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CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

The following study is aimed at examining the effect of institutional quality on infrastructure investment in SSA region. In this context, the descriptive statistics, correlation analysis, FE regression, Pooled OLS regression and GMM methods are applied to get the results. The following section presents the results of this study.

4.2 Descriptive Analysis

Variables	Mean	Standard Deviation
Infrastructure	8.51	1.49
GDP per capita	1706	2909.863
Savings	17.37	17.02271
Inflation	274	2405.398
Grants	19267417	59208266
FDI	533000000	132000000
Institutions	0.36	0.130894
Interest rate	11.94	31.52342

The following table above describes the descriptive statistics for the study. This shows that infrastructure investment over the past 21 years has shown variation by 1.49 units showing low standard deviation. Secondly, the GDP per capita shows a large standard deviation that is deviation from mean by 2909 units which is even higher than the mean showing macroeconomic instability in most of the regions among the sample due to which GDP per capita has a high standard deviation. The savings expressed as a percentage of GDP has shown that mean and standard deviation are almost equal for the countries thus there are no significant changes in the savings variable. The inflation shows a mean value of 274%

while the standard deviation is 2405% which is high value. Inflation occurs when the value of money decreases and prices of goods increase. Thus, the high standard deviation for the sub-Saharan African countries have indicated that there is macroeconomic instability in the country because of inflation showing a great deviation from the mean value This is because many countries have high inflation including Zimbabwe having inflation of over 29000% in its economy as compared to standard consumer price index. Thirdly, the grants have shown a high value which means macroeconomic instability exists in the study. Then, the FDI is investigated which shows a low value as compared to mean and shows that macroeconomic instability is not much worse in the case of FDI in SSA. Then, the institutional quality is investigated expressed as a percentage of each variable which is measured on a scale of -2.5 to +2.5 where the negative value close to 2.5 shows worse indication of institutional quality and positive value close to 2.5 indicates high institutional quality in the country. The mean score is 0.36 which is a mediocre score in terms of percentage while the overall score as in negative for most of the estimates and most of countries showing that institutional quality has been in poor from in the SSA region. However, standard deviation is low at 0.13 showing that scores do not mediate but still is a sign of danger for the SSA economies as they are already reflecting poor institutional quality. Then, the interest rate for the country has been shown which also reflects a high percentage of over 34% indicating real interest rate is unstable and overall, macroeconomic instability exists and prevails in the country.

4.3 Panel Unit Root

Group unit root test: Summary
Series: EXCHANGE_RATE, FDI, GDP_PER_CAPITA, GRANTS__CURRENT _US$_, INFLATION, INFRASTRUCTURE_DEVELOPME, INSTITUTIONAL_QUALITY, REAL_INTEREST_RATE____, SAVINGS
Date: 10/26/17 Time: 16:46
Sample: 1 840
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 11
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.19157	0.0000	9	7526
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-19.4517	0.0000	9	7526
ADF - Fisher Chi-square	408.199	0.0000	9	7526
PP - Fisher Chi-square	708.743	0.0000	9	7551

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

The above depicted image illustrates the results of a panel unit root test which is the testing of unit root in the data set combining all the observations and variables. The criterion for Levin, Lin & Chu, IPS, Fisher – ADF and Fisher – PP test the null hypothesis as the presence of a unit root in the data set indicating that data is not stationary. From the probability or p-values in the output image above shows 0.0000 which is lesser than statistical significance level thus indicating that null hypothesis has been rejected. In other words, it can be stated that the data is stationary and no presence of unit root is observed.

