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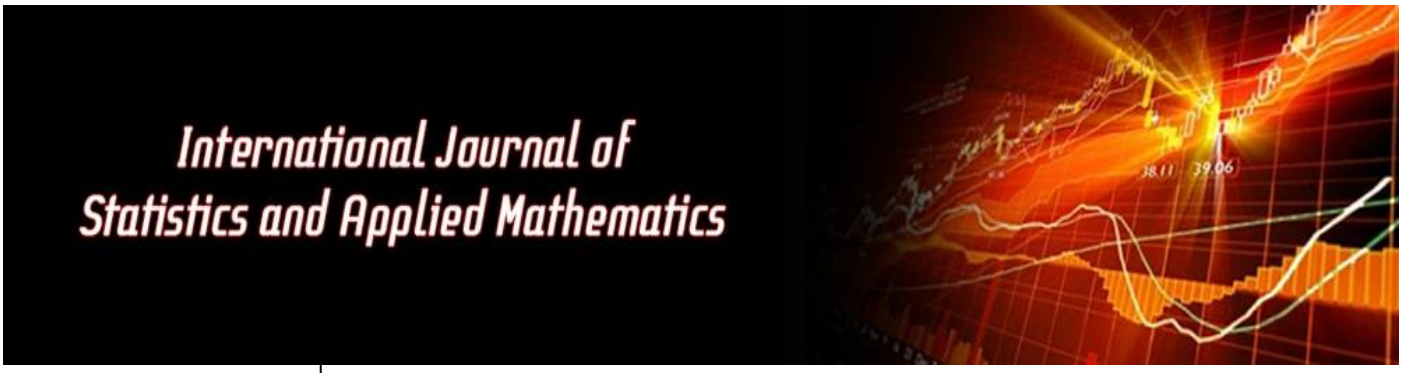

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Cointegration analysis of youth unemployment in Kenya

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Abstract
In this paper analysis of contribution of macroeconomic variables gross domestic product (GDP), external debt (ED), foreign direct investment (FDI), private investment (PI), youth population (POP), and youth literacy rate (LR) to youth unemployment (YUN) in Kenya over time is done. The analysis is done under framework of cointegration of time series data. First, logarithmic transformation of the series is carried out followed by stationarity test to determine the order of stationarity. The Philip-Ouliaris cointegration test is carried out to determine whether the series are individually cointegrated in a pair-wise manner. Then the Johansen cointegration test is conducted to determine the rank of cointegration. The paper does not proceed to identify cointegration relations as that is superfluous as far as estimation of linear cointegration model is concerned. Finally the linear cointegration equation of the macroeconomic variables is estimated and interpreted. Philip-Ouliaris test reveals that six pairs are I(0) while 15 pairs are I(1). The Augmented Dickey-Fuller test finds that GDP, FDI, and ED are stationary at level, i.e. without differencing whereas PI, LR, YUN, and POP are stationary of first difference. According to Johansen cointegration test, the rank of cointegration is 3, revealing three cointegration relations among the variables used. The results indicate that 1% increase in GDP, ED, FDI, and LR increases YUN by 0.356204%, 0.269%, 0.002441%, and 0.154216 respectively. Contrarily, 1% increase in population reduces youth unemployment by 0.350833%.The model is subjected to F-test and p-value test and found to be statistically significant.

Keywords: Linear Cointegration, Unemployment

Introduction
The East Africa's population is disproportionately youthful. The proportion of youth of the total population was estimated in 2015 to be 55%. This is attributed to high fertility rate essential for demographic momentum. The increase is projected to continue until 2035. It is cited that level of education, experience, low skill levels, and skill-jobs mismatch cause youth unemployment in the region. Thus millions of unemployed youth in East Africa.

The most frequently cited barriers for youth absorption in employment are inadequate job creation, exposure of young workers to layoffs during economic crises, high labour costs associated with unrealistic wage expectations by youth, discrimination based on inexperience, skill mismatch hence little to no access to on-the-job training, ineffective government policies, and rapid economic change. It was revealed that most early school leavers in East Africa find work in the informal sector. This is the case in Kenya, Uganda and Burundi ILO (2012) [2].

