ECONOMETRIC ANALYSIS OF THE RELATIONSHIP BETWEEN UNEMPLOYMENT AND CRIME

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Onuche Peter[1], Terse Abanger Yanfa[1] and Olalekan Sunday Babatunde[2]
[1]Mathematics/Statistics/Computer Science Department, Federal University of Agriculture, Makurdi, Nigeria
[2]Mathematics, Statistics & Computer Science Department, Kwararafa University Wukari, Nigeria
*Corresponding author: ptrnch@yahoo.co.uk

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Abstract: This study focuses on the determination of the relationship between Unemployment rate and Crime rate in Nigeria. Data on crime rate and unemployment rate were collected from National Bureau of Statistics 1995 to 2012. We used co-integration to determine if there exist a long run relationship between unemployment rate and crime rate. Granger causality was also applied to know if unemployment granger cause crime or verse versa. Using Eview version 7, we discovered from the unit root test (ADF) result that the variables under consideration were co-integrated of the same order at I(1). The co-integrated results showed that there is a long run relationship between unemployment rate and crime rate in Nigeria which implies that both variables move together in a long run. The result of granger causality test showed that there is a unidirectional since unemployment granger cause crime within the study period since the p_value of 0.03575 is less than alpha level of 0.05. The result indicates that unemployment rate must be reduced in order to curtail crime.

Keywords: Co-integration, unit root, unemployment, crime

Introduction

Every society across the world has its peculiar problems and challenges. Nigeria at large is not an exception. Nigeria as a developing country is plagued with her own share of social, political, economic, and cultural problems which has greatly affected the lives and well-being of the people. Such problems bedeviling the country include youth unemployment and the incessant increase in crime which have serious implications for national development.

Unemployment rate in Nigeria has continued to be on the increase despite the abundance of human and natural resources available in the country. There have been thousands of graduates produced but there are no jobs to match the majority of them. Nigeria is littered with youth hawkers who ordinarily would have found gainful employment in some enterprises (Okafor, 2011). The large number of youths who are unemployed is capable of undermining democratic practices as they constitute serious threat if engaged by the political class for clandestine and criminal activities (Adepegba *et al.,* 2011). Unemployment has become pronounced in the last two decades due to the upsurge in the output from tertiary education and inelastic labour market for the services of these graduates.

Unemployment seems to be the fundamental cause of violence and crime in Nigeria. Research suggests that unemployed youths are disproportionately more likely to be perpetrators as well as victim of crime and violence (Okafor, 2011a). According to the Oxford Dictionary of Sociology (2009), "a crime can be an offence which goes beyond the personal and into the public sphere, breaking prohibitory rules or laws to which legitimate punishment or sanctions are attached and which requires the intervention of a public authority". For a crime to be known as such, it must come to the notice of and be processed through the administrative system or enforcement agency.

The prevalence of crime in Nigeria today is a call for serious concern for all. It undermines the social fabrics by eroding the sense of safety and security. Crime impacts on society in different ways depending on the nature and extent of crime committed. It constitutes a problem when its incidence is as rampant in the society as to constitute a threat to the security of persons and property as well as social order and solidarity (Onoge, 1998). Crime is a threat to the economic, political and social security of a nation and a major factor associated with underdevelopment because it discourages both local and foreign investment in the country reduces the quality of life, destroys human and social capital, and damages relationship between citizens in the country.

One of the major problems facing developing countries like Nigeria is that of unemployment relation to crime. It is a common observation in Nigeria that unemployment rates and crime may have been positively associated. A more contentious issue is whether this association means that unemployment causes crime, or crime cause unemployment. This problem has increasingly come to be recognized as one of the serious socio-economic problems currently confronting the Nigerian economy of which this fact needs to be established.

The National Bureau of Statistics (2010) shows that the national un employment rates for Nigeria between the years 2000 and 2009 showed that the number of persons unemployed stood at 13.1% in 2000, 13.6% in 2001, 12.6% in 2002, 14.8% in 2003, 13.4% in 2004, 11.9% in 2005, 12.3% in 2006, 12.7% in 2007, 14.9% in 2008, and 19.7% in 2009. Whereas the age report shows that as at March 2009, persons between the ages of 15 and 24 years, 41.6% were employed; between 25 and 44 years, 17% were unemployed, more so, for those with only primary education, 14.8% were unemployed, for those with only secondary education, 23.8% were unemployed, while for those with tertiary education, 21.3% were unemployed, and also for those who never attended school and those below primary education, 21.0% and 22.3% respectively were unemployed. The implications have been especially harsh for Nigerian youths as an estimated 95% of who are without a source of livelihood. It is however to be noted that the rate of youth unemployment indicates great danger for the country's stability and national development as unemployment has the potential of raising a larger number of criminals. Unemployment can be classified in various forms. They can be grouped by personal characteristics, such as age, sex, degree of skill or education, or ethnic groups. They can also be classified by geographical location, occupation, and the duration of unemployment or reasons for their unemployment.