4.4 Unit Root – ADF

Null Hypothesis: EXCHANGE_RATE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.276219	0.0000
Test critical values:	1% level	-3.437920	
	5% level	-2.864771	
	10% level	-2.568544	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXCHANGE_RATE)
Method: Least Squares
Date: 10/26/17 Time: 17:12
Sample (adjusted): 2 840
Included observations: 839 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCHANGE_RATE(-1)	-0.149942	0.018117	-8.276219	0.0000
C	0.060585	0.007638	7.931873	0.0000

R-squared	0.075645	Mean dependent var	0.000210
Adjusted R-squared	0.074540	S.D. dependent var	0.068155
S.E. of regression	0.065566	Akaike info criterion	-2.609134
Sum squared resid	3.598192	Schwarz criterion	-2.597854
Log likelihood	1096.532	Hannan-Quinn criter.	-2.604811
F-statistic	68.49579	Durbin-Watson stat	2.054875
Prob(F-statistic)	0.000000		

The ADF test for testing unit root for exchange rate is determined. Based on the criterion for statistical significance, it has been determined that data for exchange rate is stationary and does not contain unit root because the probability value is 0.000 which is less than 0.05 indicating rejection of null hypothesis. Therefore, the data for exchange rate is stationary.

Null Hypothesis: FDI has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.255874	0.0000
Test critical values:	1% level	-3.437957	
	5% level	-2.864787	
	10% level	-2.568553	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FDI)
Method: Least Squares
Date: 10/26/17 Time: 17:20
Sample (adjusted): 6 840
Included observations: 835 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI(-1)	-0.216716	0.029868	-7.255874	0.0000
D(FDI(-1))	-0.195538	0.039889	-4.902072	0.0000
D(FDI(-2))	-0.131914	0.038985	-3.383740	0.0007
D(FDI(-3))	-0.092395	0.037328	-2.475201	0.0135
D(FDI(-4))	0.036180	0.034631	1.044732	0.2965
C	1.14E+08	35860877	3.192868	0.0015

R-squared	0.183882	Mean dependent var	139638.9
Adjusted R-squared	0.178959	S.D. dependent var	1.03E+09
S.E. of regression	9.29E+08	Akaike info criterion	44.14526
Sum squared resid	7.16E+20	Schwarz criterion	44.17923
Log likelihood	-18424.65	Hannan-Quinn criter.	44.15829
F-statistic	37.35685	Durbin-Watson stat	1.989638
Prob(F-statistic)	0.000000		

Next, the data for FDI was investigated and it has been analysed that there is no unit root in the data set because of significance value being less than 0.05 and therefore, the null hypothesis is rejected. The data for FDI is stationary and there is no unit root in data set.

Null Hypothesis: GDP_PER_CAPITA has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.099593	0.0000
Test critical values:	1% level	-3.437948	
	5% level	-2.864783	
	10% level	-2.568551	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP_PER_CAPITA)
Method: Least Squares
Date: 10/26/17 Time: 17:21
Sample (adjusted): 5 840
Included observations: 836 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP_PER_CAPITA(-1)	-0.084939	0.011964	-7.099593	0.0000
D(GDP_PER_CAPITA(-1))	0.098439	0.033903	2.903512	0.0038
D(GDP_PER_CAPITA(-2))	0.162369	0.033987	4.777429	0.0000
D(GDP_PER_CAPITA(-3))	0.126548	0.034448	3.673552	0.0003
C	147.3331	38.66160	3.810840	0.0001

R-squared	0.083615	Mean dependent var	4.491260
Adjusted R-squared	0.079204	S.D. dependent var	990.8681
S.E. of regression	950.8182	Akaike info criterion	16.55849
Sum squared resid	7.51E+08	Schwarz criterion	16.58677
Log likelihood	-6916.447	Hannan-Quinn criter.	16.56933
F-statistic	18.95610	Durbin-Watson stat	1.990257
Prob(F-statistic)	0.000000		

The GDP per capita is also investigated in the unit root test. The test illustrated that there is no unit root in data set and data is stationary over the time period. This has been concluded based on the significance value which is 0.0000 less than alpha value of 0.05 thus, the null hypothesis is rejected for GDP per capita.