Based on statistics from Ministry of Education, Science and Technology (MoEST), (Sessional Paper No.14, 2012 on Reforming Education and Training Sectors in Kenya), 1.2 milion youth enter labour market without formal training or skills. At age 24 less than 11% have formal training. As such education is a major determinant in youth unemployment in Kenya. Ponge (2013) [3] found that graduates in Kenya are largely unemployed and unemployable due to lack of skills resulting from disconnect between education and labour market demand. The study concluded that unemployment rate needs urgent attention.

Literature Review

GDP is defined as the total market value of all finished goods and services produced annually within the boundaries of a country. The study assumed that increase in GDP reduces youth unemployment, whereas decreases in GDP increases youth unemployment. This is a negative relation-ship.

There is a positive relationship between employment rates and countries economic development Okun (1962) [14]. On this, Dimian (2011) as quoted by Kabaklalri *et al.* (2011) [9] reported that youth un-employment rate has negative impact to country's gross domestic products. Kabaklarli *et al.* (2011) [9] noted that when the economic activity is healthy and developing, employment as well as youth employment will be better. However, economic meltdown and crises affect employment as well as youth unemployment negatively. According to Msigwa and Kipesha (2013) [12], youth employment results into increased aggregate demand as well as increase in capital formation. Further on this ILO (2011) [2] pointed out that youth were likely to spend a higher percentage of their income on goods and services, which boost the countries' aggregate demand: thus economic growth. In addition ILO (2011) [14] explained that employed youth who received higher salaries saved and invested or deposited them in banks. The argument followed that, the savings result in increase in pool of capital which can be used to finance SME and start small businesses thereby boosting a counties economic development. In addition, Kabaklarli *et al.* (2011) [9] observed that young people possess a marginal propensity to consume more than adults, therefore, increasing unemployment rate in young people negatively affects consumption, total investment and as a result GDP.

On a different note, studies showed that youth employment reduces the social costs its leads to reduction of violence, criminal activities, gambling, drug addiction as well as prostitution McLean *et al.*, (2009), as quoted by Msigwa and Kipesha, (2013) [12]. From previous studies considered herein, increase in GDP was found to reduce youth unemployment.

External debt is described as the total debt a country owe foreign citizens, firms and institutions. The debt includes money owed to private commercial banks, other governments, or international financial institutions, like IMF and World Bank. The study assumed that increase in external debt leads to decrease in youth unemployment. However, high public debts could be counter-productive since it attracts associated tax increase which reduces investment and consumption expenses; with less youth employment and lower GDP growth rates as observed by (Maqbool *et al*., 2013) [13].

Foreign Direct Investment is defined as a company from a country making a physical investment like building a factory in another country. Thus, it is the establishment of an enterprise by a foreigner. The assumption is that FDI too has a negative relationship with youth employment.

According to Maqbool *et al*., (2013) [13], it is also referred to as private investment capital subscriptions (PICS) -financial tool that relies on a small pool of investors' money for real estate investment. The money managers of PICS are experienced real estate investment experts, for closures, notes, as well as development projects on behalf of subscribers and themselves. Hypothetically, private investment leads to decrease in youth unemployment.

For the purposes of this study, education was taken as youth literacy rate.The number of persons aged between 15-34 years with basic education and above, divided by the population of people of the same age group at a particular time multiplied by 100. Education is one of the main determinants of youth unemployment rate Kabaklarli *et al*., (2011) [9] revealing a strong link between educational level and unemployment.

Also, Weber, (2000), as quoted by Kabaklarli *et al*., (2011) [9] estimated relationship between educational rates of return and unemployment rate and found that youth unemployment had important role in pursuing educational investment. When people invest in their education as a result they decrease their unemployment opportunity cost. There is lower risk of unemployment at higher levels of education because educated workers adapt to new jobs easily. Educated workers are more efficient than non-educated lot in seeking new jobs and gaining more wages.

