Macroeconomic Determinants of Unemployment in Africa: A Panel Data Analysis Approach

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Abstract: The study explored the macroeconomic determinants of unemployment in Africa using panel data analysis (fixed effects, random effects, pooled ordinary least squares, dynamic generalized methods of moments), with data spanning from 2001 to 2015. Several empirical studies on the determinants of unemployment have been done, results of which are convergent, divergent and quite mixed. What is clearly coming out of this empirical research is that there is no universal agreed list of the determinants of unemployment. Across all the four econometric estimation methods used, the variables which were found not to be significant determinants of unemployment include information and communication technology, human capital development and infrastructural development. The dynamic GMM method observed that the lag of unemployment exacerbated unemployment in Africa. All the four econometric approaches used produced results which show that FDI increased unemployment in the African continent. African authorities are therefore urged to ensure that they implement policies which ensures that the inflow of foreign direct investment (FDI) translates into easing unemployment woos in the continent. The random effects and pooled OLS noted that financial development had a significant positive effect on unemployment in the case of Africa. The relevant African authorities should therefore implement programmes and policies that enhances the poor people's financial inclusion so that they can benefit from developed financial markets. As expected and justified by literature, the pooled OLS shows that trade openness and population growth had a significant positive impact on unemployment in Africa. However, the interaction between information and communication technology (ICT) and human capital development was found to have had a significant negative influence on unemployment across all the four econometric estimation approaches. Africa is therefore urged to enhance human capital development if they intend to economically benefit from new technologies especially during the present day 4th industrial revolution otherwise their people becomes redundant. As expected, fixed effects and pooled OLS methods shows that economic growth had a significant negative influence on unemployment in Africa. It is against this backdrop that the study urges African authorities to implement growth-oriented policies if they intend to reduce unemployment in the region.

Keywords: Unemployment; Africa; Determinants; Panel Data

JEL Classification: E24; N17; C23

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1. Introduction

Background of the study, research gaps and problem statement

The rapidly rising rate of unemployment in developing countries and Africa has been a major source of concern not only to international developmental bodies such as United Nations, African Development Bank and the African Union, but to scholars and policymakers (Folawewo and Adeboje. 2017). The unsettling concern is understandable given that unemployment gives rise to other socially related problems such as drug abuse and increase in general crime rate, both of which slows down economic growth in the continent. Due to this reason, it has become imperative for every government especially in the African continent to come up with policies and strategies that ensures that there is unemployment reduction in the continent, consistent with Belabbas et al (2018). Consistent with Riaz and Zafar (2018), upping efforts to reduce unemployment begins with a thorough understanding of the determinants of unemployment. The argument motivated the author to undertake this study to lay bare determinants of unemployment's policy implications to the African authorities so that they can have a starting point.

The intricate relationship between unemployment, poverty and inequality is one of the reasons why the author undertook this study. The Millennium Development Goal of poverty eradication cannot be achieved if unemployment rates continue to rise therefore as a scholar, the author is of the view that further empirical tests on unemployment determinants are imperative if the academic community is going to contribute or make any difference in our society.

What is worth noting is that the impact of economic growth on unemployment is now a settled issue in finance and economics. What has not yet been satisfactorily or finalized in the literature is the agreeable list of variables that determine unemployment as can be seen by divergent, convergent and mixed findings established by prior empirical research on determinates of unemployment (see Table 2). What further shows that the issue of determinants of unemployment is still an unsettled issue is that even the empirical research work which agrees on the same list, they cannot concur on how each of that variable influence unemployment. For example, Gaber (2018), Maqbool et al (2013), Folawewo and Adeboje (2017), Riaz and Zafar (2018), Baah-Boateng (2014), Baah-Boateng (2016), Ebaidalla (2016) noted economic growth reduced unemployment whilst Kerckhoffs et al (1994) and Alrayes and Wadi (2018) could not find any clear relationship between economic growth and unemployment. Whilst Folawewo and Maqbool et al (2013), Adeboje (2017) and Gaber (2018) noted that inflation was a significant determining factor on unemployment, Alrayes and Wadi (2018) observed no significant impact of inflation on unemployment. Such divergent views on the subject matter triggered the current study to add a voice on the determinants of unemployment in an African context.

