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Regression Analysis Student Project
Winter 2013

The Effect of Economic Indicators on the Unemployment Rate in the Philippines

Introduction

The unemployment rate is a key statistic in a developing economy such as the Philippines. The unemployment rate can be seen as a measure of economic health that directly translates into household quality of living, and indirectly as a poverty indicator. What we seek in this project is to explain the unemployment rate in terms of the economic indicators on aggregate supply and aggregate demand, namely the Philippine Stock Exchange Index, the Overseas Filipino Workers' Remittance, and the Consumer Price Index.

The Variables

Dependent Variable:

Philippine Unemployment Rate (PUR) – This represents the portion of the labor force that are actively but unsuccessfully seeking employment. In this model, this variable is a measure of economic health that directly translates into household quality of living, and indirectly as a poverty indicator.
Source of data: http://www.census.gov.ph/

Explanatory Variables:

Philippine Stock Exchange Index (PSEi) – The so-called barometer of the Philippine economy, an aggregate measure of market capitalization of common stocks. This reflects the performance of major industry drivers and is composed of a fixed basket of thirty listed common stocks which are carefully selected to represent the general market trend. In the model, this variable represents the state of domestic production (aggregate supply), taking into account both domestic and foreign investment. Economic theory suggests that the higher the PSEI, the better the domestic performance and thus the lower is the rate of unemployment.
Source of data: The Philippine Stock Exchange, Inc.

Overseas Filipino Workers' Remittance (OFWR) – The income from workers abroad sent as inflows to the domestic economy, which is the portion of foreign inflows not covered by foreign investment. In the model, this variable represents the employment pattern not directly explained by the domestic economy indicators, and can be seen as an implicit stimulator of aggregate demand. Of course, it is intuitive to assume that the higher the OFW remittance, the higher the number of OFWs, thus the lower the unemployment rate.
Source of data: http://www.bsp.gov.ph/

Philippine Consumer Price Index (PCPI) – The price index of a representative basket of goods. In the model, this variable represents the state of household consumer appetite (aggregate demand) and the monetary strategies employed by the Central Bank. Economic theory suggests that greater aggregate demand reflects greater per capita demand, which indicates healthy domestic circulation and thus lower unemployment rate.
Source of data: http://www.bsp.gov.ph/

The Data

The gathered data are transformed into quarterly data, as the data for the unemployment rate are only available on a quarterly basis. The time period spans from the first quarter of the year 2000 until the fourth quarter of 2011, yielding 48 data points. The unemployment rate is expressed with the base of 100.

The PSEi is taken as the average daily closing levels per quarter. The OFWR is the total amount, in millions of U.S dollars, of overseas Filipinos' remittances from the Americas, Asia, Europe, Middle East, Oceania, and Africa. The PCPI is the average monthly CPI per quarter, where the base year is 2006.

Tabulated below are the data for this analysis. The figures below are rounded to the nearest 2 decimal places, but actual data used in the analysis are not rounded so, for better accuracy.

	Dependent Variable	Explanatory Variables		
Quarter	PUR	PSEi	OFWR	PCPI
Q12000	9.50	1,875.00	1,584.43	75.43
Q22000	13.90	1,568.07	1,481.92	75.93
Q32000	11.20	1,486.82	1,490.47	76.87
Q42000	10.10	1,394.22	1,429.67	78.40
Q12001	11.30	1,579.80	1,295.65	79.83
Q22001	13.30	1,435.38	1,368.60	80.23
Q32001	10.10	1,302.76	1,407.16	81.33
Q42001	9.80	1,060.59	1,421.37	81.80
Q12002	10.30	1,344.25	1,649.64	82.33
Q22002	13.90	1,328.41	1,858.51	82.70
Q32002	11.20	1,130.45	1,737.70	83.40
Q42002	10.20	1,045.64	1,578.91	83.57
Q12003	10.60	1,032.70	1,770.57	84.07
Q22003	12.20	1,113.93	1,876.89	84.67
Q32003	12.60	1,263.89	1,881.76	85.23
Q42003	10.20	1,364.34	1,998.58	85.57
Q12004	11.00	1,475.35	1,944.47	86.53
Q22004	13.69	1,529.27	2,053.86	87.73
Q32004	11.74	1,618.06	2,172.77	90.20
Q42004	10.91	1,798.94	2,335.27	91.33
Q12005	11.30	2,008.74	2,454.63	92.80
Q22005	8.28	1,917.15	2,709.64	93.93
Q32005	7.70	1,936.38	2,799.83	95.63
Q42005	7.38	2,036.97	2,724.02	96.90
Q12006	8.10	2,127.72	2,814.27	98.67
Q22006	8.20	2,258.96	3,144.27	99.63
Q32006	8.10	2,342.29	3,152.99	100.60
Q42006	7.40	2,741.91	3,648.96	101.10