Null Hypothesis: GRANTS__CURRENT_US$_ has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.265564	0.0000
Test critical values:	1% level	-3.437929	
	5% level	-2.864775	
	10% level	-2.568547	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GRANTS__CURRENT_US$_)
Method: Least Squares
Date: 10/26/17 Time: 17:24
Sample (adjusted): 3 840
Included observations: 838 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GRANTS__CURRENT_US$_(-1)	-0.205013	0.024803	-8.265564	0.0000
D(GRANTS__CURRENT_US$_(-1))	-0.252833	0.033482	-7.551303	0.0000
C	3959501.	1446378.	2.737528	0.0063

R-squared	0.192348	Mean dependent var	0.000000
Adjusted R-squared	0.190414	S.D. dependent var	43907905
S.E. of regression	39507020	Akaike info criterion	37.82543
Sum squared resid	1.30E+18	Schwarz criterion	37.84237
Log likelihood	-15845.85	Hannan-Quinn criter.	37.83192
F-statistic	99.43073	Durbin-Watson stat	2.007985
Prob(F-statistic)	0.000000		

The next variable investigated was grants to countries in terms of US dollars. The results showed that data for grants is stationary and unit root is not observed in the data set. This is because the probability value is 0.0000 less than 0.05 indicating rejection of null hypothesis and thus, the data is said to be stationary.

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.348049	0.0000
Test critical values:	1% level	-3.437929	
	5% level	-2.864775	
	10% level	-2.568547	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INFLATION)
Method: Least Squares
Date: 10/26/17 Time: 17:31
Sample (adjusted): 3 840
Included observations: 838 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION(-1)	-0.144611	0.019680	-7.348049	0.0000
D(INFLATION(-1))	-0.119786	0.034029	-3.520088	0.0005
C	38.02348	45.60263	0.833800	0.4046

R-squared	0.095578	Mean dependent var	-0.105940
Adjusted R-squared	0.093412	S.D. dependent var	1376.847
S.E. of regression	1310.963	Akaike info criterion	17.19849
Sum squared resid	1.44E+09	Schwarz criterion	17.21542
Log likelihood	-7203.166	Hannan-Quinn criter.	17.20498
F-statistic	44.12090	Durbin-Watson stat	2.002463
Prob(F-statistic)	0.000000		

The data was inflation was furthermore analysed producing the same results as other variables indicating that data for inflation in terms of CPI and there is no unit root in the data due to significance value being 0.000 less than statistical alpha value of 0.05. Therefore, the data is considered to be stationary.

Null Hypothesis: INFRASTRUCTURE_DEVELOPME has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.209749	0.0000
Test critical values:	1% level	-3.437920	
	5% level	-2.864771	
	10% level	-2.568544	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INFRASTRUCTURE_DEVELOPME)
Method: Least Squares
Date: 10/26/17 Time: 17:34
Sample (adjusted): 2 840
Included observations: 839 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFRASTRUCTURE_DEVELOPME(-1)	-0.062761	0.012047	-5.209749	0.0000
C	53737438	20719720	2.593541	0.0097

R-squared	0.031409	Mean dependent var	273812.7
Adjusted R-squared	0.030251	S.D. dependent var	5.29E+08
S.E. of regression	5.21E+08	Akaike info criterion	42.98421
Sum squared resid	2.28E+20	Schwarz criterion	42.99549
Log likelihood	-18029.88	Hannan-Quinn criter.	42.98854
F-statistic	27.14149	Durbin-Watson stat	1.970817
Prob(F-statistic)	0.000000		

The data for infrastructure development and financing is also stationary because of significance value being 0.0000 that is less than acceptable value of 0.05 indicating that null hypothesis for ADF test is rejected. Therefore, it can be safely concluded that there is no unit root in the data set.

