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SECTION 4: DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

The following research study is based on examining the financing mechanism and its role in the infrastructure development in the Sub-Saharan African region. Based on previous two essays the examined the nexus between infrastructure development and growth in SSA and the impact of institutional quality on SSA infrastructure, this essay is the third essay that assesses the financing mechanism for the SSA for pre-colonial, colonial and post-colonial period for 40 SSA countries. Defining the periods considered in this study, the pre-colonial era data has been taken from 1920 to 1945 as per the data availability, the colonial data is from 1946 to 1960 and period of 1960 onwards is the post-colonialism or the independence period for SSA. The research has followed a mixed design of research where the data is analysed through quantitative techniques and the qualitative techniques are also used to analyse the three periods that why the gap exists and role of institutional policies in the infrastructure development. Moreover, the qualitative part of the analysis critiques the current infrastructure financing frameworks available that are traditional model, western model, and Chinese infrastructure for resource model. Thus, the study has followed a qualitative and econometrics approach.

4.2 Descriptive Analysis

4.2.1 Pre Colonialism

Pre Colonial	
Mean	822951597.2
Standard Deviation	2422566641
Minimum	1011125
Maximum	21031989204

The pre-colonial period statistics are described above which show that mean investment during that period was $0.8 billion in the infrastructure projects from 1920 to 1945. The standard deviation from the mean is low at $2.4 billion shows a large standard deviation from the mean across the countries in the Sub-Saharan African region. The minimum investment $1.01 million while the maximum investment across the countries in all sectors is $21 billion in Burkina Faso. The minimum and maximum values show huge differences in the values showing the instability in investment. Secondly, the standard deviation is higher than mean showing unrealistic difference in investment in SSA region.

4.2.2 Colonialism

During Colonial	
Mean	740053146.2
Standard Deviation	1909492707
Minimum	2953000
Maximum	21388400685

The period during colonialism where the colonial powers were dominant and before leaving the African continent to independence is considered from 1946 to 1960. The mean investment in SSA region over the colonialism period is $0.74 billion among which, most of the investment has been done in the transport and railway lines to use the continent for its own advantage. The standard deviation from the mean was around $1.9 billion showing that there is vast different from the mean value because of uneven investment over the years for all the 40 countries considered in the study. Moving forward, the minimum investment in the SSA region during colonialism is $2.9 million. The maximum investment is $21.3 billion in the infrastructure development over the colonial years in the Equatorial Guinea. The uneven investment in the region is due to excessive investment in transport and rail lines during the colonial period.

4.2.3 Post Colonialism

Post Colonialism	
Mean	1200682436
Standard Deviation	2256187569
Minimum	2809611.429
Maximum	22556955789

The post colonialism or the independence period for SSA regions when the colonial powers of British and France left Africa was from 1960 onwards where Ghana was the first state to gain independence under African rule in 1957. In the post colonialism period, the infrastructure development has been immense in the country but still lacks the benchmarking needs for the region. The mean investment in the region was approximately $1.2 billion which is more than the previous pre-colonial and colonial period. The standard deviation, on the other hand, is high as compared to mean at $2.2 billion which again shows uneven investment without planning. The minimum investment in this context was at $2.80 million. The maximum investment in the post colonialism period which is estimated at around $22.5 billion has been in Republic of Congo. However, different from the first two periods, the investment has been diversified over the power, transportation, water and ICT sectors for physical infrastructure development.

4.3 Panel Regression

The panel regression analysis has been conducted for all the periods that are pre-colonial, colonial and post-colonial eras. The regression have been conducted for determining the impact of infrastructure investment and financing on the infrastructure development in SSA region based on a sample size of 40 countries for all periods. In the quantitative aspect, the investment level is taken irrespective of sources financing the activities of infrastructure which have been studied in the qualitative part of analysis.

4.3.1 Pre Colonialism

Dependent Variable: INFRASTRUCTURE
Method: Least Squares
Date: 09/19/17 Time: 18:35
Sample: 1 1040
Included observations: 1039

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFRASTRUCTURE_FINANCI...	-0.094362	0.017884	-5.276358	0.0000
C	1.14E+09	45758756	24.97646	0.0000

R-squared	0.026145	Mean dependent var	1.07E+09
Adjusted R-squared	0.025206	S.D. dependent var	1.41E+09
S.E. of regression	1.40E+09	Akaike info criterion	44.95420
Sum squared resid	2.02E+21	Schwarz criterion	44.96372
Log likelihood	-23351.70	Hannan-Quinn criter.	44.95781
F-statistic	27.83995	Durbin-Watson stat	0.119760
Prob(F-statistic)	0.000000		

