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The relationship between output growth and unemployment in the Philippines economy (1990-2014): An empirical analysis of variants of Okun's Law

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ABSTRACT

This paper examines the empirical relationship between unemployment and real output in the Philippines utilizing quarterly data from the Labor Force Survey by the Philippine Statistics Authority for the period from 1990-2014. The study employed three variants of Okun's Law – the "gap" approach, the "first difference" approach, and a dynamic approach. Findings show that the Okun's coefficients based on the gap approach are consistent with the theoretical expectation of a negative relationship. In the ARDL model, labor force participation rate and trade openness were found to be significantly related to unemployment. The result of dummy variable test revealed the presence of structural break following the re-definition of unemployment in the Philippines in 2005. Recursive least squares and rolling regressions show evidence of parameter instability in several sub-periods.

1. Introduction

It is a widely accepted view in macroeconomics that the rate of growth of output of an economy generates employment and reduces, therefore, the rate of unemployment (Dornbusch et al, 2014; Jones,2002). The empirical regularity of this observation between output growth and unemployment has become known as "Okun's Law". This relation is among the most well-known in macroeconomic theory and has been found to hold for a number of countries and regions particularly in developed economies (Okun, 1962 cited in Kreishan, 2011).

Arthur Okun (1962) was primarily interested in deriving a measure of potential GNP for the US economy and how actual output deviated from this potential. Okun's estimate of the trend unemployment or the natural rate of unemployment is based on the agreement that the reasonable target of unemployment under the existing labor market conditions was 4%. The "gap" estimate of 0.032 was derived from various techniques such as first differences, trial gaps, and fitted trends and elasticity model. The coefficient of 0.032 implied that a 1% gap in the unemployment from its

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natural rate which is 4% during the period of 1947-1960 would result to a gap of 3.2% in output from its potential level.

In recent years, the robustness of Okun's Law has been questioned by many economists and raised doubts about the regularity of the three-to-one output-unemployment ratio particularly in the US. It was observed that the last 3 recessions were followed by a "jobless" recovery in which unemployment did not fall as much as Okun's Law predicts. Evans (1989) and Gordon (1984) in Lee (2000) believe that output and unemployment have passed through a structural change. Several reasons that have further contributed to skepticism about the robustness of Okun's Law were developments such as rising female labor force participation, productivity and wages slowdown, and corporate restructuring.

According to Pitterle and Zhang (2014), the recent surge in growth of the Philippine economy has not been matched by a similar improvements in the labor market. Unemployment and underemployment in the Philippines have remained obstinately high, well above the rates seen in most East Asian economies. In 2013, the average unemployment rate was 7.1 percent, while underemployment was 19.3 percent which is about the same levels as in the last few years and only slightly below the combined rate of about 30 percent registered in the early 2000s. This has led many economists to refer to the recent episode in the Philippines as "jobless growth".

According to the World Bank Philippine Development Report (2013), the elasticity of employment to GDP growth in the Philippines was very low during the period 1998 to 2010, particularly in agriculture and industry. This was also affirmed in the study of Hanusch (2013) were the output growth-employment coefficients were weak and insignificants in two different sub-periods. There were also studies confirming the significant relationship between unemployment and output growth in the Philippine economy. Brooks (2002) examined the employment-output relationship over the period 1990-2000 and arrived at a significant cointegration coefficients ranging from 0.68-0.93 depending on the sample period. The findings of Connoly (2013) suggest that for every percentage increase in the GDP growth rate, the unemployment rate will decrease by 0.56%.

The main objective of this paper is to validate the cogency of Okun's Law in the Philippine economy using the quarterly data from 1990 to 2014. This paper utilized three approaches: the "gap" model, the "first difference" model, and the Auto Regressive Distributed Lag (ARDL) model to empirically validate Okun's Law. The perceived presence of structural change as cited by Canlas (2005) due to the adoption of the new unemployment definition was addressed by providing separate Okun's coefficients before and after the new method was adopted in 2005. This was supported by the application of dummy variable test for the "gap" and differenced models. The paper also explored the possible existence of stable Okun's coefficient using recursive and rolling regressions.

The study is presented as follows: the second section provides the data and methodology used in the estimation of the relationship; the third section discusses the results and findings of the study which is consist of the diagnostic tests such as unit root testing and cointegration test, and the application of the three models in the estimation of Okun's relationship, and, lastly, the test for stability of the Okun's coefficient was performed; the last section discusses the summary and conclusions of the study.

2. Methodology and data

2.1. Data sources and collection

Quarterly time series data on unemployment, unemployment rate, employment level, labor force, and labor force participation rate, real Gross Domestic Product (at constant 2000 prices) from 1990 to 2014 were used in this study. The data consist of 96 quarterly observations.

The data series were down-loaded from the websites of Philippine public agencies and institutions such as the Department of Labor & Employment (DOLE), Philippine Institute for Development Studies (PIDS), and Philippine Statistics Authority (PSA). Relevant empirical studies and scholarly articles cited in this paper were obtained from a number of university libraries in the Philippines and from internet sources.