Even though Africa has high unemployment rates and face quite similar unemployment problems, majority empirical studies have shied away from exploring the determinants of unemployment in Africa as a whole. Majority of the available empirical research on unemployment determinants in Africa are single country studies (Kyei and Gyekye. 2011; Raifu. 2017; Khumalo and Eita. 2015; Baah-Boateng; 2014; Eita and Ashipala. 2010; Baah-Boateng. 2016; Dagume and Gyekye. 2016; Batu. 2016; Fila et al. 2016; Batel and Choga. 2018; Mbekeni and Phiri. 2019). The scant empirical research work that explored the determinants of unemployment as a bloc were done by Ebaidalla (2016) which focused on Sub-Saharan Africa and Folawewo and Adeboje (2017) which studied on Economic Community of West African States (ECOWAS). Still, these empirical studies were not representative of Africa enough and suffered from the following methodological weaknesses: (1) They ignored the fact that unemployment data is characterised by dynamic features, just like poverty and (2) they did not consider the endogeneity problem. The current study fills in these gaps.

Structure of the paper:

The remaining part of the study is organized into five different components. Section 2 explains the theoretical literature on various factors that determines unemployment. Section 3 is a discussion of empirical literature on the determinants of unemployment. Section 4 is the research methodology, which focuses on data description, general and econometric estimation models, pre-estimation diagnostics, diagnostic tests, main data analysis, results discussion and interpretation. Section 5 concludes the paper whilst Section 6 is the reference list.

2. Determinants of Unemployment -Theoretical Literature Review

The Determinants of Unemployment, from a Theoretical Point of View are Summarized in Table 1.

Table 1. Theory Intuition and a Priori Expectation

Variable	Proxy used	Theory intuition	Expected sign
GROWTH (Economic growth)	Gross domestic product (GDP) per capita	Thirwall (1989) noted that a larger size of the economy is more capable of employing more people, in comparison to small economies. In contradiction, a study done by Abdul-Khaliq et al (2014) found out that an increase in economic growth had a deleterious effect on employment in the case of Arab group of nations.	+/-
ICT (Information and Communication Technology)	Individuals using internet (% of population)	According to Vivarelli (2007), ICT generate new jobs in the capital sector of the economy whilst displacing jobs in the user industries. The same author argued that new technologies create new investments thereby opening new opportunities for the unemployed people.	-
HCD (Human capital development)	Human capital development index	Samiullah (2014) argued that human capital development improves the productivity of the people by equipping them with the necessary job skills. Massingham and Leona Tam (2015) noted that human capital development involves better schooling, attitude towards words, health, skills and job knowledge hence making the people better employable in the industry.	+/-
Interaction between ICT and human capital development	Individuals using internet (% of population) x Human capital	Educated, healthy and skilled personnel are better placed to take advantage of the advent of new technologies either to take up emerging jobs during	-

	development index	the 4th industrial revolution era to create their own employment (Samiullah. 2014).	
FIN (Financial development)	Domestic Credit to private sector by banks (% of GDP)	A report by the International Monetary Fund (2015) argued that financial markets which are developed exclude small businesses into the main stream economy hence disfranchising a lot of jobs that could have been created that that economic sector. This is despite Kargbo et al's (2016) assertion that financial development complements human capital development through the provision of not only financial skills but small loans to start businesses that would ordinarily ensure that the people become self-employed.	+
OPEN (Trade openness)	Total of exports and imports (% of GDP)	Mitra and Ranjan (2010) believes high level of trade openness improves the international competitiveness of local businesses, allowing them to expand locally, regionally and abroad thus creating more jobs. Trade openness contributes to more unemployment, according to Helpman and Itskhoki (2010). This is because big companies can end up purchasing materials from abroad, setting up their manufacturing branches in other countries thus exporting jobs to those countries.	+/-

INFR (Infrastructure development)	Fixed telephone subscriptions	According to Smith (2003), transport and communications infrastructure investment and development reduces unemployment, consistent with the labour markets theory. Smith (2003) also noted that developed infrastructure in general allows the employees to easily, in a timely and secure manner reach to their destination of employment.	-
POP (Population growth)	Population growth (% annual)	According to Aiyedogbon (2012), high levels of population growth cause a rapid supply of the job seekers in the labour market to grow at a pace which outpace the rate at which jobs are being created in the economy hence leading to unemployment. High levels of population growth enlarge the market size, attracts FDI and consequently induce economic growth-related advantages in the economy (such as employment creation), consistent with Jorgenson's (1963) market size hypothesis.	+/-
FDI (Foreign direct investment)	Foreign direct investment, net inflows (% of GDP)	According to Irpan (2016:3), some foreign investors prefer to bring their own unskilled labour force hence exacerbating unemployment in the host country. Foreign direct investment brings into the host country new capital, new skills, managerial expertise, new jobs and networking the local companies to the	+/-

		international family of businesses further helping to ease unemployment (Johnny et al. 2018).	