Null Hypothesis: INSTITUTIONAL_QUALITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.332525	0.0000
Test critical values:	1% level	-3.437920	
	5% level	-2.864771	
	10% level	-2.568544	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INSTITUTIONAL_QUALITY)
Method: Least Squares
Date: 10/26/17 Time: 17:35
Sample (adjusted): 2 840
Included observations: 839 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INSTITUTIONAL_QUALITY(-1)	-0.065793	0.012338	-5.332525	0.0000
C	0.024289	0.004749	5.114289	0.0000

R-squared	0.032857	Mean dependent var	0.000468
Adjusted R-squared	0.031702	S.D. dependent var	0.047472
S.E. of regression	0.046714	Akaike info criterion	-3.287182
Sum squared resid	1.826468	Schwarz criterion	-3.275902
Log likelihood	1380.973	Hannan-Quinn criter.	-3.282858
F-statistic	28.43583	Durbin-Watson stat	1.995405
Prob(F-statistic)	0.000000		

The institutional quality variable was investigated in this study opining that there is no unit root in data set and data is stationary. This is due to the significance value being 0.0000 less than 0.05 indicating the rejection of ADF null hypothesis. Conclusively, the data is stationary for institutional quality.

Null Hypothesis: REAL_INTEREST_RATE____ has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.489725	0.0000
Test critical values:	1% level	-3.437957	
	5% level	-2.864787	
	10% level	-2.568553	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REAL_INTEREST_RATE____)
Method: Least Squares
Date: 10/26/17 Time: 17:38
Sample (adjusted): 6 840
Included observations: 835 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REAL_INTEREST_RATE____(-1)	-0.332695	0.035058	-9.489725	0.0000
D(REAL_INTEREST_RATE____(-1))	0.042749	0.039360	1.086092	0.2778
D(REAL_INTEREST_RATE____(-2))	-0.121496	0.038639	-3.144401	0.0017
D(REAL_INTEREST_RATE____(-3))	0.096155	0.035450	2.712407	0.0068
D(REAL_INTEREST_RATE____(-4))	-0.100359	0.034071	-2.945578	0.0033
C	4.155502	0.911154	4.560703	0.0000

R-squared	0.213372	Mean dependent var	0.082329
Adjusted R-squared	0.208628	S.D. dependent var	26.17789
S.E. of regression	23.28762	Akaike info criterion	9.140880
Sum squared resid	449577.5	Schwarz criterion	9.174850
Log likelihood	-3810.317	Hannan-Quinn criter.	9.153903
F-statistic	44.97308	Durbin-Watson stat	2.005912
Prob(F-statistic)	0.000000		

The real interest rate which is a control variable in this study has been investigated and thus, it is determined that the data is stationary. The significance value is 0.000 which is lesser than 0.05 indicates the alternate hypothesis of the ADF test has been accepted and there is no unit root in the data set.

Null Hypothesis: SAVINGS has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.447844	0.0000
Test critical values:	1% level	-3.437938	
	5% level	-2.864779	
	10% level	-2.568549	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SAVINGS)
Method: Least Squares
Date: 10/26/17 Time: 17:41
Sample (adjusted): 4 840
Included observations: 837 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SAVINGS(-1)	-0.188029	0.025246	-7.447844	0.0000
D(SAVINGS(-1))	-0.170810	0.035834	-4.766658	0.0000
D(SAVINGS(-2))	-0.149232	0.033519	-4.452208	0.0000
C	3.269856	0.580207	5.635672	0.0000

R-squared	0.158745	Mean dependent var	0.020839
Adjusted R-squared	0.155715	S.D. dependent var	11.99926
S.E. of regression	11.02551	Akaike info criterion	7.643068
Sum squared resid	101261.1	Schwarz criterion	7.665672
Log likelihood	-3194.624	Hannan-Quinn criter.	7.651733
F-statistic	52.39578	Durbin-Watson stat	2.005199
Prob(F-statistic)	0.000000		

The study has tested the variable of savings in $US and has produced the results which have shown that there is no unit root in the data set because of probability value less than 0.05 which has rejected the null hypothesis for the study. Overall, the data is stationary for savings.

Overall from the ADF test for all variables, it has been determined that all variables have a stationary data and no presence of unit root is observed in either of the variables.