2.2. The economic model

To validate Okun's Law given the empirical data for the Philippines and to test its applicability, three (3) versions of the law which include a dynamic or "modified" version were adapted as follows:

2.2.1. The "gap" version of Okun's Law

$$(U_t - U_t^{*}) = -\beta(Y_t - Y_t^{*}) + \varepsilon_t \qquad (1)$$

Where U_t = *natural* logarithm of the actual level of unemployment;
U_t^{*} = H-P filtered trend of the actual level of unemployment in natural logarithm
Y_t = natural logarithm of actual real GDP;
Y_t^{*} = H-P filtered actual output in natural logarithm
and e_t = error term

Both trend level of unemployment, U^{*}, and potential output, Y^{*}, were estimated from the data using a filtering technique known as Hodrick-Prescott (HP) filter (see Grant, (2003) and Lee,(2000). The H-P filter is a moving average filter that breaks down a time series (X_t) into a *random trend* and a *cyclical* component.

2.2.2 First difference or "changes" version

This version relates the change in unemployment, ΔU, to the change in real output, ΔGDP. The estimating equation, therefore, is as follows:

$$\Delta U_t = \alpha + \beta rGDPgr_t + \omega_t, \qquad (2)$$

Where Δ is the change from previous period's unemployment rate. $RGDPgr_t$ It is the current period's real GDP growth rate which is equivalent to ΔGDP; **α** is the intercept, and **β** is the Okun's coefficient which measures the amount of change in the unemployment rate brought about by changes in the real output and $\omega_t = \Delta\varepsilon_t$ or the error term. It is assumed that growth in output and the change in the unemployment rate are inversely related.

2.2.3 Dynamic version model

The dynamic version adopts an autoregressive distributed lag (ARDL) model with the following specification:

$$U_t = \alpha + \beta_1 U_{t-1} + \beta_n U_{t-n} + \delta_1 GDP_t + \delta_n GDP_{t-n} + \vartheta_1 LProd_t + \vartheta_{1+n} LProd_{t-n} + \gamma_1 LFPR_t + \gamma_{1+n} LFPR_{t-n} + \varphi_1 Trade_t + \varphi_{1+n} Trade_{t-n} \quad (3)$$

where U_t is the unemployment level at time t expressed in natural logarithm U_{t-n} is the lagged unemployment up to n quarter expressed in natural logarithm
GDP_t is the real GDP at time t expressed in natural logarithm
GDP_{t-n} is the lagged value of real GDP up to n quarter expressed in natural logarithm
$LProd_t$ is the value of labor productivity at time t expressed in natural logarithm
$LProd_{t-n}$ is the lagged value of labor productivity up to n quarter expressed in natural logarithm
$LFPR_t$ is the value of labor force participation rate at time t expressed in percent
$LFPR_{t-n}$ is the lagged value of labor force participation rate up to n quarter expressed in percent
$Trade$ is the value of the percentage share of exports and imports to real GDP at time t
$Trade_{-n}$ is the lagged value of the percentage share of exports and imports to real GDP up to n quarter
$\alpha, \beta_1, \beta_n, \delta_1, \delta_n, \vartheta_1, \vartheta_{1+n}, \gamma_1, \gamma_{1+n}, \varphi_1, \varphi_{1+n}$ refer to the short-run and intermediate elasticity coefficients of the regressors.

It is assumed that current and previous labor productivity levels affect current employment decisions. Past (previous) data on productivity could reflect the medium run or long-term effect on unemployment. Two other important assumptions could be considered with respect to the behavior of the level of productivity to affect the unemployment rate. The first one is when the increase in growth of output is higher than the growth in the employment rate. This signals increased demand for workers to facilitate production activities thereby reducing the current unemployment rate. The second assumption is when the employment rate during the previous periods is higher than the growth of output, labor productivity during the previous period(s) will decline. This indicates lower demand for labor in the current period due to lower production activity thereby increasing the level of unemployment in the current period.

Another factor that motivates the current level of unemployment is the labor force participation rate which is considered as a proxy for the supply of labor in the economy. It is further assumed that unemployment positively responds to variations in the current and previous supply of labor. Trade openness was also introduced in the dynamic model since the level of exposure of an economy to global trade could significantly alter the level of domestic employment and unemployment. It is argued that improved exports enhance employment, thus lowering unemployment, while higher imports could worsen unemployment because of lower demand for domestic products.

3. Results

3.1 Diagnostic tests

The standard test of significance and other diagnostic tests were employed to satisfy the final regression models. Among the tests used were R^2, the F-ratio, test of autocorrelation using the DW statistic, stability test using the Chow test, Jarque-Bera test of normality of residuals, Ramsey's RESET model specification error test, White's multi-collinearity test, unit root test, and cointegration test using the Johansen procedure. Tables 1 to 3 summarize the results of the diagnostic examinations on the variables of the model.

Table 1 confirms the following findings: both the "gap" variables are stationary at levels with p-values lower than 5% level of significance; the differenced unemployment rate is stationary at level. Among the variables in the modified Okun's Law, Real GDP, Average Labor productivity, Labor Force Participation rate, Imports, and Exports were found to have unit roots and became stationary at first difference while real GDP became stationary at a 2nd difference.