Source: Author compilation

3. Determinants of Unemployment -Empirical Literature Review

Table 2 below is a discussion of the empirical literature on the determinants of unemployment.

Table 2. The Determinants of Unemployment – An Empirical View

Author	Country/Countries of study	Period	Methodology	Results
Gaber (2018)	Palestine	1994-2017	Multiple regression analysis	Economic growth had a significant negative impact on unemployment whilst inflation, and labour force movement restrictions had a positive significant effect on unemployment.
Maqbool et al (2013)	Pakistan	1976-2012	Autoregressive Distributive Lag (ARDL)	In the long run, economic growth, inflation, foreign direct investment (FDI) and population growth were found to be significant factors that influenced unemployment in Pakistan.
Folawewo and Adeboje (2017)	Economic Community of West African States (ECOWAS)	1991-2014	Fully modified ordinary least squares (FMOLS)	Economic growth had an insignificant reducing influence on unemployment whilst inflation was found to have had a significant positive impact on unemployment in ECOWAS.
Riaz and	Less developing countries	1990-2015	ARDL	Economic growth was found to have reduced

Zafar (2018)				unemployment whilst population growth had a significant positive effect on unemployment in less developing countries.
Kerckhoffs et al (1994)	Netherlands	1987	Reduced form estimation of duration models	The study found no clear determinants of unemployment in the Netherlands during the period under study.
Kyei and Gyekye (2011)	South Africa, Limpopo Province	1995-2001	Regression, Principal Component and Cluster Analyses	Youth, matriculation, male and economic growth had no significant impact on unemployment in the Limpopo Province of South Africa. The same study noted that variables such as postgraduate studies, middle aged, primary, incomplete, females and race were significant predictors of unemployment in Limpopo.
Kamran et al (2013)	Pakistan	1981-2010	Multiple regression model and descriptive statistics	Population growth increased unemployment whilst FDI and high literacy rates reduced unemployment.
Raifu (2017)	Nigeria	1981-2014	ARDL	In the short and long run, trade openness worsened unemployment in Nigeria. Current account balance reduced unemployment in the long run whilst it had a positive influence on unemployment in the short run in Nigeria.
Aysit and	Turkey	2000-2001	Non-Parametric and Parametric	Women faced high levels of unemployment

Mehmet (2004)			estimation methods	in comparison to their men counterparts in Turkey.
Feriyanto (2018)	Regency/City in Special Province Yogyakarta	2010-2015	Panel data analysis methods	Wages reduced unemployment whilst population growth had a significant positive influence on unemployment.
Khumalo and Eita (2015)	Swaziland	2007-2009	The Engle-Granger procedure	Unemployment can be reduced by accelerating increasing investment activities, economic growth and reducing inflation.
Sabir (2015)	Pakistan	1990-2013	Multiple linear regression analysis	Literacy rate and population growth had a significant positive influence on unemployment whilst economic growth's impact on unemployment was found to be positive but insignificant. Inflation had a significant negative effect on unemployment in Pakistan.
Ductor and Grechyna (2019)	Organization for Economic Co-operation and Development (OECD) countries	2001-2013	Bayesian model averaging approach	Expenditure on passive labour market policies were the main determinant of outflows from unemployment whilst duration of benefit entitlement was the major determinant of inflows into the employment.
Morrisroe et al (2016)	Australia	2014	Multivariate logistic regression model	Patience with digital amputation, diffuse disease subtype, sicca symptoms, physical job and pulmonary arterial hypertension to be the most unemployed

Baccaro and Rei (2007)	OECD countries	1960-1998	Panel data analysis methods	Restrictive monetary policies by an independent Central Bank and not real interest rates determined unemployment than institutional variables.
Alrayes and Wadi (2018)	Bahrain	1980-2015	Multiple regression analysis	Inflation and economic growth had no significant influence on unemployment whilst fixed capital formation and government expenditures had a significant influence on unemployment in Bahrain.
Eita and Ashipala (2010)	Namibia	1971-2007	Engle-Granger two-step econometric procedure	Inflation and investment in the economy reduced unemployment in Namibia.
Trimurti and Komalasari (2014)	Indonesia	2004-2012	Multiple regression analysis	Economic growth had a significant impact on unemployment whilst inflation had a significant positive influence on unemployment in Indonesia.
Dagume and Gyekye (2016)	South Africa	1995-2013	Binary logistic regression model	Being skilled and being well trained reduced unemployment rates among the youths.
Abshoko (2016)	Ethiopia	2011 survey data	Logistic regression model	Educational level, age, access to market information, economic status, gender and electric power were some of the variables that played a big role in influencing unemployment in Ethiopia.