In its definition, population refers total number of persons of a country at a given time.

The study assumed population growth leads to increase in unemployment

Table 1: Number of youth entering job market annually

Level of Education	Numbers
No education	200,000
Drop out of primary	300,000
Complete Primary	250,000
Drop out of secondary	180,000
Complete secondary	250,000
Drop out of tertiary education	45,000
Complete Tertiary Education	155,000
Total	1,380,000

Youth represents an important cohort of the Kenya's population. The number of youth almost tripled from 4.94 million in 1979 to 13.67 in 2009 (Census, 2009).

When youth population grows beyond a margin the labour market can absorb, the youth unemployment increases and results in backlog of unemployment (Maqbool *et al*., 2013) [13]

Empirical Review

From the considered literature, GDP was deciphered as the major youth unemployment determinant. The relationship is based on Okun's law. In his ground breaking paper, Okun (1962) [14] de-scribed a coefficient that gives the rate of change of real GDP for a measure of unemployment rate. According to Okun's Law, an increase in the economic growth rate by 3%, above the normal rate, reduces the unemployment rate by 1%. This requires that the rate of GDP and potential growth ought to be equal in order to keep the unemployment rate at equilibrium. To reduce unemployment, therefore, the rate of GDP growth must be above the growth rate of potential output. Gul *et al.* (2012) [1] noted unemployment rate and rate of inflation have a negative relationship in a country's economy. It is acknowledged clearly, the lower the unemployment in an economy, the higher the rate of inflation.

Also Valadkhani (2003) [20] analyzed relationships between unemployment, population and GDP using data set for thirteen years between 1986 and 1999. The result revealed a positive relationship between unemployment rate and population. GDP and unemployment have a negative relationship. Examined the determinants of youth unemployment using data from 1991 to 2004. The results revealed that GDP, service sector growth and private investment had greater impact compared to government investment in reducing unemployment. Also Eita used data between 1971 and 2007 and revealed that in cases where real GDP was below potential GDP unemployment increased Kabaklarli *et al.* (2011) [9] employed long term cointegration

analysis from an econometric analysis perspective to determine the effects of GDP, Price Index, Gross Fixed Capital Formation and Productivity on youth unemployment as was done by Eita and Eshipala (2001). The results indicated that inflation and productivity had positive effects on youth unemployment rate despite the fact that GDP and investment had negative effects on the long-run.

From the considered literature, the most commonly used variables of youth unemployment are population, GDP, FDI, PI, and ED. In this study, we considered Education as one of the key determinants. All studies considered mentioned the importance of education in youth unemployment but none provided a mathematical model on it. It was for these reasons that this study adopted the same variables. On mathematical models Hassler and Wolters (2010) [17] considered cointegration analysis within an ARDL framework and the review of cointegration tests based on ECM regression paying particular attention to linear time series without detrending. The results indicated that conditional ECM model is superior to unconditional one. For stationarity test and cointegration to solve challenges of spurious regression Engle and Granger (1987) [6], Johansen (1991) [11], Phillip (1991) [15], Phillip and Hansen (1990) [16], and Phillips and Loretan (1991) [15] offer solutions. The tests are further simplified by Dickey and Fuller (1978) [5] and (1981) [4] in ADF unit root test.

Stationarity Tests

Series are considered stationary when mean and variance are time invariant. The stationarity test is conducted to ensure that variable used do not exhibit spurious regression. The Augmented Dickey-Fuller unit root test is used to verify stationarity status of each variable at level. The test checks whether the variables have unit roots and stochastic trend. When variables are not of the same stationary order, cointegration test is conducted to ascertain that the series do not drift apart over time. The results for stationary test are presented in *table*

Table 2: Results of stationarity tests of variables

Variable	p-value	First Diff
YUN	0.99	0.01
GDP	0.04211	NA
ED	0.02464	NA
FDI	0.01	NA
PI	0.6188	0.01
LR	0.6146	0.01
POP	0.0815	0.01

From the results presented in the table, and focusing on p-values, the study observed that GDP, ED an FDI are I(0), that is, stationary at level while YUN, PI, LR, and POP are I(1) stationary .i.e. difference stationary. Since the variables are stationary at different levels, we cannot use them in linear regression model unless we are certain that they are cointegrated. We proceed to conduct cointegration test.