4.5 Correlation Analysis

Correlation	EXCHANGE...	FDI	GDP_PER_...	GRANTS__...	INFLATION	INFRASTRU...	INSTITUTIO...	REAL_INTE...	SAVINGS
EXCHANGE_RATE	1.000000								
FDI	0.051659	1.000000							
GDP_PER_CAPITA	0.408707	0.129369	1.000000						
GRANTS__CURR...	0.068996	0.050753	-0.126610	1.000000					
INFLATION	0.047701	-0.019776	-0.034454	-0.037620	1.000000				
INFRASTRUCTUR...	0.056233	0.643088	0.038498	0.048919	0.093376	1.000000			
INSTITUTIONAL_Q...	0.197484	0.038841	0.343063	-0.163069	-0.126764	0.033132	1.000000		
REAL_INTEREST_...	0.009988	-0.036348	-0.048920	-0.032672	0.722973	0.050174	-0.078475	1.000000	
SAVINGS	0.085009	0.016671	0.381393	-0.037823	-0.071193	-0.026901	0.142321	-0.086480	1.000000

The above table shows the correlation analysis conducted to analyse the relationship between institutional quality, infrastructure investment and other variables reflecting upon the macroeconomic variables in the study. As the dependent variable for this study is infrastructure development, the relationship of infrastructure development with other variables is investigated. The results from the study show the coefficient for the relationship between different variables. The infrastructure development has a weak relationship with exchange rate of the 40 SSA countries in this context. This shows that even if the exchange rate goes up or comes down, the infrastructure development does not get affected. Then, the infrastructure relationship has been examined with the foreign direct investment (FDI). The coefficient shows that there is a 64.3% relationship between infrastructure and FDI which shows that increase in FDI leads to infrastructure development and no investment in the country through FDI leads to slow or no infrastructure development. Then, the relationship of infrastructure with grants is determined through the analysis and it has been noted that there is 0.04 or 4% relationship between the two variables showing that grants has a negligible relationship with infrastructure. This shows that even if the grants increase or decrease, there will be slight change in infrastructure. Then, the inflation has been investigated with the infrastructure and it has been investigated that there is 9% relationship between the variables. This shows that inflation in the country does not have any effect on infrastructure development within the SSA region. In the correlation, it has also been determined that there

is a weak and negligible relationship between infrastructure investment and institutional quality with regards to political and economic institutions. This tends to show that even if the institutional quality is high and effective, it would have no relationship with the infrastructure development within the country. Then, the relationship of infrastructure with real interest rate has been determined and it has been investigated that there is a 5% relationship between real interest rate and infrastructure development showing a weak impact. Then, the last impact investigated is of infrastructure development and savings for the country. It has been investigated that savings and infrastructure development are negatively correlated but the relationship is very weak having a value of 2%.

Overall from the results, it has been examined that institutional quality has a weak and negligible relationship with infrastructure development showing that the variables do not influence each other. Among the other macroeconomic variables, it has been determined that FDI has a significant impact on infrastructure development and financing while others have a weak relationship with it.

4.6 Pooled OLS Regression – Fixed Effects

Dependent Variable: INFRASTRUCTURE_DEVELOPME
Method: Pooled Least Squares
Date: 09/12/17 Time: 22:07
Sample: 1 840
Included observations: 840
Cross-sections included: 9
Total pool (balanced) observations: 7560

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.78E+08	58311758	3.058316	0.0022
EXCHANGE_RATE	4.20E+08	1.16E+08	3.611879	0.0003
FDI	0.733573	0.009945	73.76416	0.0000
GDP_PER_CAPITA	-32256.31	5580.158	-5.780537	0.0000
GRANTS__CURRENT_US$_	0.395804	0.226550	1.747094	0.0807
INFLATION	70890.68	7893.904	8.980434	0.0000
INSTITUTIONAL_QUALITY	4.67E+08	1.08E+08	4.320477	0.0000
REAL_INTEREST_RATE____	-460262.4	598249.2	-0.769349	0.4417
SAVINGS	-1289581.	831610.0	-1.550704	0.1210
Fixed Effects (Cross)				
EXCHANGERATE--C	-2.85E-06			
FDI--C	-2.85E-06			
GDPPERCAPITA--C	-2.85E-06			
GRANTS--C	-2.85E-06			
INFLATION--C	-2.85E-06			
_INFRASTRUCTUREDEVE...	-2.85E-06			
INSTITUTIONALQUALITY...	-2.85E-06			
REALINTERESTRATE--C	-2.85E-06			
SAVINGS--C	-2.85E-06			