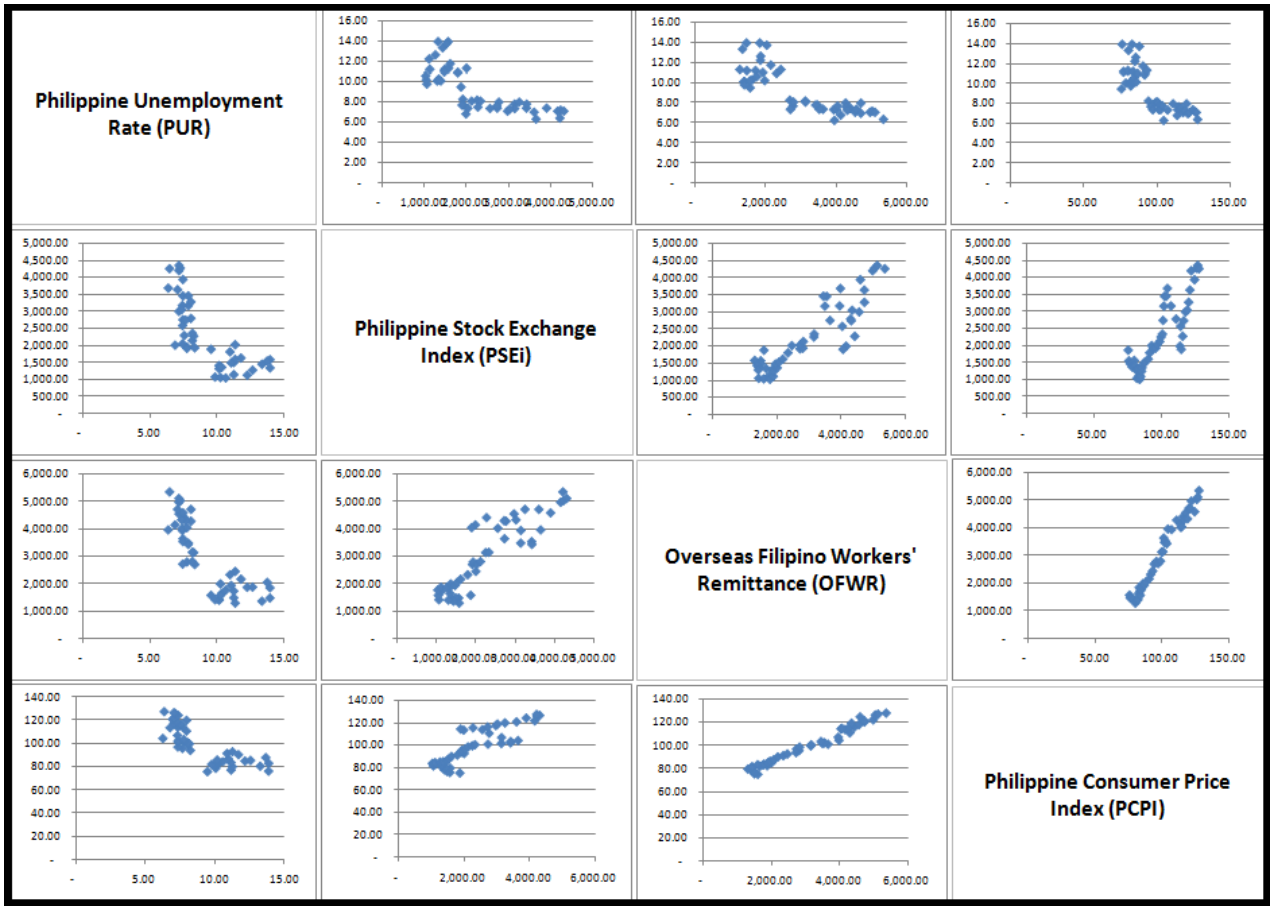
	Dependent Variable	Explanatory Variables		
Quarter	PUR	PSEi	OFWR	PCPI
Q12007	7.80	3,155.21	3,489.52	101.73
Q22007	7.40	3,438.78	3,544.18	102.27
Q32007	7.80	3,442.72	3,443.21	103.43
Q42007	6.30	3,668.54	3,972.17	104.33
Q12008	7.36	3,160.55	3,950.21	107.00
Q22008	8.00	2,779.52	4,290.49	110.77
Q32008	7.36	2,568.87	4,031.60	114.07
Q42008	6.81	1,994.71	4,153.60	113.60
Q12009	7.70	1,900.85	4,056.96	114.50
Q22009	7.50	2,280.07	4,422.62	115.60
Q32009	7.60	2,731.14	4,310.04	116.40
Q42009	7.10	2,986.24	4,558.33	117.67
Q12010	7.30	3,035.42	4,339.41	118.97
Q22010	8.00	3,266.01	4,722.78	120.03
Q32010	7.00	3,623.06	4,720.22	120.93
Q42010	7.10	4,181.93	4,980.59	121.87
Q12011	7.40	3,921.89	4,594.36	124.33
Q22011	7.20	4,254.54	5,041.42	125.97
Q32011	7.10	4,334.38	5,121.05	126.67
Q42011	6.40	4,239.76	5,360.16	127.57

Preliminary Analysis

The table below summarizes the correlation between any two variables from our set of variables.

