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Unraveling Unemployment: A Macroeco-Lens Empirical Analysis

Yusufjon Pulatov

yusufjoneryus@gmail.com

1. Introduction

All countries around the world always aim at achieving three main macroeconomic goals: full employment, high rate of output growth and price stabilization. As they are interconnected with one another, a change in one of those variables can affect the others. This typical scenario was especially the case during the recession in 2008 when output level fell and resultant rise in unemployment rate which subsequently pushed the prices down. As a consequence, discrete use of policy tools seemed to be in need so as not to face undesirable outcomes. Unemployment is one part of the chain which many developing countries are facing these days. It is a situation when people actually want and are able to work but cannot find jobs to make their living. Closely analyzing the determinants of unemployment can open the doors to better understand and somehow control the world economies. In addition, from the perspective of microeconomics, the higher the rate is, the more social problems such as crimes, suicides, alcoholism or poverty arouse in a society (Rafik et al., 2010 and Eita and Ashipala, 2010). Henry et al., in 1999 and Haile 2003 have also proved the relationship between higher unemployment rate and the spread of HIV/AIDS in developing countries. Having said those issues, unemployment could safely be regarded as a direct contributor either to prosperity or to destruction of economies. Therefore, the paper intends to look through the possible determinants of unemployment and their effects to the average unemployment rate. They can later be used to tackle the aforementioned problems through policy actions. Data in taken from The World Bank and the possible factors from previously conducted theories have been tested with the help of linear regression model. While estimating the parameters in the model, ordinary least squares (OLS) method has been used because Gauss-Markov theorem says that it has the lowest sampling variance and could bring best linear unbiased estimator (BLUE).

1.1. Literature review

Inflation is believed to be the main disaster for unemployment rate. The researches of Li and Liu (2012), Vermeulen (2015) and Yelwa, David, and Awe (2015) have already proved the negative relationship between the both. Phillip Curve can provide clear understanding for policy makers when considering inflation and unemployment according to Furuoka & Munir's findings in 2014. In spite of this, Alisa (2015) questioned the validity of Phillip Curve and stated that it did not work for either short or long run.

Additionally, Ashipala and Eita (2010) sought after some other determinants of unemployment rate in Namibia from 1971 to 2007 and the Engel-Granger two-step econometric approach used in process turned out to be consistent with Harrod- Domar and Okun's law. This has proved growth in Gross Domestic Product (GDP) as a factor that can effect unemployment rate in a country. As GDP grows, people without jobs will be less common confirmed Abdulla in 2012 and Zivanomoyo & Mukoka later on in 2015. However, there were some opposers such as Kreishan (2011) and Dunsch (2016) as well saying that Okun's Law cannot cover the whole picture as to the relationship.

Foreign Direct Investment (FDI) has also increased in importance for policy makers to handle incremental unemployment rate in their countries. Such inflow of investments can boost economies, hence economic growth (Davidescu, & Paul, 2015). It may in turn affect unemployment rate in a country.

One more part of the chain is population growth. Orumie (2016) says that GDP growth can lead to the intention and conditions of having more babies, therefore, possibly even more labor force in the future. Such positive relationship had also previously been found by Aqil, Qureshi, Ahmed, and Qadeer in 2014. They said unemployment is prone to increase population growth as those with lower education and without work tend to have higher birth rates.

Nwosa (2014) examined if there were a relationship between government expenditure and unemployment and his results in Nigeria have proved the positive relationship. He also used OLS method. But previously, with the help of error correction modelling technique Auerbach and Gorodnichenko (2012) had found the answer and showed how an increase in government purchases could cause unemployment rate to go down

2. Empirical research

2.1. Data:

The research paper looked at the topic from macroeconomics aggregates so information from 263 countries all around the world has been used to run the analysis. To clarify, the cross sectional data from World Bank allowed a number of possible determinants of unemployment – FDI inflow, GDP growth, inflation rate, population growth rate and government expenditure - to be tested in almost all economies around the world. The obtained dataset is relatively new dating back to 2017.

The dependent variable in the model is unemployment rate as a percentage of total labor force and it includes 127 observations. Considering the other 5 explanatory variables, they are population growth rate, inflation rate, GDP growth rate, government expenditure and FDI inflow as percentages of GDP. Government expenditure in this sense excludes the autonomous spending which are must whatsoever and considers the other expenditure to improve the welfare. In the same way, GDP growth only included real GDP in order to achieve as exact determinant as possible.

2.2. Methodology

As a technical continuation of the research by Rafiq in 2010, my simple regression model estimated how much of variation in population growth, Inflation rate and FDI could explain the variation in unemployment rate as a whole. However, to achieve clearer picture, hence BLUE, two more variables have been added to the model.