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.429713	Mean dependent var	8.51E+08
Adjusted R-squared	0.428504	S.D. dependent var	1.49E+09
S.E. of regression	1.13E+09	Akaike info criterion	44.52927
Sum squared resid	9.61E+21	Schwarz criterion	44.54486
Log likelihood	-168303.6	Hannan-Quinn criter.	44.53462
F-statistic	355.2302	Durbin-Watson stat	0.511368
Prob(F-statistic)	0.000000		

The Pooled OLS regression is an estimated technique applied to panel data analysis that is used to extract and generate unbiased consistent estimates of regression parameters even if there is a time constraint. Here, the fixed and random effect is investigated separately for fixed and random effects.

The fixed effect model is presented above which shows the impact of different macroeconomic variables on the infrastructure development and financing in the Sub-Saharan

African region. The results from the study have shown that all of the variables except for savings and real interest rate have a significant impact on infrastructure development. This tends to show that exchange rate, foreign direct investment, GDP per capita, grants, inflation, and institutional quality significantly impact the infrastructure development. As per the coefficients regarding the main aim of study that is to analyse the effect of institutional quality on infrastructure development, it has been determined that one unit change in institutional quality will lead to a 4.67 unit change in infrastructure development with a significance value of 0.0000 which is less than 0.05 indicating significant impact. This tends to show that impact is strong and it is necessary under the fixed effect results to better the quality of institutions within the Sub-Saharan African region with respect to control of corruption, political stability, rule of law, regulatory quality, voice and accountability, and government effectiveness should be made better for better infrastructure development within the Sub-Saharan African region.

The R-squared value shows that overall from the model all the independent variables explain 42.9% variance in the dependent variable of study. The Adjusted R-squared is an advanced value of R-squared which eliminates the value of regressor having insufficient power to explain the model. The Adjusted R-squared value in this context is 38.2% showing that originally, the independent variables overall explain 42.8% variance in dependent variable of model.

Overall from the fixed effect regression analysis, it has been determined that there is a significant overall impact because of probability at the bottom half of the table presents a p-value of 0.000 which is less than 0.05 indicating overall significance of impact of all independent variables on the dependent variable.

4.7 Pooled OLS Regression – Random Effects

The second analysis conducted in this context relates to the presentation of random effect model results. The random effect model is the hierarchical linear model which tends to show that data is drawn from different populations that are present in a hierarchy and their differences are related to that hierarchy. The results extracted from the analysis are presented as follows as part of output from E-views software.

Dependent Variable: INFRASTRUCTURE_DEVELOPME
Method: Pooled EGLS (Cross-section random effects)
Date: 09/12/17 Time: 22:10
Sample: 1 840
Included observations: 840
Cross-sections included: 9
Total pool (balanced) observations: 7560
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.78E+08	58311758	3.058316	0.0022
EXCHANGE_RATE	4.20E+08	1.16E+08	3.611879	0.0003
FDI	0.733573	0.009945	73.76416	0.0000
GDP_PER_CAPITA	-32256.31	5580.158	-5.780537	0.0000
GRANTS__CURRENT_US$_	0.395804	0.226550	1.747094	0.0807
INFLATION	70890.68	7893.904	8.980434	0.0000
INSTITUTIONAL_QUALITY	4.67E+08	1.08E+08	4.320477	0.0000
REAL_INTEREST_RATE____	-460262.4	598249.2	-0.769349	0.4417
SAVINGS	-1289581.	831610.0	-1.550704	0.1210
Random Effects (Cross)				
EXCHANGERATE--C	0.000000			
FDI--C	0.000000			
GDPPERCAPITA--C	0.000000			
GRANTS--C	0.000000			
INFLATION--C	0.000000			
_INFRASTRUCTUREDEVE...	0.000000			
INSTITUTIONALQUALITY...	0.000000			
REALINTERESTRATE--C	0.000000			
SAVINGS--C	0.000000			