Methods and Materials

The data used in this work are secondary data which was gotten from the Annual Abstract of the National Bureau of

Statistics (NBS, 1995, 1997, 1999, 2006, 2008, 2009, 2010, 2011, 2012).

To analyze the data collected the researcher adopts the method of co-integration. The technique of co-integration has been adopted as models containing non-stationary stochastic variables can be constructed in such a way that the results are both statistically and economically meaningful. Co-integration is an econometric concept that follows the existence of a long-run equilibrium among economic time series. If two or more series are themselves, non-stationary, then they are said to be co-integrated (Wei, 2006). Time series data consists of observation which are considered a realization of random variables that can be describes by some stochastic processes. The concept of stationarity is related to the properties of these stochastic processes. Non-stationarity in time series occurs when there is no constant mean μ and variance σ^2 or both of these properties. It can originate from various sources but the most important one is the unit root.

Unit root

Sequences that contain one or more characteristics roots that are equal to one are called a unit root process. The simplest model that may contain a unit root is the autoregressive process of order one $AR(1)$

Consider the $AR(1)$ below;

$Y_t = \emptyset Y_{t-1} + e_t$ (1)

Where: e_t denotes a serially uncorrected white noise error term with a mean of zero and a constant variance.

If $\emptyset = 1$, then equation (1) becomes a random walk without drift model, meaning that it is a non-stationary process, thus indicating a unit root problem.

Suppose $\emptyset < 1$, then the series Y_t is stationary.

The unit root problem can be solved or stationarity can be achieved by differencing the data set (Wei, 2006).

Augmented Dickey-Fuller (ADF) Test

The basic idea behind the ADF unit root test for non-stationarity is to regress Y_t on its lagged value Y_{t-1} and find out if the estimated $\emptyset$ is statistically equal to 1 or not thus subtracting Y_{t-1} from both sides of equation (1).

$Y_t - Y_{t-1} = (\emptyset - 1)Y_{t-1} = e_t$ (2)

which can be written as

$\Delta Y_t = \partial Y_{t-1} + e_t$ (3)

Where: $\partial = (\emptyset - 1)$ and Δ is the first difference operator

Instead of estimating equation (1), we estimate equation (2) and test for the null hypothesis of $\partial = 0$; this implies that the series under consideration is non-stationary indicating a unit root problem. The decision to reject or not to reject the null hypothesis of $\partial = 0$ is based on the Dickey-Fuller (DF) critical values of the τ (tau) statistic which is based on the assumption that the error of term e_t are uncorrelated.

However, the error of the term in the DF test usually shows evidence of serial correlation. Hence the augmented Dickey-Fuller (ADF) test was formulated in which lags of the first difference are included in the regression equation of equation (3) above in order to make the error term e_t white noise. The regression equation now becomes:

$\Delta Y_t = \partial Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + e_t$ (4)

The intercept may be included as well as a time trend t thus making the model into:

$\Delta Y_t = \beta_1 + \beta_2 t + \partial Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + e_t$ (5)

The testing procedure for the ADF unit root test is applied to the following model

$\Delta Y_t = \alpha + \beta_t + \tau Y_{t-1} + \sum_{j=1}^{m} \partial_j \Delta Y_{t-j} + e_{it}$ (6)

Where: α = constant, β = cooefficient on a time trend series

τ = coefficient of Y_{t-1}, m = lag order of the autoregressive process

$\Delta Y_t = Y_{t-1}$ are first difference of Y_t

Y_{t-1} are lagged values of order one of Y_t

Y_{t-j} are changes in lagged values and e_{it} = white noise

ADF test can be tested on at least three possible models

i. A pure random walk without drift; that is when the constraint $\alpha = 0$, $\beta = 0$ and $\tau = 0$ in equation (6) making it become;

$\Delta Y_t = \Delta Y_{t-1} + e_t$ (7)

ii. A random walk with a drift which is obtained by imposing the constraint $\beta = 0$ and $\tau = 0$ in equation (6) making it