The panel regression is conducted for the pre-colonialism period and it has been analysed through panel data estimation that infrastructure financing has a significant impact on the infrastructure development within the SSA region. This is because the significance value of the impact denoted by probability value is 0.0000 which is less than 0.05 which is threshold for statistical significance. However, through the analysis it has been found that there is a negative impact of infrastructure financing on development in infrastructure across countries. The impact is negative but is not adverse as the coefficient or beta shows a value of 9.4 units indicating that if financing increases by 1 unit, the infrastructure development decreases by 9.4 units. These results do not indicate the involvement of institutional policies and method of financing due to which, the results are negative. The R-squared shows the big picture indicating that overall, infrastructure financing varies infrastructure development by 2. 6% but a positive variation is observed in the overall model. The variation is, however, slight not adverse. Moreover, probability values for the model show a value of 0.0000 which indicate that there is an overall significant impact of infrastructure financing on infrastructure development.

4.3.2 Colonialism

Dependent Variable: INFRASTRUCTURE
Method: Least Squares
Date: 09/19/17 Time: 19:53
Sample: 1 600
Included observations: 600

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFRASTRUCTURE_FINANCI...	-0.042150	0.018455	-2.283985	0.0227
C	5.55E+08	37765353	14.70219	0.0000

R-squared	0.008648	Mean dependent var	5.24E+08
Adjusted R-squared	0.006990	S.D. dependent var	8.65E+08
S.E. of regression	8.62E+08	Akaike info criterion	43.99178
Sum squared resid	4.45E+20	Schwarz criterion	44.00644
Log likelihood	-13195.53	Hannan-Quinn criter.	43.99749
F-statistic	5.216587	Durbin-Watson stat	0.117016
Prob(F-statistic)	0.022722		

The results from the analysis show the results that even during the colonial period, infrastructure financing has a significant impact on infrastructure development within the Sub Saharan African region across all the 40 countries into consideration. The significance value for the impact is 0.02 which is less than acceptable level of statistical significance at 0.05 indicating that impact is significant. This is because in this region, the colonial powers invested in infrastructure but the budget was all allocated towards railways and transport rather than other sectors. Likewise of the previous analysis, it has been estimated that the impact is negative but is very minimal at 4.2 units indicating that if financing is increased by 1 unit, the infrastructure development decreases by 4.2 units and vice versa. From the bottom half of the analysis table, it has been determined that there is a positive but minimal impact overall for the model that is 0.8% yet in a positive direction. The overall probability is also at 0.02% indicating overall significance of model and impact of independent variable on the dependent variable.

4.3.3 Post Colonialism

Dependent Variable: INFRASTRUCTURE
Method: Least Squares
Date: 09/19/17 Time: 20:08
Sample: 1 2240
Included observations: 2238

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFRASTRUCTURE_FINANCI...	-0.152515	0.014943	-10.20637	0.0000
C	2.54E+09	38201603	66.38684	0.0000

R-squared	0.044514	Mean dependent var	2.35E+09
Adjusted R-squared	0.044087	S.D. dependent var	1.63E+09
S.E. of regression	1.60E+09	Akaike info criterion	45.21928
Sum squared resid	5.69E+21	Schwarz criterion	45.22438
Log likelihood	-50598.37	Hannan-Quinn criter.	45.22114
F-statistic	104.1699	Durbin-Watson stat	0.048136
Prob(F-statistic)	0.000000		

In the third estimation, the results are similar to previous two analyses where it has been observed that infrastructure financing in the Sub-Saharan African region across 40 countries has significantly impacted the infrastructure development in the region with respect to four sectors that are water & sanitation, energy, transport and ICT. However, it is to be noted here that ICT in the country was not introduced till 1994 because of technological breakthrough coming in early 90s around the world that led to the dot com bubble. The results have shown that there is a significant impact of infrastructure financing on the infrastructure development because of probability value being 0.0000 which is less than 0.05 indicating that impact of independent variable on the regressor is significant. However, again it has been observed that the impact is negative indicating a coefficient value of 15.25 units showing that 1 unit increase in infrastructure financing will lead to a decrease of 15.25 units in infrastructure development within SSA region. The overall impact, surprisingly, has been observed to be positive but nominal at 4.45% showing that infrastructure financing in this context helps in predicting the infrastructure development by 4.45%. Furthermore, the significance value of the model shows that impact of independent variable on the dependent variable is significant and the model used for the study is appropriate.

From the panel estimation, it has been determined that there is a significant impact of infrastructure financing on the infrastructure development in SSA region across 40 countries in pre-colonial, colonial period and post-colonial. However, the impact is determined to be negative across all regions.