	PUR	*PSEi*	*OFWR*	*PCPI*
PUR	1			
PSEi	-0.75119	1		
OFWR	-0.82052	0.895083	1	
PCPI	-0.80124	0.865813	0.987704	1

As economic theory suggests, the unemployment rate is negatively correlated with each of the PSEi, the OFW remittance, and CPI. As each of the explanatory variables partly explains economic health, these variables are also expected to have positive correlation with each other, especially since mechanisms in the economy inter-relate all the various economic indicators through the multiplier effect, much similar to the interconnectedness of the various organs in a biological body. These correlations are further fleshed out in an examination of the scatterplot matrix, as shown below.



One interesting thing to note is the very high correlation between the CPI and the OFW remittance. In itself, this high correlation tells us that either the PCPI or OFWR would suffice in explaining the aggregate demand effect on the unemployment rate. Another thing worth noting from the onset is that the lowest correlation is observed between the unemployment rate and the Philippine Stock Exchange

Index, which means that aggregate supply has a less substantial effect on the unemployment rate than aggregate demand. As this observation is not directly supported by economic theory, the reason for this observation may be that the PSEi may not be as comprehensive a measurement of the aggregate supply, at least with regards to affecting the unemployment rate. Put another way, the measured performance of the thirty listed common stocks may not directly translate to accurately assessing the performance of the labor force in general, and the companies representing these stocks dictate market trends to a greater extent than dictating the multiplier effect these companies bring to the economy that in theory should trickle down to smaller businesses affecting the unemployment rate.

Lastly, the observed high correlations between the explanatory variables should be noted from this stage, as this might lead to a distortion in the model where at least two of these explanatory variables are included. Hence, the method we shall use in fitting the model is a successive omission of explanatory variables, starting from the most expansive model including all variables.

The Regression Analysis

Ordinary Least Squares method is used for the regression model, using the Excel Data Analysis tool pack. Optimization of the model compares results between iterations where the explanatory variable with the highest P-value is omitted from the previous iteration. The comparison will be based on the Adjusted R Square, which is the percentage of the variation in the dependent variable that is captured by the regression model, adjusted to incorporate the decline in model fitness as explanatory variables are added. The P-value is defined as *the probability of obtaining a test statistic at least as extreme as the one that was actually observed, assuming that the null hypothesis is true (Source: Wikipedia)*, which means that the higher the P-value, the greater is our need to refrain from rejecting the null hypothesis, which is the assumption that, in the current model, the explanatory variable in question does not explain the dependent variable at all (or, equivalently, that the coefficient for this variable is zero). Put another way, the higher the P-value for the explanatory variable coefficient, the less is its relevance in the model.

We begin by regressing the unemployment rate on all the explanatory variables, yielding the summary of results below:

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.822940
R Square	0.677231
Adjusted R Square	0.655224
Standard Error	1.289870
Observations	48

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	153.599261	51.199754	30.773417	0.000000
Residual	44	73.205688	1.663766		
Total	47	226.804948			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	10.630389	4.769798	2.228688	0.030991	1.017493	20.243284	1.017493	20.243284
PSEi	-0.000118	0.000439	-0.268444	0.789612	-0.001002	0.000766	-0.001002	0.000766
OFWR	-0.001885	0.001087	-1.734127	0.089898	-0.004076	0.000306	-0.004076	0.000306
PCPI	0.045590	0.076997	0.592104	0.556812	-0.109587	0.200767	-0.109587	0.200767

One key thing to observe here is that the coefficient for PCPI is positive, which means, if taken as valid, the CPI has a positive relationship with the unemployment rate. This is counter to economic theory, hence an observation of a high P-value for the PCPI coefficient is expected. We observe high P-values for both the PSEi and PCPI coefficients, but we would eliminate the one with the highest P-value first, and then make further omissions if needed. We observe that the PSEi coefficient has the highest P-value, which is reinforced by our earlier assessment on correlations where we observed the lowest correlation between the unemployment rate and the PSEi. We thus eliminate PSEi in our next model iteration.