$\Delta Y_t = \alpha + \Delta Y_{t-1} + e_t$ (8)

iii. A deterministic trend with a drift for $\beta = 0$ making equation (6) become

$\Delta Y_t = \alpha + \beta_t + \Delta Y_{t-1} + e_t$ (9)

The sign of the drift parameter (α) causes the series to wander upward if positive and downward if negative. Whereas, as the size of the absolute value affects the steepness of the series (Pfaff, 2006). The parameter of interest in the ADF model is τ. For $\tau = 0$, the Y_t sequence contains a unit root and hence is integrated of order one.

Test for unit root

i. set the hypothesis against the alternative hypothesis

$H_0 : \tau = 0$ (10)

$H_0 : \tau < 0$ (11)

ii. determine the test statistics using

$F_\tau = \frac{\hat{\tau}}{SE(\hat{\tau})}$ (12)

Where: SE($\hat{\tau}$) is the standard error of τ, τ is the parameter of interest in ADF models.

iii. Compare the calculated test statistic in equation (12) with the critical value from the Dickey-Fuller table to reject or accept the null hypothesis.

iv. The ADF test is a lower tailed test, so if F_τ is less than the critical value, the null hypothesis of unit root is rejected which shows that the variable of the series does not contain a unit root problem and is stationary.

Test for co-integration

If a group of variables are individually integrated of the same order and there is at least one linear combination of these variables that is stationary, the variables are said to be co-integrated of the same order. Testing for co-integration implies test for the existence of a long-run relationship between variables. There are several tests for co-integration; these include the Engle-granger method, the Phillips-Oliaris (1998) methods and the Johansen method (1998). For the purpose of this study, the Johansen method shall be adopted owing to the advantage that the Johansen procedure can estimate more than one co-integration relationship if the data set contains two or more time series.

Johansen Method

Johansen method builds co-integrated variables directly on maximum likelihood estimation rather than the ordinary least square method. Johansen method of testing co-integration takes as a starting point the vector auto-regression (VAR) of order *p* given by the formula:

$X_t = \prod_1 X_{t-1} + \prod_2 X_{t-2} + \cdots + \prod_p X_{t-p+1} - \prod X_{t-p} + U_t$ (13)

Where: $X_t = n \times 1$ vector of variables that are integrated of order one

U_t is an $n \times 1$ vector of innovations

$\prod_1, \prod_2, \ldots, \prod_p$, are $m \times m$ coefficient matrices

subtracting X_{t-1} on both sides of equation (13)

$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \cdots + \Gamma_{p-1} \Delta X_{t-p+1} - \prod X_{t-p} + U_t$ (14)

Where: $\Gamma_1 = \prod_1 - I, \Gamma_2 = \prod_2 - \Gamma_1, \Gamma_3 = \prod_3 - \Gamma_2$,

$\prod = I - \prod_1 - \prod_2 - \ldots - \prod_p$. (15)

The matrix determines the extent to which the system is co-integrated considering equation (13) as

$\Delta X_{1t} = \dot{\gamma}_{11}\Delta X_{t-1} + \dot{\gamma}_{12}\Delta X_{t-1} + \cdots + \dot{\gamma}_{1p-1}\Delta X_{t-p+1} - \prod_1' X_{t-p} + U_{1t}$ (16)

Where: $\dot{\gamma}_{1t}$ is the first row of $\mathrm{r}_j, j = 1,2,\ldots,p-1$, and $\prod_l' =$ the first row of $\prod$.

Here ΔX_{1t} is stationary; that is $I(0)$, $j = 1,2,\ldots,p-1$ are all $I(0)$, U_{1t} is assumed to be $I(0)$, and so for a meaningful equation, $\prod_1' X_{t-p}$ must be stationary $I(0)$.

Granger-causality test

The common way to test the causal relationship between two variables is the Granger-causality test proposed by Granger (1969). Granger-causality test involves the estimation of the simple vector auto-regression (VAR).

$X_t = \sum_{i=1}^{n} \alpha_i Y_{t-i} + \sum_{j=1}^{n} \beta_j X_{t-j} + \mu_{1t}$ (17)

$Y_t = \sum_{i=1}^{m} \lambda_i Y_{t-i} + \sum_{j=1}^{n} \delta_j X_{t-j} + U_{2t}$ (18)

Where: the disturbances μ_{1t} and μ_{2t} are assumed to be uncorrelated, equation (17) indicates that variable X is decided by lagged variables Y and X likewise equation (18) except that its dependent variable is Y rather than X.