Table 1. Unit root test results

"Gap" Model		**"Differenced" Model**		**Modified Model**		
Variables	P-value	Variables	P-value	Exogenous	Variables	P-value
Unemployment Gap	**0.0149***	D(Unemployment)	**0.0000***	Constant	Log(unemployment)	0.0000**
RGDP Gap	**0.0001***	D(RGDP)	**0.0000****	Trend and intercept	Log(RGDP)	0.0101**
				Trend and intercept	Log(LaborProd)	0.0016**
				Trend and intercept	Labor Force Participation Rate	0.0000**
				Intercept	Log(Exports/RGDP)	0.0214*
				Intercept	Log(Imports/RGDP)	0.0242*

* significant at levels
** significant at first difference
*** significant at second difference

Table 2 highlights the cointegration test results to determine if the variables used in the 3 models have long-run or equilibrium relationships. The ADF statistics for the "Gap" model (ADF (-2.57416, p-value (0.0105) and "difference" model (ADF(-5.8761, p-value 0.000) suggest that the residuals of the regression models are stationary indicating a long-term equilibrium relationship.

Table 2. Cointegration using the augmented Dickey-Fuller test

	"Gap" Model	**"Difference" Model**
ADF test statistic		
t-statistic	-2.574160	-5.876107
Probability	0.0105	0.0000
Test critical values		
1% level	-2.591204	-2.591204
5% level	-1.944487	-1.944487
10% level	-1.614367	-1.614367

For the dynamic or modified version which is a multivariate model, Johansen cointegration technique was used. The result of the Trace test and the Max-eigenvalue test in Table 3 revealed that there is one cointegrating equation which indicates the existence of a long-run equilibrium relationship among the variables of the model. Spurious regression results are therefore ruled out for this model.

Table 3. Johansen cointegration test results for dynamic model

Trend assumption: No deterministic trend (restricted constant)

Series: UNEMP RGDP LABORPROD LFPRATE EXPORTS IMPORTS

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.486513	152.1034	103.8473	0.0000
At most 1 *	0.399367	89.44944	76.97277	0.0041
At most 2	0.165068	41.53094	54.07904	0.3957
At most 3	0.127490	24.57283	35.19275	0.4264
At most 4	0.079960	11.75301	20.26184	0.4712
At most 5	0.040837	3.919241	9.164546	0.4243

Trace test indicates 2 cointegrating Eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

3.2 Estimating the natural rate of unemployment

The concept of the natural rate of unemployment has become very vital in implementing economic policy. In Grant (2002), Friedman considers the natural rate of unemployment as a reflection of an economy's existing institutional features and labor market imperfections. The natural rate of unemployment (NARU) was defined by Rogerson (1997), also in Grant(2002) as "the normal unemployment rate that results from the process of labor allocation when workers and firms correctly perceive the levels and rates of change of prices and wages." As defined earlier, Okun measured the NARU to be at 4% in the US from 1948-1960. From then on, several attempts to measure the natural rate of unemployment and potential output have been conducted.

In this study, we adopted the econometric procedure employed by Grant (2002) in estimating the natural rate of unemployment. The computation was supplemented by employing the Hodrick-Prescott (HP) filtering technique in decomposing output and unemployment and generating the natural rate of unemployment and potential output series.

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As shown in Table 4, the estimates revealed that the natural rates of unemployment were different prior and during the adoption of the ILO definition of unemployment. The estimated NARU for the first period was recorded at 10.15%, which was 3 percent higher than the NARU for the second period (2005:2 -2014:3) with 7.343%. The estimates for the two periods were comparably higher relative to other Asian countries. As Okun suggested, variations in the estimates of the NARU could be attributed partly to the changes in the labor force. During the *conduct of the Labor Force Survey by the NSO, once the respondent answered that he/she did not look for* work at any time during the past week for no valid reasons, the respondent is automatically excluded from the labor force. The quarterly average labor force participation rate covering the 3rd quarter of 1990 to the first quarter of 2005 was estimated at 66.264 and 2 percentage point higher than the quarterly average recorded from the 2nd quarter of 2005 to the 3rd quarter of 2014 which is 64.158%. As explained by the Ibon Foundation, the country has the worst unemployment rate in Southeast Asia. The unemployed in the labor force is comprised mostly of vulnerable workers within the age group of 15-24 years and mostly those who were not able to attend college education.

Table 4. Natural rate of unemployment, Okun's coefficient using the Gap Model

Coefficient	**1990:3-2014:3**	**1990:3 – 2005:1**	**2005:2-2014:3**
NARU*	9.05	10.145	7.343
Okun's Coefficient**	-0.85322	-0.92	-0.701403

* The natural rate of unemployment was computed using the econometric equation presented by Grant (2002)
* the researchers were able to arrive at the same values for the NARU using the average of the H-P trended unemployment series in natural log form which were computed separately for the 2 sub-periods.
** the coefficients are duplicates from the regression using the "gap" approach

3.3 The regression results

This section provides significant results for the three models of Okun's Law in the Philippines using the quarterly data from 1990 to 2014. An important question that was posed in the derivation of Okun's coefficient using the "gap" approach is how to determine the unobserved natural rate of unemployment and the level of potential output in an economy. We followed the econometric procedure employed by Grant (2002). The first step was to transform the data series on real GDP into the natural logarithm. Then the level of potential output was estimated by obtaining the smoothed trend using the Hodrick-Prescott filtering technique. Thereafter, the "gap" was computed by subtracting the H-P trended series from the actual real GDP series. To be consistent with the findings of Canlas (2005) regarding the drastic change in the estimation of unemployment by the Philippine Statistics Authority starting April of 2005, we presented separate computations for the periods covering the data series prior to and during the second quarter of 2005 and we summarized the results in table 4.