The simples statistical modelling is through Ordinary Least Squares (OLS) method which aims at minimizing the error terms or residuals according to the method, I defined the statistical version:

UNR= β0 +β1*GDP Gr+β2*FDI INF+β3*INFLA R+β4*POP Gr+β5*GOV.EX+Ui

Where: UNR= Unemployment rate in the given period of 2017

GDP GR= GDP growth rate in 2017

FDI INF= FDI inflow as a % of GDP in 2017

POP GR= Population growth rate in 2017

GOV.EX= Government expenditure as a % of GDP in 2017

INFLAR= Inflation rate in 2017

Ui= error term or residuals

Whatever variable was omitted while defining the model lies in residuals and OLS intends to minimize the residual. It squares them up first, then sum all in order not to end up with zero because of the distribution.

The dataset included i=1 ……., N where i represents the countries observations took place.

3. Results

The regression analysis using OLS in STATA software gave the following results.

UNR=3.3802+0.0632*FDI INF+0.2993*GOV.EX+0.3750*INFLA R-0.0199*POP GR-0.5036*GDP GR

Source	SS	df	MS	Number of obs	=	118
				F(5, 112)	=	3.06
Model	450.018487	5	90.0036974	Prob > F	=	0.0125
Residual	3289.36476	112	29.3693282	R-squared	=	0.1203
				Adj R-squared	=	0.0811
Total	3739.38325	117	31.9605406	Root MSE	=	5.4193

unemploymentrate	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
fdiinflowasagdp	.0632084	.0541258	1.17	0.245	-.0440349	.1704517
govexasagdp	.2993306	.1408129	2.13	0.036	.0203278	.5783334
inflationrate	.3750173	.1467416	2.56	0.012	.0842677	.6657669
populationgrowthrate	-.0199401	.5521012	-0.04	0.971	-1.113858	1.073978
gdpgrowthrate	-.5036564	.2723606	-1.85	0.067	-1.043304	.0359912
_cons	3.38023	3.199334	1.06	0.293	-2.95884	9.7193

Figure 1: Regression analysis results

The simple linear model can only explain 12% of the dependent variable (See R-squared). It means that the 5 tested variables have in fact parts to play affecting unemployment rate, though they cannot wholly influence the pattern. The rest 88% explanation comes from U1- residuals. Considering the individual factors, t statistics for government expenditure and inflation rate turned out to be more than 2 which means according to rule of thumb, they are statistically significant. Meanwhile, one can check the p value of confidence interval those factors fall into. The interval does not include 0, plus α=0.05 which is higher than the p values of government expenditure and inflation rate confirms the same results. Considering the other variables: FDI inflow, GDP growth rate and population growth they are statically insignificant in this research (See t statistics/p values/ confidence intervals).

All in all, the model states that when holding other variables constant, one unit increase in government expenditure may lead to on average 0.2993 unit increase in unemployment rate. Inflation rate, at the same time, has larger part to play as it can increase the unemployment rate by 0.3750. Along with other variables, the constant value has also turned out to be statistically insignificant with having less t statistics and less p value. Therefore, the coefficient – 3.3802 does not completely mean that when all other variables are unchanged, the unemployment rate is 3.3802.

3.1. OLS assumptions

Before using OLS, one must look through the conditions needed to be met. To put it differently, under certain conditions, OLS might not be valid and another method of econometric analysis could be better to use. The assumptions that must be held are:

1. The regression model is linear in parameters
2. The mean of residuals is zero
3. Homoscedasticity of residuals or equal variance
4. No autocorrelation of residuals
5. X values and Residuals are not correlated
6. The number of observations must be greater than number of Xs
7. The variability in Xs is positive

8. The regression model is correctly specified
9. No perfect Multicollinearity
10. Normality of residuals

The assumption one is satisfied by looking through the power of parameters or simply raising one of the βs to the power of 2. When calculated, the Beta parameter was still linear confirming the assumption.

UNR=3.3802+0.0632*FDI INF+0.2993*GOV.EX+0.3750*INFLA R-0.0199*POP GR-0.5036*GDP GR

The second assumption has been checked by finding the means of the residuals. They were very close to zero which supports the assumption.