Effects Specification			
		S.D.	Rho
Cross-section random		0.000000	0.0000
Idiosyncratic random		1.13E+09	1.0000
Weighted Statistics			
R-squared	0.429713	Mean dependent var	8.51E+08
Adjusted R-squared	0.429109	S.D. dependent var	1.49E+09
S.E. of regression	1.13E+09	Sum squared resid	9.61E+21
F-statistic	711.2138	Durbin-Watson stat	0.511368
Prob(F-statistic)	0.000000		
Unweighted Statistics			
R-squared	0.429713	Mean dependent var	8.51E+08
Sum squared resid	9.61E+21	Durbin-Watson stat	0.511368

The second table in this study has been investigated related to Pooled OLS regression but this time, the random effects have been analysed for the model. From the analysis, it can be observed that results for the main variables of the study are identical for the independent and dependent variables showing that institutional quality have a significant impact on the dependent variable of infrastructure development indicating that improving the quality of infrastructure leads to infrastructure development in the country that further helps in closing the gap of $93 billion in the Sub Saharan African region.

The R-squared value shows that overall from the model all the independent variables explain 42.9% variance in the dependent variable of study. The Adjusted R-squared is an advanced value of R-squared which eliminates the value of regressor having insufficient power to explain the model. The Adjusted R-squared value in this context is 42.97% showing that originally, the independent variables overall explain 42.91% variance in dependent variable of model.

4.8 Generalised Method of Moments

Dependent Variable: INFRASTRUCTURE_DEVELOPME
Method: Generalized Method of Moments
Date: 09/12/17 Time: 22:26
Sample: 1 840
Included observations: 840
Linear estimation with 1 weight update
Estimation weighting matrix: HAC (Bartlett kernel, Newey-West fixed bandwidth = 7.0000)
Standard errors & covariance computed using estimation weighting matrix
Instrument specification: EXCHANGE_RATE FDI GDP_PER_CAPITA GRANTS__CURRENT_US$_ INFLATION REAL_INTEREST_RATE___ _ SAVINGS
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.20E+09	6.42E+08	3.428019	0.0006
INSTITUTIONAL_QUALITY	-4.45E+09	1.75E+09	-2.536313	0.0114

R-squared	-0.208486	Mean dependent var	8.51E+08
Adjusted R-squared	-0.209928	S.D. dependent var	1.49E+09
S.E. of regression	1.64E+09	Sum squared resid	2.26E+21
Durbin-Watson stat	0.111642	J-statistic	10.66224
Instrument rank	8	Prob(J-statistic)	0.099393

The last analysis technique applied in this case is the Generalised Methods of Moments which is another parameter estimation technique similar to regression analysis. The GMM regression is applied for the finite dimension where maximum likelihood cannot be applied and therefore, the GMM is used. From the analysis above, it can be observed that institutional quality which is the independent variable in this study and estimated through six other variables which reflect the institutional quality of variables. The significance value of 0.01 which is less than 0.05 indicates a significant impact of institutional quality on infrastructure development and financing which indicates that effect of institutional quality on infrastructure development is noteworthy because improving the institutional quality of economic and political institutions will help in determining the development and financing infrastructure.

The overall impact, however, is significant at 10% level indicating a p-value of 0.09 showing that under 10% significance level, the impact of institutional quality and other macroeconomic variables on the infrastructure development is significant.

4.9 Co-integration (FMOLS)

The fully modified least square (FMOLS) is used for determining the cointegration using variables for correcting the problem of endogeneity and serial correlation. This test has been applied in this study to test the cointegration between dependent and independent variables in the study. The results from the test are as follows.

