spontaneously results these developing countries economic growth may lift up. Governments of developing countries and their leaders should learn it from these Asian countries.

The aim of this paper is to test the Okun's law validity in Asian countries like China, Pakistan, India, Srilanka and Bangladesh. Since present study is the initial effort to discover the connection between the unemployment gap and the output gap in the case of developing economies. It is considered that characteristics of these taken developing countries e.g. labor characteristics, geographical, natural resources and climate conditions are more or less similar. The data of the output gap and the unemployment gap is taken from 1980 to 2006. This study empirically investigated that whether a relationship between the measures of unemployment gap and output gap is statistically significant in long-run as well as in short run or not in respect to okun's law coefficient. For this purpose the unit root test and cointegration approach have employed for stationary and long run relationship respectively and error correction mechanism for short run dynamics.

Moreover, we are working to find out the natural unemployment rate in developing countries of Asian region especially Pakistan and India, where normally inflation rate is very fluctuated which distorts the Non Accelerating Inflation Rate of Unemployment (NAIRU) principle.

## Model Specification

Generally, there are two standard model specifications of Okun's law, first is the 'First difference model' and second is the 'Gap model'. According to the first-difference model, the link between the natural log of real output (yt) and the natural log of unemployment rate (ut) is given as

$$Yt - Yt_{-1} = \alpha + \beta(\mathrm{ut} - \mathrm{u}t_{-1}) + \varepsilon t \text{----------(1)}$$

The second is "Gap model" as given as:

$$Yt - Yt^{*} = \alpha + \beta(\mathrm{ut} - \mathrm{ut}^{*}) + \varepsilon t \text{----------(2)}$$

where yt* refers the log of potential output, ut* is the natural rate of unemployment. where α is the intercept, β is Okun's coefficient computing that how much variation in the unemployment rate pass the changes in output, and ε is the disturbance term.

The Gap model has been chosen for further analysis of the okun's law, where the left-hand side represents the output gap and right-hand side represents the unemployment gap $(\mathrm{ut} - \mathrm{ut}^{*})$. Thus, the difference between the observed and potential real GDP postulates the fluctuation in output. Similarly, the difference between the observed and natural rate of unemployment refers the cyclical rate of unemployment.

## Data sources, measurement and description

Data of unemployment (ut) and output, Gross Domestic Product (yt) and GDP deflator are obtained from the World Bank dataset (WDI). Nominal GDP is deflated by the GDP deflator. For potential out put yt*, yt is regressed on trend variable and consider fitted value as potential output. In equation (2) output gap variable is the difference between real GDP and potential GDP and unemployment gap$(\mathrm{ut} - \mathrm{ut}^{*})$ is difference between the observed and natural rate of unemployment.

## Econometrics methodology

Generally the most of macroeconomic variables are non-stationary series and predictable technique of ordinary least square (OLS) give the possibility of spurious regression or co-movement between variables. Differencing of time series variable can remove the non stationarity in the variables. In this context, co integration and Error correction modeling retains long run information. Cointegration technique confronts the spurious regression, and Error correction provides short run dynamics which tries to find out the causal

relationship in short run. A series will stationary by differencing "d" and denoted as I (d). Augmented Dickey Fuller (ADF) test also known as unit root test and used for testing the stationary and non stationary of the series. ADF regression equation as follows:

$$\Delta Y_t = \alpha + \beta\, Y_{t-1} + t + \sum \beta_2 \Delta Y_{t-k} + \mu_t \text{ ----------(3)}$$

Where $Y^t$ is a time series, $\Delta$ denotes the first difference operator, T is the linear trend, $\alpha$ is a constant intercept and $\mu$ is an error term. The null hypothesis of existence of unit root is $\beta = 0$. If any variable is found to be non-stationary, it will be tested for stationary at its first difference form. If each variable is achieved stationarity after first differencing then bivariate cointegration test will be employed to know the relationship between variables.

**Fully Modified Ordinary Least Square (FMOLS)**

At once the order of integration decides then long-run elasiticities can be measured by the FMOLS method. FMOLS technique was originally introduced by Philips and Hansen, (1990) which provide the most favorable estimation of Co-integration regressions. In order to get asymptotic efficiency (normal distribution) this technique advances the least squares to explain for serial correlation stationary at same order, the condition to employ the FMOLS for estimating long-run parameters that the existence of a Cointegration relation between a set of I(1) variables is satisfied.

In this study Engle Granger (1987) test is used for long run cointegration. Cointegration is employed to know the number of co integration vector (Kerry Patterson). Engle and Granger (1987) co-integration technique is applied because this study consists bivariate model otherwise, Johnson's or ARDL co integration techniques are employed in multivariate model

.

The following steps have been taken to empirically analyze this research: Note that all the variables are in natural log form.

**Step 1:** Firstly, each variable is to find out for its order of integration. Engle Granger cointegration technique precondition that the variables should be integrated at the same order. If the variables are integrated at different orders, it is concluded that they are not cointegrated. Additionally, if the variables are stationary at level then there is no need to proceed any further. The Dickey-Fuller and Augmented Dickey-Fuller can be employed to deduce the number of unit roots in each of the variables.

**Step 2**: If the results point out that the variables are integrated at same order, the next step is to calculate the long run relationship in the form as: where left hand side is the output gap and right hand side is unemployment gap, and $\mu$ is the white noise disturbance term. If the sequence of residuals from this regression is stationary, the sequences OG and UG are said to be co-integrated of order (1, 1). On the other hand, if these residuals are non-stationary, it is concluded that there is no long run equilibrium relationship or no cointegration lies between the output gap the and unemployment gap.