3.3.1. Regression results of the "gap" model

Table 5(A) presents the "gap" model for the period 1990:3 to 2014:3.

Table 5. Regression results for the Gap model

Dependent Variable: Unemployment Gap
Independent Variable: GDP Gap

Variable	**Gap Model 1*** **1990 – 2014***	**Gap Model 2*** **1990:3 – 2005:1**	**Gap Model 3** **2005:2 – 2014:3**
Regression Coefficient (Okun;s Coefficient)	-0.853220	-0.920006	-0.701403
Standard Error	0.118424	0.139832	0.254989
t-Statistic	-7.204788	-6.579356	-2.750718
Probability	0.0000	0.0000	0.0091
R^2	0.099729	0.082876	0.069755
Adjusted R^2	0.099729	0.082876	0.069755
Durbin-Watson Statistic	2.358845	2.523900	0.905163
Akaike info Criterion	-1.139258	-0.749148	-2.360802
Schwarz Criterion	-1.112715	-0.713935	-2.317707
Ramsey's RESET Test	0.1047	0.465	0.0003
JB test of Normality	0.000024	0.06959	0.4533
White's Test	0.0332	0.0101	0.2025
Chow Forecast Test**			

* HAC standard errors & covariance (Bartlett kernel, Newey-West fixed
**Chow test assumes that the residuals are normally distributed and homoscedastic

The estimated Okun's coefficient for "gap" model 1 of -0.85322 which pertains to the entire period is significant and consistent with the expectation of an inverse relationship between unemployment and output. The diagnostic tests revealed that the model while correctly specified based on RESET was plagued with heteroscedasticity and non-normality on the residuals. The model was re-estimated by employing the HAC Newey-West procedure to correct for heteroscedasticity and autocorrelation. Also shown in Table 5(b) and (c) are the "gap" model parameter estimates using 2 different sub-periods. Although gap model 3 was misspecified given a significant RESET, it would be noted that its Okun coefficient during the first sub-period was lower than the second sub-period and when using the overall data set. For model 2, the value of -0.92 indicates that a 1 percent increment in the real GDP from its equilibrium level could improve unemployment by 0.92%. In the second sub-period, the coefficient is statistically lower than the first sub-period with a value of 0.70%. This seems to strengthen the suspicion that the inverse

relationship between output and unemployment has become weaker as the Philippines officially adopted a re-definition of unemployment in 2005. The aforementioned results highlight the link between the economy's natural rate of unemployment and the possible variation in the estimated "gap" coefficients. Okun (1962) claimed the possibility of arriving at varying estimates when the natural rate of unemployment deviates from 4%.

3.3.2 Regression results of the first differenced model

The first differenced models 1 and 2 showed evidence of a significant relationship between the quarterly change in real GDP and the quarterly change in the unemployment rate as suggested by the p-value of the coefficients. However, the positive coefficients for the 2 models are inconsistent with the expectation that the growth rate in output and the change in the unemployment rate are inversely related. This was due to the following results: the presence of autocorrelation, the heteroskedastic variance, and variance is not normally distributed. For model 3 of the differenced version, the regression coefficient is insignificant since the probability is higher than 0.05 level of confidence. In addition, the overall significance of the model using the probability of F-statistic is also higher than 0.05 level. The model was re-estimated using AR(1) correction but still produced insignificant coefficients.

Table 6. Regression results for the differenced model

Dependent Variable: D(UNEMPLOYMENT RATE)
Independent Variable: REAL GDP GROWTH

Variable	**Differenced Model 1***	**Differenced Model 2**	**Differenced Model 3**
	1990 – 2014*	**1990:3 – 2005:1**	**2005:2 – 2014:3**
Regression Coefficient (Okun;s Coefficient)	0.127429**	0.220898**	-0.021810
S.E. of regression	1.486152	1.164660	0.751225
t-Statistic	-3.057711	13.23764	-1.599911
Probability	0.0000	0.0000	0.1184
R^2	0.382264	0.757822	0.069755
Adjusted R^2	0.375693	0.753498	0.040449
Durbin-Watson Statistic	3.057792	2.849827	1.773434
Akaike info Criterion	3.650871	3.176609	2.316973
Schwarz Criterion	3.704295	3.247659	2.403162
Ramsey's RESET Test	0.8148	0.8644	0.2900
Prob (F-statistic)	0.0000	0.0000	0.118359
JB test of Normality	0.8865	0.865348	0.000059
White's Test	0.00005	0.157663	0.3696
Chow Forecast Test**			

* HAC standard errors & covariance (Bartlett kernel, Newey-West fixed
** The coefficients are insignificant given the theoretical assumption of negative relationship
***Chow test assumes that the residuals are normally distributed and homoscedastic

3.3.3. Regression results of dynamic model (ARDL Model)

Another model of Okun's law that was employed in this study was the modified version wherein several regressors were incorporated in the original Okun's relationship. Aside from real GDP, labor productivity, labor force participation rate, the ratios of exports and imports to the real GDP were also identified as significant variables of the model. Okun (1962) also considered the size of the labor force, average weekly hours, and labor productivity as important components in arriving at a 3:1 output-unemployment ratio. Gujarati & Porter (2009) emphasized the role of lag or past values of the explanatory variables and the lag values of the dependent variable in determining the short-run and long-run effects. In this study, lag values were extended up to the 3rd lag since the time series data were presented on a quarterly basis to include the possible seasonal impact on the current unemployment and to capture the long-run elasticity of unemployment on the regressors.