Phillips-Ouliaris Test

The cointegration test helped to check long-run relationship between the variables. The Phillips-Ouliaris cointegration test of the variables was conducted to ascertain the order of cointegration between two variables in turns.If Dickey-Fuller test reveals non-stationarity we proceed to determine cointegration between the variables.Non-stationary time series variables should not be used in regression models, to avoid the problem of spurious regression. However, there is an exception to this rule: If y_t and x_t are non-stationary variables, then we expect their difference, or any linear combination, such as

$$e_t = y_t - \beta_1 - \beta_2 x_t \quad (1)$$

Is said to be I(1) as well.

However, there is an important case when (1) is stationary I (0) process. In this case y_t and y_t are said to be cointegrated. The idea in cointegration analysis is that a group of non-stationary variables might individually wander extensively in such a way that they do not drift too far apart from one another, given that the difference is stationary. That is, individually they are time series with unit roots but a particular linear combination of them is stationary. We outline the definition and estimation for cointegrated vectors as follows:

An (m×1) vector time series is defined as cointegrated in (c;b) order if each of the series is I(d) process, that is, a nonstationary process with d unit roots, whereas a certain linear combination of the series y_t is an I(c-b) process for some nonzero (m×1) constant vector α. The vector y_t considered in this study is (7×35) seven variables with 36 observations: yt1; yt2; yt3; yt4; yt5; yt6 & yt7y_t1,y_t2,y_t3,y_t4,y_t5,y_t6 &,y_t7 representing YUN, Population, GDP, FDI, ED, PI, and LR respectively. Suppose y_t is cointegrated of order I(1), then Granger representation of y_t follows an error correction of the form:

C(L)Δlny_t=q+〖gy〗_(t-1)+e_t

Where C(L) is (7×35) matrix polynomial in the lag operator L of order p (p in the maximum lag), Δ is the first order difference operator, q is an intercept vector, g constant matrix, and e_t the error term vector. Two or more series which are individually integrated yielding residuals with lower order of integration as cointegrated if their linear combination is stationary.

Table 3: Philip-Ouliaris Cointegration result of paired variables

R-CODES	VARIABLES	P-VALUE	Po-demeaned	Differential Order
po.test(diff(log(cbind(YUN,GDP))))	YUN and GDP	0.02140	-24.8909	1
po.test(diff(log(cbind(YUN,ED))))	YUN and ED	0.01	-34.185	1
po.test(diff(log(cbind(YUN,FDI))))	YUN and FDI	0.01	-30.4839	1
po.test(diff(log(cbind(YUN,PI))))	YUN and PI	0.01	-31.1498	1
po.test(diff(log(cbind(YUN,LR))))	YUN and LR	0.01	-29.2731	1
po.test(diff(log(cbind(YUN,POP))))	YUN and POP	0.01	-33.1063	1
po.test(diff(log(cbind(GDP,ED))))	GDP and ED	0.04044	-21.7589	1
po.test(diff(log(cbind(GDP,PI))))	GDP and PI	0.02022	-25.2477	1
po.test(log(cbind(GDP,LR))	GDP and LR	0.02079	-25.0744	1
po.test(diff(log(cbind(GDP,POP))	GDP and POP	0.01094	-28.0382	1
po.test(diff(log(cbind(ED,PI))))	ED and PI	0.01273	-27.5002	1