If the variables are cointegrated then the short run relationship must exist and it is estimated by an error correction model (ECM) as follows:

$$\Delta Outputgap_t = \alpha + \beta_2 \Delta unemp.gap_t + \beta_3 \mu_{t-1} + \varepsilon \qquad \text{-----(4)}$$

Where the error correction term is stationary residual form cointegration equation. In ECM we checked the significancy of coefficient $\mu_{t-1}$, and whether it is negative or positive which shows the short run dynamics of the model. Technically, Error Correction Method measures the speed of adjustment return to Co-integrated relationships. The ECM postulates that a force affecting the integrated variables to go back their long-run relation when they deviate from the deviation

## Empirical results

**Unit root test**

Table no.1

| Variables | ADF at 1st difference | | |
|---|---|---|---|
| | Coefficients | P-Value | Lags |
| Gdp gapP | 5.3* | 0.00 | 2 |
| Gdp gapB | 4.4** | 0.00 | 6 |
| Gdp gapI | 3.8* | 0.00 | 2 |
| Gdp gapS | 4.2* | 0.01 | 6 |
| Gdp gapC | 3.3* | 0.02 | 6 |
| U.E gapP | 5.7* | 0.00 | 7 |
| U.E gapB | 2.7** | 0.09 | 6 |
| U.E gapI | 3.8* | 0.00 | 2 |
| U.E gapS | 4.2* | 0.01 | 6 |
| U.E gapC | 3.2* | 0.02 | 6 |

*show the first difference stationary and ** show second difference stationary

Table-1 exhibits the stationarity of variables at different form. However, the stationary is found on the same differencing level of the variables (output gap and unemployment gap) of same country that fulfill the Engle granger requirement.

**Engle and Granger**

Table No.2

| Variables | ADF at 1st difference | | |
|---|---|---|---|
| | Coefficients (t-value) | P-Value | Decision |
| U1(Pak) | 5.6** | 0.00 | Co-integrated |
| U2 (Bangla) | 3.3* | 0.02 | Co-integrated |
| U3 (India) | 3.8* | 0.00 | Co-integrated |
| U4 (Lanka) | 7.1* | 0.01 | Co-integrated |
| U5 (China) | 6.2** | 0.00 | Co-integrated |

Table-2 summarizes the results of Co-integration analysis between output gap and unemployment gap of selected countries.

Engle and Granger result identifies the existence of long run association, error term of both equations are stationary at level and first difference as well as, which reflects the evidence

of cointegration. Thus, the presence of co integration vector shows the existence of a long run equilibrium relationship between the variables. Therefore our annual data (1980-2006) supports the proposition that in Pakistan, Bangladesh, India, Sri Lanka and China exist long run relationship among out put gap and unemployment gap. Having found the long-run relationship between the output gap and unemployment gap, in this context our goal is to estimate long-run elasticities. They can be calculated through using Phillips and Hansen (1990) fully modified ordinary least squares (FMOLS) as:

**Fully Modified Least Squares(FMOLS)**

Table no. 3

| Countries | Coefficient | T-Value | P-Value |
|---|---|---|---|
| Pakistan | -0.03 | 2.08 | 0.02 |
| Bangladesh | -0.08 | 3.05 | 0.06 |
| India | -0.29 | 1.95 | 0.08 |
| Sri Lanka | -0.12 | 1.66 | 0.11 |
| China | -0.56 | 1.75 | 0.12 |

Table-3 exhibits the results of same order stationary series which are not satisfied the condition of Okun's law coefficients while, Srilanka and China results are statistically insignificant which are postulated by 't' and 'p' value in above table. In fact, these developing countries data reliability is the question mark.

**Error Correction Method Result**

Table no.4

| Variables | Coefficient | Std Error | t–Value | Prob-Value |
|---|---|---|---|---|
| | | | | |
| UT.P(-1) | -0.05 | 0.056 | 8.4 | 0.00 |
| UT.B(-1) | -0.07 | 0.03 | 1.9 | 0.01 |
| UT.I(-1) | -0.09 | 0.12 | 1.89 | 0.08 |
| UT.S(-1) | -0.14 | 0.09 | 2.3 | 0.03 |
| UT.C(-1) | -0.39 | 0.03 | 2.1 | 0.08 |

Table.4 exhibits the empirical result of Error Correction Model equation. Short run behavior does not show hopeful picture, which indicates our variables output gap and unemployment gap of all countries are long run phenomena. The estimated lagged error correction terms UT.P(-1) for Pakistan, UT.B(-1) for Bangladesh, UT.C(-1) for china, UT.S(-1) for Srilanka and UT.I(-1) for India are negative and statistically significant. This

result supports the cointegration between the variables. The responded coefficients UT(-1) which imply a sluggish adjustment process, coefficients UT(-1) reflect the percentage of the disequilibria of the earlier period's shock adjust get back to the long run equilibrium in the current year.

## Conclusion:

The most interesting finding is that the natural unemployment rate in developing countries of Asian region especially Pakistan and India can not be anticipated due to very high fluctuations in inflation rates which also distort the Non Accelerating Inflation Rate of Unemployment (NAIRU) and also the NAIRU principle does not hold its validity in these developing countries.

The implications of Okun's law for economic policy that economists need to anticipate the further development of unemployment for a given projected growth level which is additionally important to forecast unemployment costs. But our results do not support the implications of Okun's Law in some developing countries because of asymmetric problems. It can be said that Okun's law interpretation may not be applicable in developing countries. Various Asian developing countries are prominent example in the World who successfully removed the unemployment problem e.g. Korea, Malaysia, Singapore and China are most recent of them. They are growing fastly because there is political stability and good governance. Pakistani, Bangladeshi, Srilankan, and Indian governments and political leaders should learn lesson from those Asian countries.

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