The data on LFPR and trade openness were not transformed into the natural logarithm since they were already in percentage form. The summary of the regression results with diagnostic tests is provided in Table 7. The initial ARDL model comprises all the four predictor variables including their lags up to 3 quarters Shown in Table 7 the original and the final ARDL models which confirm that unemployment reacts not only to the current data series but also to its past data.

Applying the backward elimination method using the SPSS, all the current and lagged data series were initially included in the analysis. Out of the 19 regressors, only five (5) were found significantly related to the dependent variable. The method performed 13 iterations to finally come up with seven variables that were considered highly significant to the current level of unemployment.

The final model revealed that the lags of unemployment up to two-quarters have the highest intermediate effect or contribution to the current level of unemployment considering its elasticity coefficient of 0.719. Labor force participation rate and trade openness also displayed positive significant contributions to the current level of unemployment though the coefficients were considerably small. The findings were in contrary with the results of Felbermayr, Prat and Schmerer (2011) for the OECD member countries, and Gaston & Rajaguru (2013) for Australia. It would not be surprising that the partial elasticity of unemployment on trade openness is statistically low since the positive effect of the growth in exports in curving unemployment is being offset by the negative effect of the increase in importation on the level of unemployment. Ranjan (2013) posited that trade liberalization ambiguously impact the economy wide unemployment.

Another important highlights of the ARDL model was the low and insignificant relationship between labor productivity and unemployment. Canlas (2005) pointed out that labor productivity in the Philippines exhibited extreme volatility. While Okun considered labor productivity to be pro-cyclical, this was not the case for the Philippines as depicted in the final ARDL model. The study of Villaverde & Maza (2009) affirmed the significance of labor productivity on the value of Okun's coefficient.

The R2 value of 0.811 for the final model indicates that 81.1% of the variation in the unemployment in the Philippines is explained by the variations in the regressors. These results pose serious challenges to Philippine policy makers since the economy is fast integrating with its Asian neighbors and possible entry into the proposed TPP (Trans-Pacific Partnership) which will further open up the economy even more and the increased competition may undermine vulnerable sectors of the economy.

Table 7. Auto regressive distributed lag model (Model 3)

Variable	**ARDL MODEL (ALL VARS)**		**ARDL MODEL (FINAL after elimination of insignificant vars)***	
	Coefficient	**Probability**	**Coefficient**	**Probability**
Constant	-1.442	0.473	-1.004	0.2289
Unemp(-1)	0.495	0.003	0.578	0.0000
Unemp(-2)	0.162	0.391	0.141	0.0196
Unemp(-3)	0.088	0.614	**-.-**	**-.-**
Rgdp	0.028	0.382	**-.-**	**-.-**
Rgdp(-1)	-0.192	0.851	**-.-**	**-.-**
Rgdp(-2)	-0.336	0.788	-.-	-.-
Rgdp(-3)	0.571	0.614	-.-	-.-
Laborprod	-0.290	0.436	-.-	-.-
Laborprod(-1)	0.054	0.955	-.-	-.-
Laborprod(-2)	0.946	0.433	0.238	0.0154
Laborprod(-3)	-0.645	0.550	-.-	-.-
LFPRate	0.078	0.000	0.086	0.000
LFPRate(-1)	-0.040	0.042	-0.050	0.000
LFPRate(-2)	0.000	0.984	-.-	-.-
LFPRate(3)	-0.004	0.847	-.-	-.-
(X+M)/RGDP	0.002	0.069	0.003	0.0004
(X+M)/RGDP(-1)	-0.003	0.074	-0.002	0.0029
(X+M)/RGDP(-2)	0.001	0.335	-.-	-.-
(X+M)/RGDP(-3)	0.000	0.815	-.-	-.-
Standard Error of Regression	0.091301091		0.088403888	
R^2	0.827		0.811	
Adjusted R^2	0.782		0.796	
Durbin-Watson Statistic	2.062347		2.074613	
F-statistic	18.56296		55.1296	
Akaike info Criterion	-1.763006		-1.944383	
Schwarz Criterion	-1.221879		-1.729320	
Ramsey's RESET Test (Prob)	2.663457	0.0766	2.410293	0.0959
J-B Normality Test (Prob)	12.10514	0.002352	2.856697	0.239704
White test	0.738556	0.7676	0.955940	0.4685

*Based on backward elimination regression method using SPSS

3.4 Stability of parameters of the models

In view of the perceived structural break in the unemployment data series identified to have started in the second quarter of 2005 following the acceptance of the new ILO definition of unemployment, dummy variables for both the intercept and slope coefficient were employed to detect where the suspected variation on the gap estimates is coming from.

3.4.1. Dummy variable test for the gap model

Table 8 presents the results of the dummy variable test for the gap model with and without a constant term.

In the model with a constant term, both the differential intercept (Dummy1 coefficient) and the differential slope coefficients are not significant at 5% level. However, if we will apply the 10% level of significance we can detect a significant difference in the intercept of the two sub-periods. This findings strongly suggest the presence of structural break as the Philippines adopted the ILO definition of unemployment. The results coincide with the analysis of Canlas (2005) that the data on unemployment undergone a structural change.