Regressing the unemployment rate on OFWR and PCPI yields the following summary of results:

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.822619
R Square	0.676702
Adjusted R Square	0.662333
Standard Error	1.276502
Observations	48

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	153.479366	76.739683	47.095238	0.000000
Residual	45	73.325582	1.629457		
Total	47	226.804948			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	10.274545	4.534413	2.265904	0.028316	1.141769	19.407322	1.141769	19.407322
OFWR	-0.002034	0.000925	-2.198471	0.033099	-0.003898	-0.000171	-0.003898	-0.000171
PCPI	0.051006	0.073537	0.693608	0.491493	-0.097105	0.199116	-0.097105	0.199116

Firstly, we note the improvement in this model in terms of the higher Adjusted R Square, which signifies a better fit from the previous model with all the explanatory variables. As noted earlier, the very high correlation between OFWR and PCPI indicates that including both of these variables in the model would cause distortion, and using only one between these is likely to result in a better fit. Proceeding with our method, we thus eliminate the variable PCPI, as the coefficient for this variable has the highest P-value. We are thus left with only one explanatory variable. Regressing the unemployment rate on OFW remittance yields the following summary of results:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.820515
R Square	0.673246
Adjusted R Square	0.666142
Standard Error	1.269282
Observations	48

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	152.695448	152.695448	94.778544	0.000000
Residual	46	74.109501	1.611076		
Total	47	226.804948			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	13.402426	0.471225	28.441688	0.000000	12.453900	14.350952	12.453900	14.350952
OFWR	-0.001400	0.000144	-9.735427	0.000000	-0.001690	-0.001111	-0.001690	-0.001111

We immediately see an improvement in fit or a higher Adjusted R Square value from the previous model, and we see that the P-value for the coefficient of the remaining explanatory variable, OFWR, is near zero, which means that we can safely reject the null hypothesis of having no observed relationship between OFW remittance and unemployment. We can thus use the linear regression model:

$$\text{PUR} = 13.402426 - 0.0014 \times \text{OFWR}$$

This leads us to a couple of important points:

1. With no OFW remittance, we can predict an unemployment rate of around 13.4%; and

2. Every million dollar increase in OFW remittance leads to a decrease in the unemployment rate of about 0.0014%.

Closing Analysis

We have observed in our preliminary analysis that the unemployment rate has the most significant correlation with the OFW remittance among all the explanatory variables. Along with our observation of high correlations between the explanatory variables, this reinforces the final model we have arrived at, where the unemployment rate is regressed on OFW remittance alone. The high correlations between the explanatory variables signify redundancy in using all of these variables in one model. Put another way, as the three explanatory variables are, in their respective ways, measurements of economic health, which in theory has a direct effect on unemployment, using either one of these variables will suffice if we seek a way to quantitatively explain the effect of economic health on unemployment. With the highest correlation found between unemployment and OFW remittance, we are led to the model using the OFW remittance as the sole economic indicator to afford us this quantitative explanation. Invoking economic theory, this signifies that the direct relationship between the OFW remittance and unemployment rate is more ostensible than the indirect effect of aggregate supply or aggregate demand on unemployment: the higher the OFW remittance amount, the smaller becomes the portion of the labor force comprising those who remain unemployed.

We finally test this observation by comparing our final model with models where the unemployment rate is regressed on each of the PSEi and PCPI variables respectively.

Regressing the unemployment rate on PSEi, we get:

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.751192
R Square	0.564290
Adjusted R Square	0.554818
Standard Error	1.465704
Observations	48

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	127.983725	127.983725	59.574767	0.000000
Residual	46	98.821224	2.148287		
Total	47	226.804948			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	12.973075	0.535535	24.224514	0.000000	11.895099	14.051051	11.895099	14.051051
PSEi	-0.001656	0.000215	-7.718469	0.000000	-0.002088	-0.001224	-0.002088	-0.001224

And regressing the unemployment rate on PCPI, we get:

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.801235
R Square	0.641978
Adjusted R Square	0.634195
Standard Error	1.328625
Observations	48

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	145.603753	145.603753	82.483670	0.000000
Residual	46	81.201196	1.765243		
Total	47	226.804948			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	19.916753	1.198108	16.623501	0.000000	17.505086	22.328420	17.505086	22.328420
PCPI	-0.108675	0.011966	-9.082052	0.000000	-0.132761	-0.084589	-0.132761	-0.084589

We can immediately observe that either of these two models is a poorer fit than the model where the unemployment rate is regressed on OFW remittance alone, based on the lower Adjusted R Square values of these two models. Nonetheless, these models could be used if we are directly seeking to explain the unemployment rate from either the aggregate supply side or the aggregate demand side, although the indirect effect on unemployment of either of the PSEi or PCPI variables would lead us to question the robustness of these variables in explaining thoroughly what is happening on the macroeconomic level.