po.test(diff(log(cbind(ED,LR))))	ED and LR	0.01832	-25.8183	1
po.test(diff(log(cbind(ED,POP))))	ED and POP	0.01	-30.7157	1
po.test(diff(log(cbind(PI,LR))))	PI and LR	0.01	-51.4342	1
po.test(log(cbind(PI,POP)))	PI and POP	0.01	-35.1818	0
po.test(diff(log(cbind(LR,POP))))	LR and POP	0.01	-42.1315	1
Po.test(log(cbind(GDP,FDI)))	GDP and FDI	0.0446	-21.2072	0
Po.test(log(cbind(ED,FDI)))	ED and FDI	0.05377	-20.1868	0
Po.test(log(cbind(FDI,PI)))	FDI and PI	0.04558	-21.0765	0
Po.test(log(cbind(FDI,LR)))	FDI and LR	0.0344	-22.5618	0
Po.test(log(cbind(FDI,POP)))	FDI and POP	0.01542	-26.691	0
po.test(diff(log(cbind(YUN,GDP))))	YUN and GDP	0.02140	-24.8909	1
po.test(diff(log(cbind(YUN,ED))))	YUN and ED	0.01	-34.185	1
po.test(diff(log(cbind(YUN,FDI))))	YUN and FDI	0.01	-30.4839	1
po.test(diff(log(cbind(YUN,PI))))	YUN and PI	0.01	-31.1498	1
po.test(diff(log(cbind(YUN,LR))))	YUN and LR	0.01	-29.2731	1
po.test(diff(log(cbind(YUN,POP))))	YUN and POP	0.01	-33.1063	1
po.test(diff(log(cbind(GDP,ED))))	GDP and ED	0.04044	-21.7589	1
po.test(diff(log(cbind(GDP,PI))))	GDP and PI	0.02022	-25.2477	1
po.test(log(cbind(GDP,LR))	GDP and LR	0.02079	-25.0744	1
po.test(diff(log(cbind(GDP,POP))	GDP and POP	0.01094	-28.0382	1
po.test(diff(log(cbind(ED,PI))))	ED and PI	0.01273	-27.5002	1
po.test(diff(log(cbind(ED,LR))))	ED and LR	0.01832	-25.8183	1
po.test(diff(log(cbind(ED,POP))))	ED and POP	0.01	-30.7157	1
po.test(diff(log(cbind(PI,LR))))	PI and LR	0.01	-51.4342	1
po.test(log(cbind(PI,POP)))	PI and POP	0.01	-35.1818	0
po.test(diff(log(cbind(LR,POP))))	LR and POP	0.01	-42.1315	1
Po.test(log(cbind(GDP,FDI)))	GDP and FDI	0.0446	-21.2072	0
Po.test(log(cbind(ED,FDI)))	ED and FDI	0.05377	-20.1868	0
Po.test(log(cbind(FDI,PI)))	FDI and PI	0.04558	-21.0765	0
Po.test(log(cbind(FDI,LR)))	FDI and LR	0.0344	-22.5618	0
Po.test(log(cbind(FDI,POP)))	FDI and POP	0.01542	-26.6911	0

The test revealed that all the variables were cointegrated at order I(0) and I(1) as shown in the Table 2 above. Out of 21 relations, 6 are I(0) while 15 are I(1) The Phillip-Ouliaris does not have the ability to conduct cointegration test of more than two variables. The test is further limited in identifying coefficients of cointegration necessary for cointegrating vectors and equations. With these limitations the study conducts Johansen Cointegration test.

Johansen Cointegration Rank Test

The Johansen (1988) [11] cointegration rank test has the ability to perform Cointegration test for more than two variables. In table 3 below, cointegration test is conducted for six variables at 95% confidence level. The Johansen test uses two test statistics: Trace test and maximum eigen value statistics. In either test, null hypothesis is rejected when the test statistics takes on a value below the critical value of a given significance level. The results are presented in Table 3 below. Test type: maximal eigenvalue statistics without linear trend and constant in cointegration.