Table 8. Dummy variable test for the gap model

Variable	**Gap Model (with constant term)***		**Gap Model (w/o constant term)**	
	Coefficient	**Probability**	**Coefficient**	**Probability**
Constant	0.016709	0.3374	-.-	-.-
Dummy1 coefficient	-0.041389	0.0923	-.-	-.-
RGDP_GAP	-0.916333	0.0000	-0.920006	0.0044
Dummy1*RGDP_GAP	0.228030	0.3348	0.218604	0.7025
Standard Error of Regression	0.136716	-.-	0.136800	-.-
R^2	0.121128	-.-	0.101118	-.-
Adjusted R^2	0.092778	-.-	0.091656	-.-
Durbin-Watson Statistic	2.42	-.-	2.381354	-.-
F-statistic	4.272499	0.007143	-.-	-.-
Akaike info Criterion	-1.101460	-.-	-1.120184	-.-
Schwarz Criterion	-0.995286	-.-	-1.067097	-.-
Ramsey's RESET Test (Prob)	2.545726	0.0285	1.359830	0.1771
J-B Normality Test (Prob)	11.354	0.007143	20.11	0.000043
White test	9.1404742	0.00000	3.058160	0.0517

* HAC standard errors & covariance (Bartlett kernel, Newey-West fixed

3.4.2. Dummy variable test for first difference model

For the first difference model, while the dummy for the intercept is not significant the dummy for the slope coefficient is found to be statistically significant as Table 9 would show. The foregoing results suggest that the first difference model is able to detect the presence of structural change which occurred during the period covered by the study. The structural break is captured by the shift in the slope coefficient of the Real GDP Gap variable.

Table 9. Dummy variable test using the first difference model

Variable	Difference Model (with constant term)	
	Coefficient	Probability
Constant	-0.228865	0.0948
Dummy1 coefficient	0.144206	0.5071
RGDPGR	0.220898	0.0000
Dummy1*RGDPGR	-0.24708	0.0000
Standard Error of Regression	1.022977	-.-
R^2	0.713537	-.-
Adjusted R^2	0.704196	-.-
Durbin-Watson Statistic	2.754089	-.-
F-statistic	76.38627	0.0000
Akaike info Criterion	2.924085	-.-
Schwarz Criterion	3.030933	-.-
Ramsey's RESET Test (Prob)	0.788260	0.4577
J-B Normality Test (Prob)	7.599266	0.022379
White test	1.561761	0.2040

3.4.2. Recursive and rolling regressions on structural break

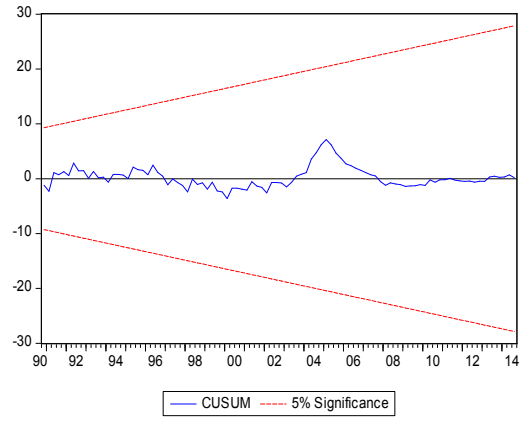
The researchers also applied recursive least squares and rolling regressions on the data series. Recursive residual test results were plotted in Figures 1-3 for the gap, first-difference, and dynamic models. In addition, rolling regression coefficients with a window size of 32 quarters were also shown in the same figures to further validate if regression coefficients are time-varying. This was also performed by Moosa (1997) and Knotek (2002) to determine the stability of Okun's coefficients for the US. Rolling regression considered a window size of 8 years or 32 quarters with the first regression window covering observations from 3rd Q of 1990 to 2nd Q of 1998.

When recursive least squares and rolling regressions were applied on the three models, evidence of structural instability in the parameters was found. In the Gap model, Figures 1.1 to 1.3 graphically illustrate the results of recursive least squares test. The plot of the cumulative sum of the residuals show that the unemployment gap coefficients were stable overtime since the plot of the CUSUM of squares is at the 5% level of significance. However, when the CUSUM of squares and one-step probability plots were included it can be seen that there were some periods indicating the variability of the parameters. Figure 1.2 displayed that starting from 1996 to 2008, the CUSUMs exceeded the critical boundaries. A similar result is evident in Figure 1.3 wherein six sample points from 1990 to 2004 posted p-values less than 0.05.

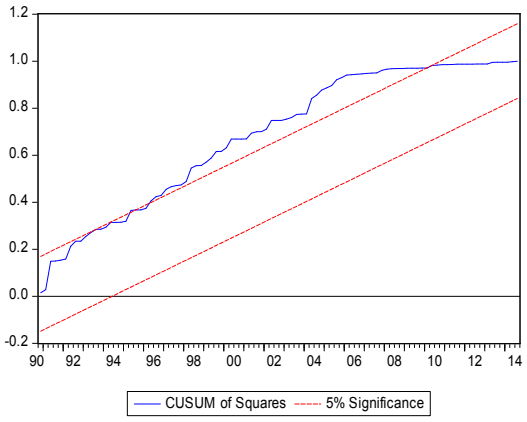
The results of rolling regressions also affirmed the presence of structural instability in the relationship. The model was estimated using an eight (8) year rolling window that corresponds to 32 observations. The first regression estimate covered the 3rd quarter of 1990 up to the 2nd quarter of 1998. The coefficients were consistently negative though slight variations in the coefficients were observed.