Variable	Obs	Mean	Std. Dev.	Min	Max
residuals	118	1.23e-09	5.302285	-7.669099	24.26947

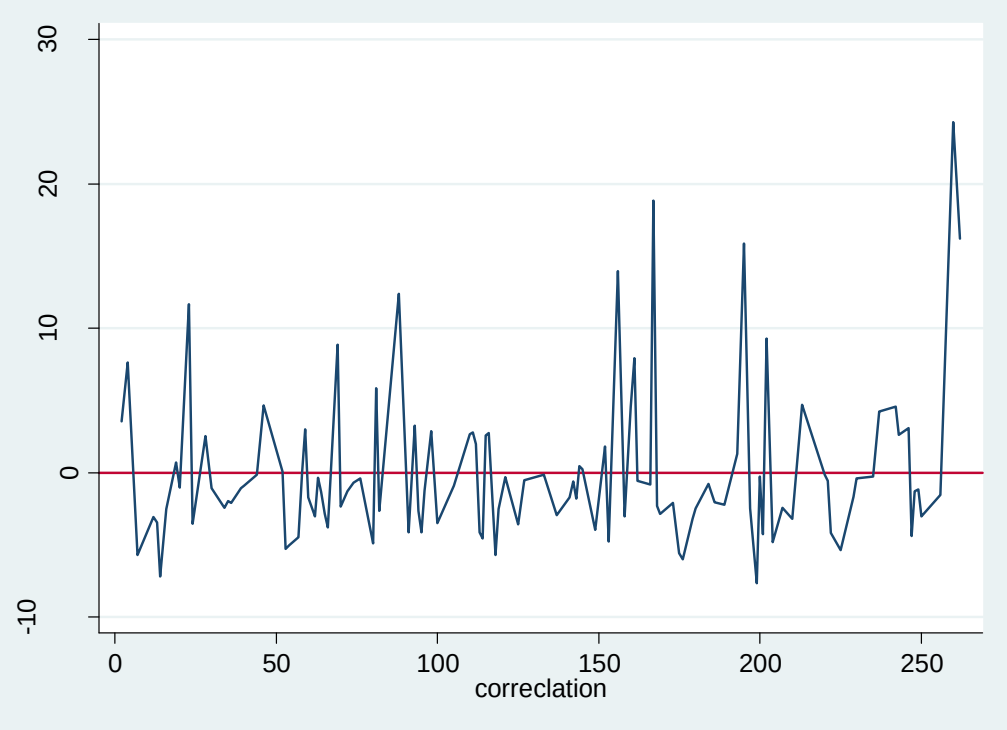
Checking equal variance of the residuals required to convert the variables into Log ones in Stata. Then regress them all after which with the help of *estat hettest* command we can get the following result.

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logunemploymentrate

         chi2(1)      =    20.35
         Prob > chi2  =   0.0000
```

The P value is almost zero which is definitely less than my α=0.05 which implies that we can reject the null hypothesis. Hence the model is homoscedastic

Assumption 4 is not common in cross sectional dataset but still one can check it though graphing it. I first generated a new variable which can run through 118 observations. Then plotted it with residuals with the command of line residuals correclation, yline(0) and got the graph.



Random pattern appeared along the line which was up the line in some parts then down in others which is the main rationale behind not having autocorrelation among residuals.

Assumption 5 was checked relatively easily by just finding the correlation matrix between residuals and X variables.

	residu~s	gdpgro~e	inflat~e	popula~e	unempl~e	fdiinf~p	govexa~p
residuals	1.0000						
gdpgrowthr~e	-0.0000	1.0000					
inflationr~e	-0.0000	0.0835	1.0000				
population~e	-0.0000	0.0490	0.2375	1.0000			
unemployme~e	0.9379	-0.2360	0.1335	-0.0144	1.0000		
fdiinflowa~p	0.0000	0.1396	-0.0829	-0.0720	0.0164	1.0000	
govexasagdp	0.0000	-0.3945	-0.4216	-0.2364	0.1776	-0.1931	1.0000

It is visible that the residuals don't have anything common with determinants of unemployment rate worldwide.

The next condition that needed to be satisfied was to see if the number of observations were more that the determinants. I had only 5 determinants (X values) and 168 observations which meets the conditions.

Assumption 7 requires to calculate the variances for each determinants. They all must be positive so as not to violate the assumption (Prabhakaran, 2017)

Variable	Obs	Mean	Std. Dev.	Min	Max
gdpgrowthr~e	249	3.148303	3.740326	-15.67141	26.67587
inflationr~e	219	4.470331	13.14973	-1.260506	187.8516
population~e	262	1.247624	1.132321	-2.421393	4.677987
fdiinflowa~p	235	4.249218	9.019533	-28.58325	81.10061
govexasagdp	212	16.45392	6.319318	4.325225	54.07993

Looking at the std. Sev, we can say that the variances are positive so the assumption holds.

The next condition was about finding the omitted variables. If they were not found it would mean that the model was correctly specified. But in reality:

```
Ramsey RESET test using powers of the fitted values of unemploymentrate
       Ho:  model has no omitted variables
                 F(3, 109) =      0.97
                  Prob > F =      0.4104
```

The probability is 0.41 which is higher than our p value=0.05. This confirms that there are some other variables lacking in the model. We observed the same scenario when checked for R-squared which turned out to be very low.

Assumption 9 says that there should not be perfect collinearity. I found it though Variance Inflation Factor (VIF)

VIF=1/(1−Rsq)

Or in stata:

Variable	VIF	1/VIF
govexasagdp	1.56	0.641040
inflationr~e	1.29	0.773910
gdpgrowthr~e	1.20	0.832900
population~e	1.10	0.911489
fdiinflowa~p	1.09	0.918751
Mean VIF	1.25	

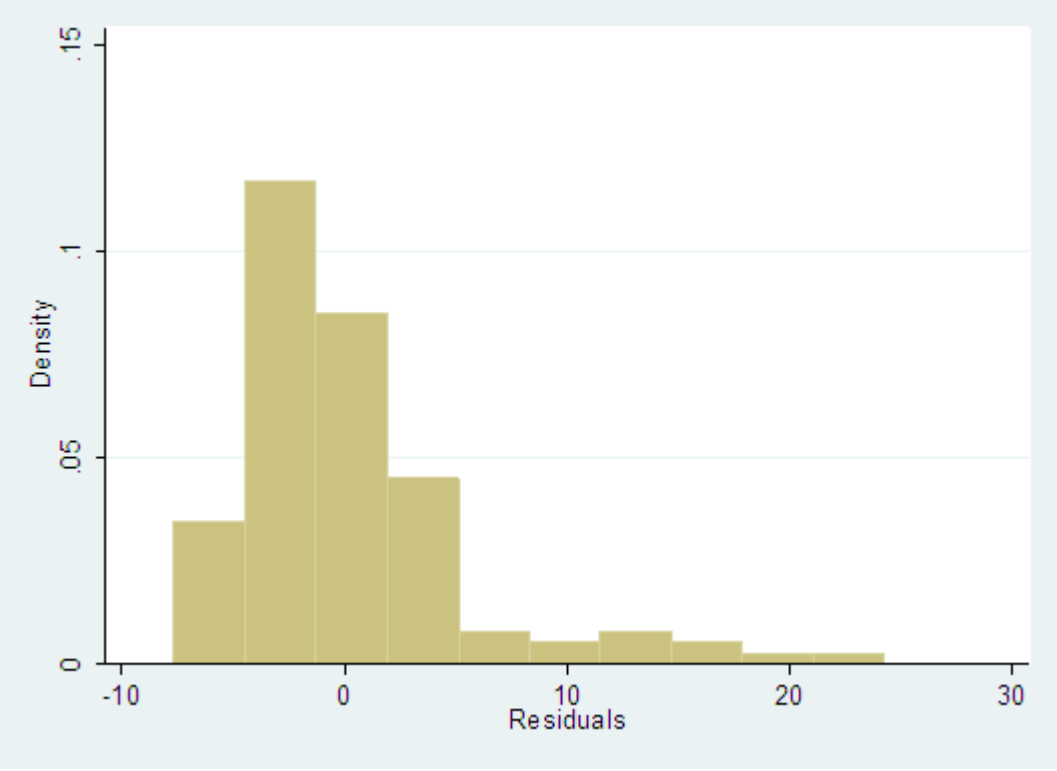
As stated in the textbook, when the mean value is was over 10, then it would mean multicollinearity. But in my case, it is equal to 1.25 which satisfies the assumption 9.

Last thing to consider was to see if the residuals were normally distributed. There were two ways of checking. One was through Swilk residuals command in stata and comparing the p value with α.

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
residuals	118	0.81158	17.875	6.464	0.00000

It is less than α that violates the assumption. I checked it with histogram as well.



They are actually right skewed so some changes such as logging could work for correcting the problem.

4. Conclusion

The paper provided an insight into the determinants of unemployment worldwide and used 263 observations in 263 countries analyzing the 5 main determinants from theories. The results almost repeated the same results by Li and Liu (2012), Vermeulen (2015) and Yelwa, David, and Awe (2015) and some contradictions to the findings of Kreishan (2011), Dunsch (2016), Auerbach and Gorodnichenko (2012). Overall, the research has been just a small explanatory portion of the

unemployment in countries and this has again been proven by only covering the 12% of the all factors effecting unemployment. Therefore, there should be an extensive research project with more sample size and control group of specialists which can be very helpful for boosting one's economy.

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