Batu (2016)	Ethiopia	2015 survey data	Descriptive and cross tabulation analysis	Lack of work place, shortage of financial resources, sex, education, regional location and marital status determined unemployment rates in the case of Ethiopia.
Fila et al (2016)	Ethiopia	Survey data	Binary logistic regression model	Migration status, education, health, access to the financial sector, work experience, social capital variables and age influenced unemployment in Ethiopia. Marital status had no impact on unemployment in Ethiopia.
Patel and Choga (2018)	South Africa	2008-2015	VECM	Unemployment was positively and significantly influenced by education in the case of South Africa.
Mbekeni and Phiri (2019)	South Africa	2009-2018	ARDL	Significant determinants of unemployment in South Africa were found to be economic growth, investment, savings, income tax, trade, household debt and repo rates.
Baah-Boateng (2014)	Ghana	Survey data	Probit regression model	Reservation wage was found to be the main determinant of unemployment in Ghana.
Baah-Boateng (2016)	Africa	2000-2010	Panel data analysis	Low economic growth was found to be the main factor driving unemployment in Africa.
Cheema and Atta (2014)	Pakistan	1973-2010	ARDL	Economic growth reduced unemployment whilst trade openness and investment had a

				deleterious effect on employment in the case of Pakistan.
Ebaidalla (2016)	Sub-Saharan Africa	1991-2012	Panel data analysis	Factors which reduced unemployment include economic growth, foreign direct investment, education, low corruption and trade openness.
Khatun (2017)	Bangladesh	2013 survey data	Probit regression model	Level of education and the quality of labour had a significant influence on unemployment in the case of Bangladesh.

Source: Author compilation

As can be seen in Table 2, several empirical studies on the determinants of unemployment have been done, results of which are convergent, divergent and quite mixed. What is clearly coming out of this empirical research is that there is no universal agreed list of the determinants of unemployment. It is also clear that despite high rates of unemployment in Africa, most empirical research on unemployment determinants have shied away from carrying out such a research on Africa. It is against this backdrop that further empirical tests on determinants of unemployment in an African context is required.

4. Research Methodology

Data used in the study: 2001 to 2015 panel data extracted from African Development Bank, World Bank Indicators and International Monetary Fund databases were used for the purposes of this study. Stratified purposeful sampling was used to choose the African countries which formed part of this study. Three African countries from each African region was chosen depending on the availability of data of the variables. For example, Burundi, Kenya and Rwanda are the Eastern African included as part of the sample. Algeria, Morocco and Tunisia were the North African nations included in the sample whereas West African nations include Nigeria, Ghana and Senegal. Central African group of countries which formed part of the sample include Gabon, Democratic Republic of Congo and Cameroon whilst Namibia, Mozambique and South Africa are the Southern African group of countries included in the sample.

Pre-estimation diagnostics

Correlation analysis and descriptive statistics are the two forms of pre-estimation diagnostics that were done in this study (see results in Table 3 and 4).

Table 3. Correlation Analysis

	UNEMPL	FIN	ICT	FDI	OPEN	POP	GROWTH	HCD	INFR
UNEMPL	1.00								
FIN	0.42***	1.00							
ICT	0.21***	0.66***	1.00						
FDI	0.27***	-0.01	-0.02	1.00					
OPEN	0.49***	0.31***	0.26***	0.48***	1.00				
POP	-0.43***	-0.75***	-0.41***	0.13*	-0.27***	1.00			
GROWTH	0.58***	0.37***	0.51***	-0.06	0.37***	-0.35***	1.00		
HCD	0.21***	0.65***	0.69***	-0.02	0.26***	-0.41***	0.51***	1.00	
INFR	0.50***	0.76***	0.51***	-0.12*	0.39***	-0.66***	0.54***	0.51***	1.00

*Note: ***/**/* denotes statistical significance at the 1%/5%/10% level respectively.*

Source: Author compilation from E-Views

Where UNEMPL, FIN, ICT, FDI, OPEN, POP, GROWTH, HCD and INFR respectively stands for unemployment, financial development, information and communication technology, foreign direct investment, trade openness, population growth, economic growth, human capital development and infrastructural development.