The First Difference Model also showed instability in the coefficient as the CUSUMs crossed the critical lines from 1998 to 2005 as shown in Figures 2.1 to 2.4.

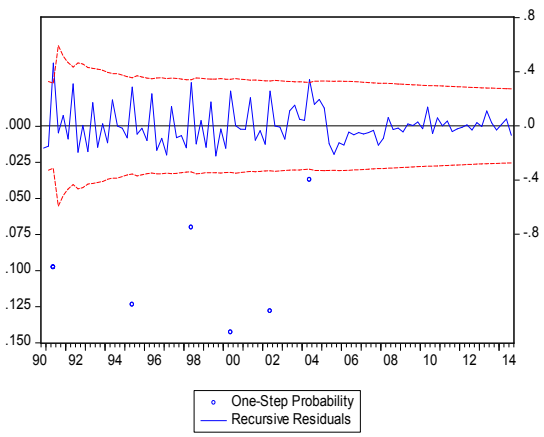
There were also some sample points with p-values that are less than 0.05. These occurred in the mid-period of the data series (1998-2008). Although the regression coefficient is not significant and did not conform to the expectation of a negative relationship, rolling regression supports the claim that Okun's coefficient varied since Figure 5.4 depicts a decreasing rolling coefficients. This finding that Okun's coefficient has undergone a structural break is consistent with the results of Grant(2002), Moosa (1997) and Knotek (2007).



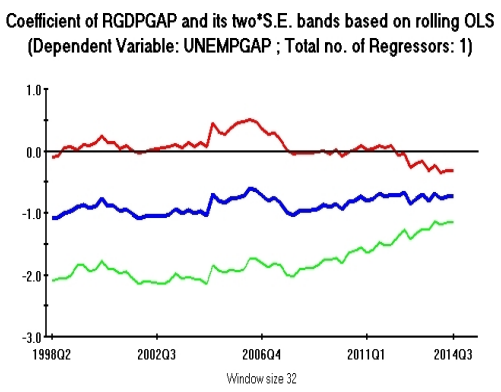
(1.1)



(1.2)

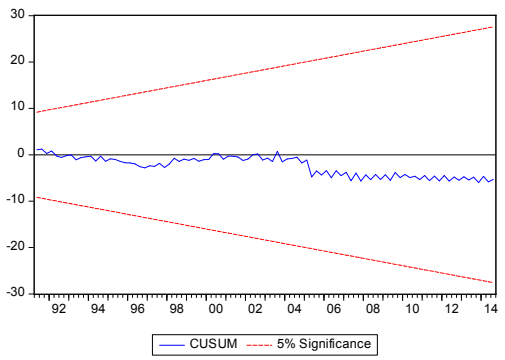


(1.3)

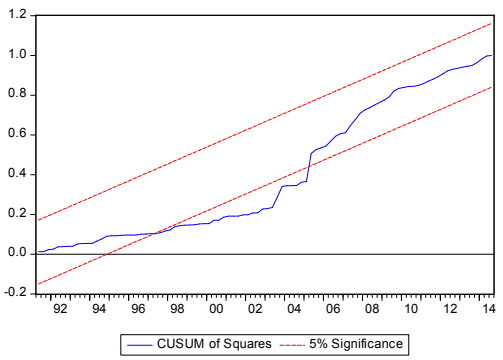


(1.4)

Fig. 1.1-1.4. Recursive least squares estimates and rolling regression coefficients for the “gap” model



(2.1)



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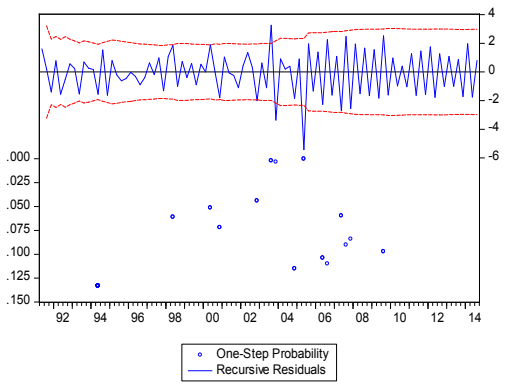
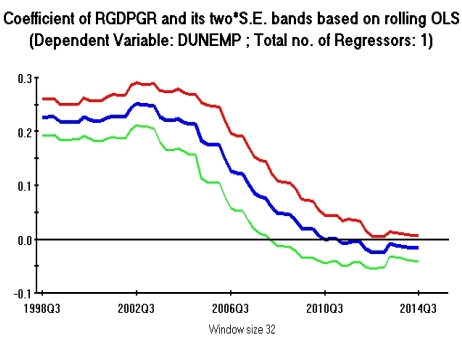


(2.3)

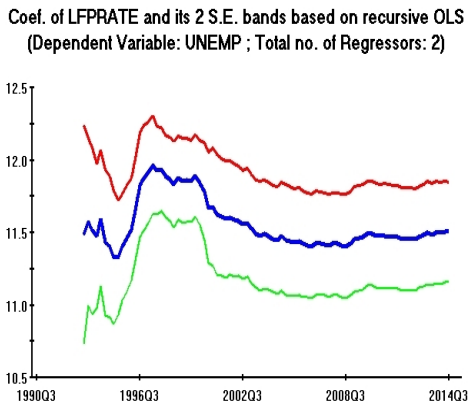


(2.4)