Table 4: Values of test statistic and critical values of test:

Cointegration Rank (r)	Test Statistics	10%	5%	1%
$r \leq 6$	5.37	7.52	9.24	12.97
$r \leq 5$	10.07	13.75	15.67	20.20
$r \leq 4$	15.58	19.77	22.00	26.81
$r \leq 3$	17.17	25.56	28.14	33.24
$r \leq 2$	40.13	31.66	34.40	37.79
$r \leq 1$	57.15	37.45	40.30	46.82
$r \leq 0$	66.89	43.25	46.45	51.91

$H_0: r = 3$, the critical value is less than the test statistics at 95% confidence level, that is, 28:14 >17.17.

The study rejects the null hypothesis and concludes that there are r = 3 cointegrating vectors at 5% confidence level. The test statistics reveals the existence of three cointegrating relationships among the seven variables. There are three cointegrating relationship among the seven variables which implies a long-run equilibrium condition binding the levels of the variables together. These results indicate that the variables would not drift apart over time from each other.

Table 5: Results of estimated linear cointegration equation*:*

Variable	Estimate	STD. Error	t value	P-value
Intercept	1.322215	0.634925	2.082	0.045925**
GDP	0.356204	0.044585	7.989	6.44e-10***
ED	0.269000	0.029884	9.001	5.00e-10***
FDI	0.002441	0.006745	0.362	0.719919
PI	0.011790	0.012108	0.974	0.241783
LR	0.154216	0.129145	1.194	0.241783
POP	-0.350383	0.084511	4.146	0.000255***

The estimated linear cointegration equation is:

$$YUN = 1.322215_{(0.634925)} + 0.356204_{(0.044585)}GDP_t + 0.269_{(0.029884)}ED_t + 0.002441_{(0.006745)}FDI_t + 0.01179_{(0.01208)}PI_t + 0.154216_{(0.129145)}LR_t - 0.350383_{(0.084511)}POP_t$$

Discussion

The Dickey-Fuller stationarity test reveals that GDP, external debt, and FDI are stationary at level whereas youth unemployment, literacy rate, private investment, and youth population are difference stationary. It is important to note that when all the variables used are stationary we proceed to estimate the linear cointegration model because they are bound and will not drift far apart from each other over time. However, when the variables are stationary of different orders

we cannot carry out estimation of linear model because we have no evidence that the series will not drift away from each other over time. For certainty of being bound within limits over time, we do cointegration tests, as done in this case before estimating linear cointegration model. Philip-Ouliaris cointegration test indicates that out of 21 relations 12 are I(0) while 9 are difference stationary, that is, I(1). The Johansen cointegration test finds three cointegration relations among the six variables. The cointegration rank is 3 i.e. (r=3). Estimating linear cointegration model does not require identification of cointegrating relations and their coefficients, which are only necessary in the estimation of vector error correction (VECM) models and other VAR models (Shem *et al*., 2019) [18]. From the linear cointegration regression results in table 4: adjusted R-squared if 0.8407 and the F-statistics is 32.66 on 6 while the p-value was 7.322e-12 or 0.001. The results indicated that 84.076% of variations in youth unemployment is explained by GDP, external debt, foreign direct investment, private investment, literacy level, and the youth population. The computed F-value is 32.66 and F-critical value is 3.29. The null hypothesis is rejected and the equation is declared statistically significant. The results indicate that 1% increase in GDP, ED, FDI, PI, and LR increase youth unemployment by 1.3225%, 0.356204%, 0.269%, 0.002441%, and 0.154216% respectively. The unique finding that increase in GDP leads to increase in youth unemployment indicates a "jobless growth" in Kenya as observed by Ajilore and Yunisa (2011) [2] in Botswana. The findings are however contrary to Kabaklarli *et al*. (2011) [9] whose study of youth unemployment in Turkey revealed 1% increase in GDP reduced youth unemployment by 3.07% in line with Okun's Law. The finding on education (youth literacy rates) is consistent with Shem *et al*. (2019) [18] on youth unemployment in Kenya; and Guillermo *et al*. (2012) which found out that in Brazil higher education levels do not compensate for unemployment episode in the past.

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