Significant positive relationships that were observed in line with the theme of the study include the following: (1) Financial development and unemployment, (2) Information and communication technology and unemployment, (3), foreign direct investment and unemployment, (4) trade openness and unemployment, (5) economic growth and unemployment, (6) human capital development and unemployment and (7) infrastructural development and unemployment. As expected, population growth and unemployment are negatively but significantly related. The weakness of these correlation analysis results is that they do no show the direction of causality hence they are not useful for policy making decision purposes. Following Stead (1996), there is no multi-collinearity problem in the data set since the maximum size of the correlation is 76% (between financial development and infrastructural development).

Table 4. Descriptive Statistics

	UNEMPL	FIN	ICT	FDI	OPEN	POP	GROWTH	HCD	INFR
Mean	11.1	39.4	10.8	3.6	68.5	2.32	2277.5	10.8	3.50
Median	10.03	31.05	5.77	2.22	65.9	2.61	1309.1	5.77	1.49
Maximum	27.3	117.4	57.1	41.8	125.5	3.71	10716	57.1	12.5
Minimum	0.83	2.86	0.01	0.00001	20.96	0.76	112.85	0.01	0.00001
Standard. deviation	7.83	25.9	13.5	5.24	21.5	0.76	2347	13.5	3.84
Skewness	0.46	1.13	1.83	4.51	0.20	-0.54	1.40	1.82	0.91
Kurtosis	1.86	3.83	5.61	28.2	2.58	1.94	4.47	5.59	2.36
Jarque-Bera	20.2	54.5	188.8	6711.3	3.14	21.23	94.12	187.16	35.02
Probability	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00
Observations	225	225	225	225	225	225	225	225	225

*Note: ***/**/* denotes statistical significance at the 1%/5%/10% level respectively.*

Source: Author compilation from E-Views

Apart from trade openness data, all other data sets have abnormal values since the probability of their Jarque-Bera criteria is equal to zero. Abnormal values are also found in the economic growth data set, considering that the standard deviation of economic growth data is way above 1 000. The fact that economic growth data's range is more than 10 000 further proves that economic growth data is characterized by abnormal values. To deal away with these problems, the author converted the data into natural logarithms to improve the overall quality of results for decision making, following Nor et al (2015) and Aye and Edoja (2017).

Panel unit root tests: Table 5 summarized results of the panel unit root tests.

Table 5. Panel Unit Root Tests –Individual Intercept

	Level				First difference			
	LLC	IPS	ADF	PP	LLC	IPS	ADF	PP
UNEMPL	-3.27***	-0.44	34.63	23.52	-7.13***	-3.12***	78.12***	102.78***
FIN	-1.71**	1.34	22.87	25.12	-6.18***	-4.69***	75.45***	121.558***
ICT	-1.65**	1.34	25.95	76.76***	-9.25***	-5.16***	72.52***	101.59***
FDI	-11.35***	-4.93***	77.11***	95.45***	-10.23***	-7.89***	117.43***	218.69***
OPEN	-2.50***	-0.75	34.90	34.84	-6.90***	-5.24***	83.90***	133.75***
POP	-10.52***	-6.14***	107.01***	59.37***	-6.81***	-3.34***	71.32***	58.37***
GROWTH	-7.90***	-4.27***	74.428***	79.18***	-3.08***	-2.52***	48.61**	69.28***
HCD	-1.53*	1.52	24.93	74.57***	-15.52***	-6.59***	65.36***	102.27***
INFR	-0.65	0.42	29.02	25.37	-3.55***	-3.17***	58.21***	106.70***

*Note: LLC, IPS, ADF and PP stands for Levin, Lin and Chu (2002); Im, Pesaran and Shin (2013); ADF Fisher Chi Square and PP Fisher Chi Square tests respectively. *, ** and *** denote 1%, 5% and 10% levels of significance, respectively.*

Source: Author's compilation from E-Views

All the data sets were stable at first difference.

Panel co-integration tests: The study used Kao (1999) approach to test whether there is a co-integration relation between and among the variables.