Granger-causality indicates that the lagged Y significantly influence X in equation (17). While in equation (18), the lagged X influences Y. More so, it can jointly be tested if the estimated lagged coefficient $\sum \alpha_i$ and $\sum \lambda_i$ is different from zero with the F-Statistic. When the joint test rejects the two null hypotheses that both do not different from zero, causal relationships between X and Y are confirmed. Granger causality between two variables cannot be interpreted as a real causal relationship but merely shows that one variable can help to predict the other one better.

Analyses and Results

Stationarity test

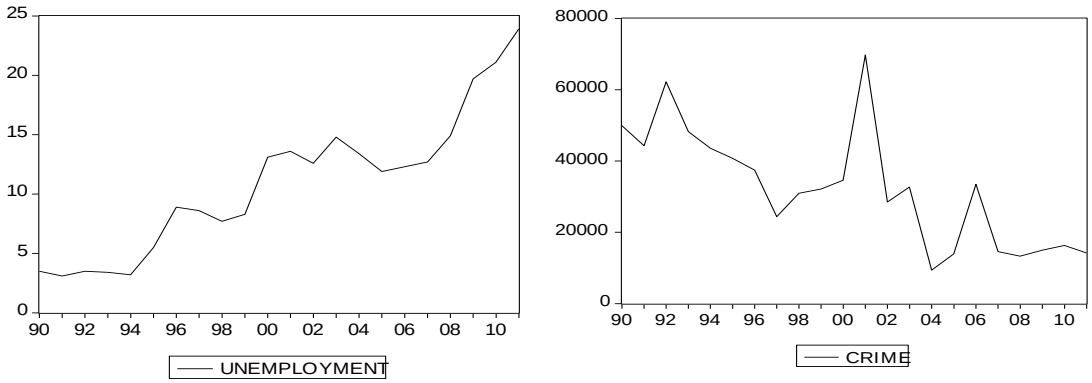

Fig. 1: Graph of unemployment and crime

From the graphs above, we observe the presence of unit root which shows that the series are not stationary; that is the series "unemployment" do not vary about a fixed level as it takes an upward increase as time changes likewise that of crime decreasing downward.

Unit root test

The unit root test for non stationarity indicates that the series of unemployment and crime at level 0 and lag 0, 1, and 2 indicates that both series contain unit root problem and the Durbin-Watson values for both series also show the presence of auto-correlation. Hence the test reveals that the two variables are non-stationary which could be made stationary after differencing.

Table 1: Unit root test for the first difference of unemployment series

ADF Statistic	Test - 2.356972	1% Value*	Critical - 2.6968
		5% Critical Value	- 1.9602
		10% Critical Value	- 1.6251
Durbin-Watson stat	1.869119		

The computed ADF test-statistic (-2.356972) is less than the critical values of tau (-2.6968, -1.9602, and -1.6251 at 1%, 5%, and 10% significant level respectively), we conclude that the series has no unit root problem which means that it is now stationary at 1%, 5%, and 10% significant level and the Durbin-Watson statistics (1.869119) is approximately 2 indicating that the first difference of the series "unemployment" has no auto-correlation problem at level 1, lag 1, without constant or trend. So we generate a series of the first difference of "unemployment" named "dunemp". The graph of the series now becomes stationary and is as shown below in figure 2.

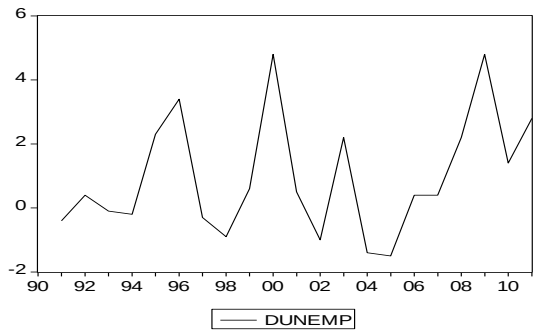

Fig. 2: Graph of 1st difference of unemployment series

Table 2: Unit root test for first difference of crime series

ADF Test Statistic -4.032586	1% Critical Value*	-2.6968
	5% Critical Value	-1.9602
	10% Critical Value	-1.6251
Durbin-Watson stat 1.958305		

The computed ADF test-statistic (-4.032586) is less than the critical values of tau (-2.6968, -1.9602, and -1.6251at 1%, 5%, and 10% significant level respectively), we conclude that the series "crime" has no unit root problem and is now stationary at 1%, 5%, and 10% significant level and the Durbin-Watson statistics is 1.958305 indicating that the first difference of the series "crime" has no auto-correlation problem at level 1, lag 1, and without no constant or trend. So we generate a series of the first difference of "crime" named "dcrime". The graph of the series now becomes stationary as shown below.