4.4 Existing SSA Infrastructure Frameworks

The existing infrastructure frameworks in Sub-Saharan Africa that have been used to financing the infrastructure projects in the region have been the traditional model, the western model and the Chinese infrastructure for resource model. The study discusses each model with the strengths and weakness of each model and then explaining of how the model led to infrastructure gap in Sub Saharan Africa.

4.4.1 Traditional Model

The traditional model refers to the most common and widely used model in the countries for financing the infrastructure needs of the country. In this framework for infrastructure financing, the government is central authority where the infrastructure is financed through public funds such as taxes collected and own sources of finance from the national treasury of the country. This has also been discussed in the report presented by Organisation for Economic Cooperation and Development (OECD) in 2015 indicated that traditional model of infrastructure financing is through the public funds where the aim is to produce positive externalities for use by the general public. The traditional model is used to financing infrastructure projects but receiving taxes from the public and creating value for money by constructing roads, bridges, water sources, transport network and ICT for use by the general public (Buger and Hawkesworth, 2011).

The advantage for using this model is that there is no increase of debt on the government because the finances are available internally and no loan is required or no external source of finance is required because of having enough resources to back the

infrastructure project themselves. Secondly, the strength of this project is that the revenue from the projects in the form of taxes is for the government and no other parties or external authorities have the claim to that revenue in contrast to other models where debt financing for the infrastructure is to be paid with the interest creating additional burden on the government and other external authorities financing would also for share in the revenue (Ehlers, 2014). However, every model has certain weaknesses. In such kinds of model, the quality of institutions and their ability to effectively and efficiently utilise the public funds has been a key contribute to the financing model. Here, the public deficit is the foremost weakness where the increased public debt to GDP and inefficiency to deliver the investment spending has led to public deficits where the general public does not entrust the government with its finance (OECD, 2014).

In the Sub-Saharan Africa, it has been studied in the previous essay that institutional quality has been poor in the SSA region and thus, infrastructure development has been withheld due to poor institutional quality. This poor institutional quality has led to the infrastructure gap of $93 billion in SSA region through the traditional model where corruption is the most prominent challenge in infrastructure development. Due to corruption at rise, the SSA has not been able to effectively use the traditional model for infrastructure financing.

4.4.2 Western Model

The Western Model is also a commonly used model for the infrastructure investment in many parts of the world. In the Sub Saharan Africa, the Western model of financing has also been used in many countries of Africa where International Monetary Fund (IMF), World Bank and other development finance institutions help to finance the infrastructure in countries. According to Julca (2012), the infrastructure development in the SSA region has been led by the collaboration of World Bank and IMF with African Development Bank and

European Commission financed the infrastructure in SSA region through Western model of financing. This model comes with certain conditions such as Economic Structural Adjustment Programmes where the grants and loans are not provided to if there are no human rights or governance indicators. The strength of this model includes the huge amount of finance provided by these institutions because they are backed by assets and for this purpose, they provide financial and monetary aid to low income countries for financing their infrastructure needs and collect revenues in form of taxes from these facilities (Alacevich, 2011). Moreover, the financing is governed by the institutions themselves to ensure that funds are allocated efficiently for public benefits. However, there is certain disadvantage that the interest rate on these funds is much higher which restricts the government on excessive spending and the credibility of the country decreases because of being unable to pay off the loan acquired through these institutions. Furthermore, it allows the IMF and World Bank to intervene in the local operations and matters for the SSA region because of burden held by the African governments and countries (Gogo Kingston, 2011). This mode has been used by the African countries regularly.

In the current scenario of SSA, the high debt on the African governments for loans from IMF and the World Bank has led to the infrastructure gap because the previous grants have not been paid off and further loans cannot be provided individually from these authorities to countries. Thus, this has increased the infrastructure gap in SSA region across all the countries. For this reason, the authorities have formed a collaboration to finance the infrastructure development in SSA region for better outcomes by governing the project themselves.

4.4.3 Chinese Infrastructure for Resource Model

The model of Chinese infrastructure for resources model has been the fastest growing method of financing in most parts of the world where the developing economies aim to