Table 6. Kao Residual Co-integration Test - Individual intercept

	T-statistic	Probability
Augmented Dickey-Fuller (ADF)	-3.4991***	0.0002

Source: Author's compilation from E-Views

The results in Table 6 indicates that there is a long run relationship between the variables used in the study. This is because the no relationship null hypothesis was rejected at 1% significance level.

General model description

UNEMPL =f(ICT, HCD, FIN, FDI, OPEN, POP, GROWTH, INFR) [1]

Two factors were considered in coming up with equation 1, namely data availability and prior empirical work on the similar subject matter. Specifically, the earlier research considered include Patel and Choga (2018), Khatun (2017), Mbekeni and Phiri (2019), Alrayes and Wadi (2018), Morrisroe et al (2016), Ductor and Grechyna (2019) and Feriyanto (2018). These variables and their proxies are clearly described in Table 7.

Table 7. Abbreviation, Variables and Proxies

Abbreviation	Variables used	Proxy used
UNEMPL	Unemployment	Unemployment total (% of total labour force)
ICT	Information and Communication Technology	Individuals using internet (% of population)
HCD	Human capital development	Human capital development index
FIN	Financial development	Domestic credit provided by the financial sector (% of GDP)
FDI	Foreign direct investment	Net FDI (% of GDP)
OPEN	Trade openness	Exports +Imports (% of GDP)
POP	Population growth	Population growth (% annual)
GROWTH	Economic growth	GDP per capita
INFR	Infrastructural development	Fixed telephone subscriptions

Source: Author compilation

The econometric representation of equation 1 looks as follows:

$$UNEMPL_{it} = \beta_0 + \beta_1 ICT_{it} + \beta_2 HCD_{it} + \beta_3 FIN_{it} + \beta_4 FDI_{it} + \beta_5 OPEN_{it} + \beta_6 POP_{it} + \beta_7 GROWTH_{it} + \beta_8 INFR_{it} + \varepsilon it \quad [2]$$

Table 8 describes the meaning of econometric terms included in equation 2.

Table 8. Description of Econometric Meaning of the Equation 2 Terms

$UNEMPL_{it}$	Unemployment in country i at time t
ICT_{it}	Information and communication technology in country i at time t
HCD_{it}	Human capital development in country i at time t
FIN_{it}	Financial development in country i at time t
FDI_{it}	Foreign direct investment in country i at time t
$OPEN_{it}$	Trade openness in country i at time t
POP_{it}	Population growth in country i at time t
$GROWTH_{it}$	Economic growth in country i at time t
$INFR_{it}$	Infrastructural development in country i at time t
β_0	Intercept term
β_1 to β_8	Co-efficient of the independent variables
i	country
t	time
εit	Error term

Source: Author compilation

The second objective of this study is to find out if human capital development is a channel through which ICT influences unemployment in Africa hence the introduction of the interaction term (ICT_{it} . HCD_{it}) into equation 2 to give rise to equation 3.

$$UNEMPL_{it} = \beta_0 + \beta_1 ICT_{it} + \beta_2 HCD_{it} + \beta_3 (ICT_{it} . HCD_{it}) + \beta_4 FIN_{it} + \beta_5 FDI_{it} + \beta_6 OPEN_{it} + \beta_7 POP_{it} + \beta_8 GROWTH_{it} + \beta_9 INFR_{it} + \varepsilon it \quad [3]$$

A co-efficient β_3 in equation 3 which is negative and significant means that the complementarity between ICT and HCD would have enhanced unemployment reduction in Africa. Pooled ordinary least squares (OLS), fixed and random effects are the panel econometric methods used to estimate the results for equation 3.

Table 9. Determinants of Unemployment in Transitional Economies

	Fixed effects	Random effects	Pooled OLS
ICT	-0.0038	-0.1021	-1.1393
HCD	0.0132	0.0540	0.7687
ICT.HCD	-0.00758**	-0.0045**	-0.0011**
FIN	0.0953	0.1920*	0.7567***
FDI	0.0229*	0.0220**	0.0857***
OPEN	-0.0052	0.0255	0.6566***
POP	-0.0435	-0.1751	0.2924*
GROWTH	-0.1438*	0.0175	-0.6442***
INFR	-0.0555	-0.0092	-0.0748
Number of countries	15	15	15
Number of observations	225	225	225
Adjusted R-squared	0.9397	0.6183	0.6521
F-statistic	152.87	58.12	83.15
Prob (F-statistic)	0.00	0.00	0.00

****, ** and * denote 1%, 5% and 10% levels of significance, respectively.*

Source: Author's compilation from E-Views

Under the fixed effects, random effects and pooled OLS methods, ICT was found to have an insignificant negative influence on unemployment. The results resonate with Vivarelli (2007) whose study noted that ICT generate new jobs in the capital sector of the economy and that new technologies create new investments thereby opening new opportunities for the unemployed people. On the other hand, human capital development had a non-significant positive influence on unemployment, a finding which contradicts with available literature which says that human capital development improves productivity and enhances employability of the workforce (Samiullah. 2014; Massingham and Leona Tam. 2015).