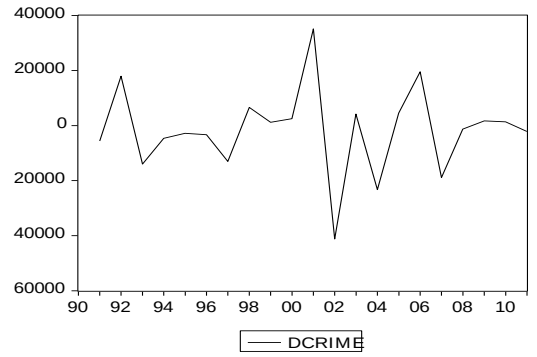

Fig. 3: Graph of 1st difference of crime series

From the unit root test above for both unemployment and crime, it is eminent that the series are now stationary indicating that they are co-integrated of the same order. That is at $I(1)$ at lag 1 with no trend or intercept.

Test for co-integration

Table 3: Co-integration test

Test assumption: No deterministic trend in the data
Series: UNEMPLOYMENT CRIME
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.212442	5.079287	12.53	16.31	None
0.015032	0.302924	3.84	6.51	At most 1

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. rejects any cointegration at 5% significance level

The Johansen Test for co-integration on both variables in the series with lag intervals of 1 shows two co-integrating equations, allowing one to conclude that the combination of the included variables are co-integrated.

Granger-causality test

Table 4: Granger causality test

Pairwise Granger Causality Tests
Date: 09/25/14 Time: 14:59
Sample: 1990 2011
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
CRIME does not Granger Cause UNEMPLOYMENT	21	1.55696	0.22810
UNEMPLOYMENT does not Granger Cause CRIME		5.15144	0.03575

Based on the result from table 4 above, the p-value of 0.22810 being greater than the □ level of 0.05, we cannot afford to reject the null hypothesis that CRIME does not Granger cause UNEMPLOYMENT but we reject the null hypothesis that UNEMPLOYMENT does not Granger cause CRIME since the p-value of 0.03575 is less than the □ value of 0.05, this means that unemployment Granger causes crime, and it is a unidirectional Granger causality.

Summary and Conclusion

This work hinged on "The Determination of The Relationship between Unemployment and Crime in Nigeria Using Co-integration". The Johansen co-integration method and the Granger causality test procedure were adopted. The results of the unit root test (ADF) indicated that the variables under consideration were co-integrated of the same order that is I(1). The co-integration results showed that there was a long run equilibrium relationship between unemployment rate and crime in Nigeria which implies that both variable move together in a long run.

The result from the Granger causality test showed that we cannot afford to reject the null hypothesis that crime does not Granger cause unemployment but afford to reject the null hypothesis that unemployment does not Granger cause crime; therefore conclude that unemployment Granger causes crime since the p-value of 0.03575 is less than the □-level of 0.05 and this indicates a unidirectional Granger causality.

The result of the findings showed that there is a long run relationship between unemployment rate and crime rate in Nigeria. Unemployment and its relationship with attendant crime are part of major social problems affecting the growth of any economy; Nigeria inclusive. Many Nigerians cannot meet the basic needs of life because they have no jobs. In order to curtail the crime rate in the country, efforts should be made towards reducing the rate of unemployment in the country. There are ways the government can tackle these social ills affecting the country. One of these ways is that the government should embark on direct measures capable of creation jobs through industrialization and agricultural mechanization by investing massively in agriculture and encourage the youth to be involved in this sector. On the other hand the youths should be creative and learn different vocational and technical skills which are guided towards self employment and self reliance in order to minimize the unemployment crisis.

Finally, from all indications, the reduction of youth unemployment will translate into reduction in crime and enhance sustainable national development. The youths should be encouraged to channel their energies to national development by being positively engaged in the system, and discouraged from activities of that are detrimental to the growth of the country. Therefore, every action taking towards

youth's unemployment is an action towards crime reduction as well as promoting national development.

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