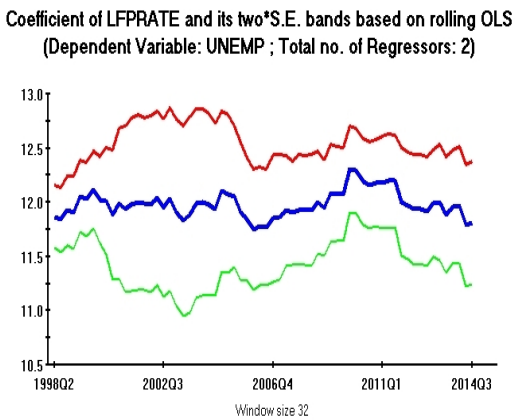
Fig. 2.1–2.4. Recursive least squares estimates and rolling regression coefficients for "differenced" model

The variability in Okun's coefficient overtime was significantly affected by labor force participation rate and percentage share of imports to real GDP as Figures 3.1 to 3.4 would show.

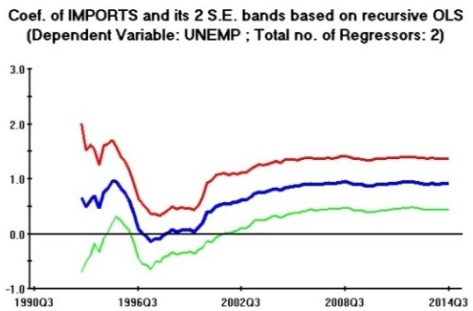
Recursive coefficients for labor force participation rate are marked with an initial sharp increase followed by a smooth downward trend. Similarly, the effects of percentage share of imports to real GDP were a sharp decline in the value of the recursive coefficients until the second quarter of 1996. From then on, additional observation produces smoothly increasing coefficients. Rolling regression models for labor force participation rate and percentage share of imports to real GDP was shown in Figures 3.2 and 3.4. Both variables produced time-variant unemployment coefficients.



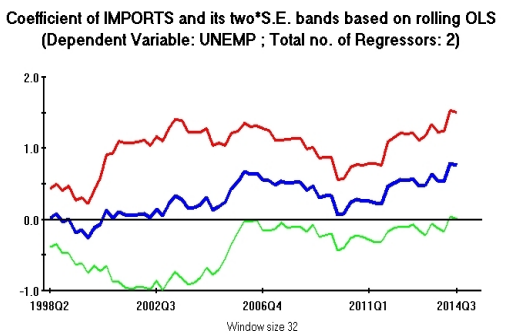
(3.1)



(3.2)



(3.3)



(3.4)

Fig. 3.1-3.4. Recursive least squares estimates and rolling regression coefficients for "dynamic" model

4. Conclusions

This paper has attempted to provide alternative approaches to measuring output-unemployment relationship in the Philippine economy using the empirical model based on Okun's Law. Summing up, the salient findings of this study are as follows:

1. The re-definition of unemployment in the Philippines in 2005 to conform with ILO standard is identified as a likely source of structural break in the parameters of the model judging from the results of the dummy variable test.
2. The three estimates of the Okun's coefficients for the "gap" model were found consistent with the theoretical expectation that output gap and unemployment gap are inversely related. In addition, the data propose that a higher equilibrium unemployment has coincided with a lower Okun's coefficient.
3. The Okun coefficient for the first-differenced model was found not only insignificant but also did not conform to the theoretical expectation of a negative relationship.
4. The dynamic model (ARDL) implied that the current level of unemployment is significantly affected by the previous unemployment level, the past and current labor force participation rate, and the degree of trade openness.

5. All three models ruled out misspecification error based on Ramsey's RESET. Moreover, there is also evidence of long-run equilibrium relationships in the three models based on cointegration tests.
6. The use of recursive and rolling regressions and CUSUMs highly suggest that the coefficients are time-variant with higher variability recorded during the late 1990's prior to the switch in the definition.

While the Okun coefficient of -0.85 for the Philippines, in particular Gap Model1, is virtually three (3) times that for the US economy, it would be premature to conclude that the Philippine labor market is more elastic in reducing unemployment as the economy grows. The reason being that potential output growth in the Philippines could also be higher. To induce an appreciably lower rate of unemployment in the Philippines, the economy may have to grow at a much more robust rate than potential output. This would imply increased build up in capital formation and higher productivity growth. Further, the size of OFWs which is a significant component of the Philippine labor force may hide or mask a genuine output elastic reduction in the unemployment rate in the economy.

The positive but insignificant effect of export-to-GDP ratio under the dynamic model should be a cause for concern among policymakers in the Philippines. It could be attributed to the relative lack of value added on traditional agricultural and primary product exports of the country which in turn dampens opportunity for higher levels of employment. Therefore, if the Philippine export sector could be motivated to introduce greater value-added processing on traditional as well non-traditional commodity exports, employment absorption maybe enhanced.

Future research along this line may consider a comparative study across the ASEAN region using either panel data regression or individual cointegrating equations to find out which country in the region has greater or lower elasticities of unemployment with respect to output growth. The results could be of value in planning how Philippine policy makers could insulate domestic employment, among others, as the country becomes more integrated with the regional economy.

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