The interaction between ICT and human capital development was found to be negative and significant, meaning the complementarity between these two variables reduced unemployment in Africa. These results apply across all the three econometric estimation approaches. The finding supports the views by Samiullah (2014) and Massingham and Leona Tam (2015) that once the people are equipped with key technical skills, they can easily take advantage of new ICT technologies to

create employment for themselves or to be better placed to take up new challenging roles in the new 4th industrial revolution.

Whilst fixed effects show a non-significant positive relationship running from financial development towards unemployment, random effects and pooled OLS indicates that financial development had a significant positive influence on unemployment. The results are in line with the International Monetary Fund (2015) report which noted that developed financial markets exclude small businesses which are the engine for job creation efforts in the economy.

Across all the panel estimation methods used, FDI was found to have had a significant positive effect on unemployment, a finding which agrees with Irpan (2016:3) whose study observed that some foreign investors prefer to bring their own unskilled labour force hence contributing to increased unemployment rates in the host country.

Fixed effects show that trade had a non-significant negative influence on unemployment, a finding which resonates with Mitra and Ranjan (2010) whose study is of the view that high trade openness enhances the international competitiveness of local businesses to generate more employment. Random effects indicate that trade openness had a non-significant positive effect on unemployment whilst pooled OLS approach noted the existence of a significant positive relationship running from trade openness towards unemployment. These results agree with Helpman and Itskhoki (2010) whose study argued that trade openness leads to more unemployment because it makes large local firms easily and cheaply purchase materials from abroad and setting up their manufacturing branches in other countries thus exporting jobs to those countries.

According to the fixed and random effects, population growth had a non-significant negative impact on unemployment, a finding which generally agrees with Aiyedogbon (2012) whose study was of the view that high levels of population growth cause a rapid supply of the job seekers in the labour market to grow at a pace which outpace the rate at which jobs are being created in the economy hence leading to unemployment. On the other hand, pooled OLS shows a significant positive relationship running from population growth towards unemployment, a finding which resonates with Jorgenson's (1963) market size hypothesis in that high levels of population enlarge the market size, attracts FDI brings along with it other advantages such as employment creation.

Fixed effects and pooled shows that economic growth significantly reduced unemployment in Africa, a finding which resonates with Thirwall (1989) whose study explained that a larger economic size is better capable of employing more people into the workforce. In line with Abdul-Khaliq et al (2014) whose study revealed that an increase in economic growth reduced employment prospects in Arab

countries, random effects approach produced results which show that economic growth had an insignificant positive impact on unemployment.

The study noted that infrastructural development had a non-significant negative impact on unemployment across the three panel data analysis methods. The results generally agree with the labour markets theory which was supported by Smith (2003) in that transport and communications infrastructure investment and development reduces unemployment.

Borrowing from the vicious cycle of poverty hypothesis argued by Azher (1995), that poverty leads to more poverty, unemployed people are likely not be able to afford quality education for their children, itself a contributor to unemployment among their children. This lag of unemployment as a source of unemployment is captured in equation 4 which is estimated using the Arellano and Bond's (1991) dynamic GMM approach.

$$UNEMPL_{it} = \beta_0 + \beta_1 UNEMPLLAG_{it} + \beta_1 ICT_{it} + \beta_2 HCD_{it} + \beta_3 (ICT_{it} \,.\, HCD_{it}) + \beta_4 FIN_{it} + \beta_5 FDI_{it} + \beta_6 OPEN_{it} + \beta_7 POP_{it} + \beta_8 GROWTH_{it} + \beta_9 INFR_{it} + \varepsilon it \quad [4]$$