Dependent Variable: INFRASTRUCTURE_DEVELOPME
Method: Fully Modified Least Squares (FMOLS)
Date: 10/26/17 Time: 16:09
Sample (adjusted): 2 840
Included observations: 839 after adjustments
Cointegrating equation deterministics: C
Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 7.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCHANGE_RATE	3.60E+08	7.42E+08	0.485006	0.6278
FDI	0.954747	0.063410	15.05664	0.0000
GDP_PER_CAPITA	-49867.92	35600.00	-1.400784	0.1617
GRANTS__CURRENT_US$_	0.508587	1.444580	0.352066	0.7249
INFLATION	100006.2	51736.49	1.932991	0.0536
INSTITUTIONAL_QUALITY	7.48E+08	6.89E+08	1.085747	0.2779
REAL_INTEREST_RATE____	-235740.0	3933533.	-0.059931	0.9522
SAVINGS	-2877438.	5349810.	-0.537858	0.5908
C	31168518	3.73E+08	0.083659	0.9333

R-squared	0.388832	Mean dependent var	8.52E+08
Adjusted R-squared	0.382941	S.D. dependent var	1.49E+09
S.E. of regression	1.17E+09	Sum squared resid	1.14E+21
Durbin-Watson stat	0.729902	Long-run variance	5.76E+18

The results from the study indicate that except for FDI, none of the variables are cointegrated with the dependent variable of infrastructure development and financing which shows that FDI in the 40 SSA countries selected, foreign direct investments can aid in financing and development of infrastructure in SSA region. Moreover, the coefficient for FDI shows that 1 unit increase in FDI leads to 0.95 unit increase in infrastructure development

and financing showing that FDI positively contributes to infrastructure development and financing. The R-squared value shows that overall from the model all the independent variables explain 38.8% variance in the dependent variable of study. The Adjusted R-squared value in this context is 38.2% showing that originally, the independent variables overall explain 38.2% variance in dependent variable of model.

However, the results of FMOLS test deteriorate from the Pooled OLS regression and GMM which has determined a significant impact of institutional quality on infrastructure and development. Yet in the FMOLS test, the cointegration of institutional quality with infrastructure financing and development is not significant.

4.10 Discussion

Objective 1: To identify and examine the determinants of institutional quality that contributes towards infrastructure development and financing in Sub-Saharan African countries.

The first objective of the study was to shed light upon the determinants of institutional quality that contribute towards infrastructure development and financing in the Sub-Saharan African region. This objective is achieved through the literature review and data collection process where the study of Kauffmann, Kraay and Mastruzzi (2009) is referred for institutional quality variables and it has been determined that there are six notable determinants of institutional quality that help in predicting the infrastructure development and financing in the Sub-Saharan African region. The determinants are control of corruption, government effectiveness, political instability and absence of violence/terrorism, rule of law, regulatory quality and voice and accountability. The control of corruption refers to the extent to which public power is used for private gain. The second is the government effectiveness which reflects upon the availability of government service quality and civil service against

any political pressure. The political instability and absence of violence/terrorism reflects upon the perception of general public regarding political instability and the absence of terrorism or violence from the country. The rule of law reflects the confidence of public in the law of country and its judicial system to which people abide by the rules. The regulatory quality reflects regarding the soundness of policies formulated by the government of any country for the welfare of its people. Lastly, the voice and accountability reflects the perception of extent to which people have the power to take decisions and select their own government.

Objective 2: To examine the effect of institutional quality on SSA infrastructure development.

The second objective was to examine the effect of institutional quality on SSA infrastructure development. From the analysis where several techniques have been applied such as Pooled OLS, both fixed effect and random effect model, and Generalised Method of Moments technique has been applied which tests the effect of institutional quality on the infrastructure development in Sub Saharan African countries. However, the FMOLS regression has shown that institutional quality is not cointegrated with infrastructure development and financing in the Sub-Saharan Africa region. From the results of Pooled OLS regression analysis for fixed and random effects, the results are almost identical showing that the effect of institutional quality on infrastructure development within the Sub-Saharan African region. Secondly, the GMM technique has also tested the effect of institutional quality on infrastructure development. The results have shown that there is a significant and positive effect of institutional quality on infrastructure development.

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