Table 10. Dynamic Generalised Methods of Moments (GMM) Results

	Co-efficient	Standard Error	t-Statistic
UNEMPLLAG	0.9609***	0.0231	41.6324
ICT	-0.1657	0.5133	-0.3227
HCD	-0.2262	0.5131	-0.4409
ICT.HCD	-0.0079**	0.0037	-2.1218
FIN	0.0607	0.0407	1.4903
FDI	0.0187**	0.0093	2.0076
OPEN	-0.0267	0.0503	-0.5303
POP	0.0586	0.0499	1.1744
GROWTH	0.0369	0.0265	1.3928
INFR	-0.0016	0.0162	-0.1017
Adjusted R-squared	0.9616		
J-statistic	214.00		
Prob (J-statistic)	0.00		

****, ** and * denote 1%, 5% and 10% levels of significance, respectively.*

Source: Author's compilation from E-Views

The dynamic GMM approach found out that the lag of unemployment had a significant positive impact on unemployment, in line with the argument put forward in the vicious cycle of poverty that poverty leads to more poverty and unemployment causes even more unemployment (Azher. 1995).

ICT had an insignificant negative influence on unemployment (reduced unemployment), a view which was shared by Vivarelli (2007) that new technologies new technologies create new investments thereby opening new opportunities for the

unemployed people. Consistent with Samiullah (2014) who opined that human capital development improves the productivity of the people by equipping them with the necessary job skills and thereby improving their employability, the dynamic GMM observed a non-significant negative relationship running from human capital development towards unemployment. The dynamic GMM also shows that the interaction between ICT and human capital development had a significant negative influence on unemployment, in line with an argument by Samiullah (2014) who noted that once the people are well equipped with necessary skills to carry out production, they can easily use the new developed technologies to their advantage for unemployment reduction purposes.

A non-significant positive relationship running from financial management towards unemployment was also detected under the dynamic GMM method, a finding which support International Monetary Fund's (2015) argument that developed financial markets can have a deleterious effect on employment. In line with Irpan's (2016) argument that certain foreign investors might contribute towards unemployment by demanding to bring into the host country their own unskilled labour force, the dynamic GMM method found out that financial development had a significant positive effect on unemployment.

The dynamic GMM noted that trade openness had a non-significant negative effect on unemployment. The finding resonates with Mitra and Ranjan (2010) whose study noted that trade openness enables easy participation of local firms on the international arena hence enabling them to enjoy advantages such as local, regional and international expansion. Population growth was also found to have an insignificant positive influence on unemployment, in agreement with Aiyedogbon (2012) whose study observed that high population growth exacerbate unemployment.

In contradiction to theory but in line with Abdul-Khaliq et al's (2014) findings, the dynamic GMM noted the existence of a non-significant positive relationship running from economic growth towards unemployment in Africa. Finally, infrastructural development was found to have had an insignificant negative impact on unemployment in the case of Africa. Such a finding is generally consistent with the labour markets theory as argued by Smith (2003).

5. Summary of the Study

The main aim of this study is to explore the macroeconomic determinants of unemployment in Africa using panel data analysis with data spanning from 2001 to 2015. For comparison purposes, panel data analysis methods include fixed effects, random effects, pooled OLS and the dynamic GMM, a method which is superior in that it takes care of the dynamic features of unemployment data and the endogeneity

problem. Across all the four econometric estimation methods used, the variables which were found not to be significant determinants of unemployment include information and communication technology, human capital development and infrastructural development. The dynamic GMM method observed that the lag of unemployment exacerbated unemployment in Africa. All the four econometric approaches used produced results which show that FDI increased unemployment in the African continent. African authorities are therefore urged to ensure that they implement policies which ensures that the inflow of FDI translates into easing unemployment woos in the continent. The random effects and pooled OLS noted that financial development had a significant positive effect on unemployment in the case of Africa. The relevant African authorities should therefore implement programmes and policies that enhances the poor people's financial inclusion so that they can benefit from developed financial markets. As expected and justified by literature, the pooled OLS shows that trade openness and population growth had a significant positive impact on unemployment in Africa. However, the interaction between ICT and human capital development was found to have had a significant negative influence on unemployment across all the four econometric estimation approaches. Africa is therefore urged to enhance human capital development if they intend to economically benefit from new technologies especially during the present day 4th industrial revolution otherwise their people becomes redundant. As expected, fixed effects and pooled OLS methods shows that economic growth had a significant negative influence on unemployment in Africa. It is against this backdrop that the study urges African authorities to implement growth-oriented policies if they intend to reduce unemployment in the region.

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