develop low income countries but use it for their own purpose. According to Mwase and Yang (2012), it has been determined that the model of BRIC economies for financing the low income countries has gained acceleration because these countries tend to invest in low income countries for infrastructure development but in return, ask for natural resources which they require or are short of producing or mining domestically. In this case, Chinese are looking to invest heavily in African infrastructure but also use natural resources and export it back to China for usage in the homeland. This model seems similar to the framework used by colonial powers who invested in infrastructure especially in transport and rail lines but for their own advantage of trading minerals back to Europe. The colonial powers developed rail lines unplanned with the cheapest or shortest route possible for exporting minerals back to Europe (Arewa, 2016). In that time of pre colonialism and colonialism, cocoa was the most exported value where European and British colonial powers made huge money by exporting cocoa cultivated in Africa back to Europe through rail lines. These rail lines were also developed through keeping commercial activities in mind which were not of use by the general public. Other sectors of infrastructure such as power, ICT and water were ignored and investments were not made. Around 30-40% of public expenditure during this period was on rail lines (Jedwab and Moradi, 2012). The author further added that these lines were used for various purposes such as military dominations against other colonies and natives, and mining and cash crop cultivation from Africa to Europe. The Chinese infrastructure for resource model is similar to model of colonial powers. According to Su (2017), the Chinese model is advantageous because it invests heavily in infrastructure without laying any debt burden on the government. Another advantage is that this financing will produce employment within the domestic and also help in employing the overpopulated regions because cultivation and agriculture requires great amount of labour. However, certain weaknesses are associated with it because the natural resources within Africa have to be taken away to China because the

minerals that were required by Europeans years ago are still required by Chinese (Kerby, Moradi and Jedwab, 2014).

In this context, the infrastructure gap through this model has been increased because China is only investing in railways, roads and transportation in areas where it is beneficial for it to export minerals and agricultural crops to China.

References

Acemoglu, D., Johnson, S. and Robinson, J.A., 2000. *The colonial origins of comparative development: An empirical investigation* (No. w7771). National bureau of economic research.

Acemoglu, D., Johnson, S. and Robinson, J.A., 2012. The colonial origins of comparative development: An empirical investigation: Reply. *The American Economic Review*, *102*(6), pp.3077-3110.

Alacevich, M., 2011. The World Bank and the politics of productivity: the debate on economic growth, poverty, and living standards in the 1950s. *Journal of Global History*, *6*(1), pp.53-74.

Arewa, O.B., 2016. Constructing Africa: Chinese Investment, Infrastructure Deficits, and Development. *Cornell Int'l LJ*, *49*, p.101.

Asongu, S.A., 2014. Law, Finance and Investment: does legal origin matter in Africa?. *The Review of Black Political Economy*, *41*(2), pp.145-175.

Austin, G., 2010. African economic development and colonial legacies. *International Development Policy| Revue internationale de politique de développement*, (1), pp.11-32.

Botlhale, E.K., 2016. Financing development through public private partnerships (PPPs) in Botswana. *Africa's Public Service Delivery and Performance Review*, *4*(1).

Burger, P. and Hawkesworth, I., 2011. How to attain value for money: comparing PPP and traditional infrastructure public procurement. *OECD Journal on Budgeting*, *11*(1), p.91.

Calderón, C. and Servén, L., 2010. Infrastructure and economic development in Sub-Saharan Africa. *Journal of African Economies*, *19*(suppl_1), pp.i13-i87.

Cogneau, D., Yannick, D. and Sandrine, M.S., 2016. African states and development in historical perspective: colonial public finances in British and French West Africa. *Paris School of Economics working paper, Paris*.

Ehlers, T., 2014. Understanding the challenges for infrastructure finance.

Ehlers, T., 2014. Understanding the challenges for infrastructure finance.

Estache, A., 2010. Infrastructure finance in developing countries: An overview. *EIB Papers*, *15*(2), pp.60-88.

Farlam, P., 2005. *Working together: assessing public-private partnerships in Africa*. South African Institute of International Affairs (SAIIA).

Foster, V., Butterfield, W., Chen, C. and Pushak, N., 2009. *Building bridges: China's growing role as infrastructure financier for Sub-Saharan Africa*. World bank.

Gogo Kingston, D., 2011. The Impacts of the World Bank and IMF Structural Adjustment Programmes on Africa: The Case Study of Cote D'Ivoire, Senegal, Uganda, and Zimbabwe.

Gutman, J., Sy, A. and Chattopadhyay, S., 2015. Financing African infrastructure: Can the world deliver?.

Jedwab, R. and Moradi, A., 2012. Colonial investments and long-term development in Africa: Evidence from Ghanaian railways. *Unpublished manuscript, George Washington University and Sussex University*.

Kerby, E., Jedwab, R. and Moradi, A., 2014. 3 policy lessons from Africa's colonial railways. Data retrieved from https://www.theigc.org/blog/what-policymakers-can-learn-from-africas-colonial-railways/ [Accessed on 19 Sep. 17].

Mueller, N.D., Gerber, J.S., Johnston, M., Ray, D.K., Ramankutty, N. and Foley, J.A., 2012. Closing yield gaps through nutrient and water management. *Nature*, *490*(7419), p.254.

OCED, 2015. Infrastructure Financing Instruments and Incentives. Data retrieved from http://www.oecd.org/finance/private-pensions/Infrastructure-Financing-Instruments-and-Incentives.pdf [Accessed on 19 Sep. 17].

Pistor, K., 2013. A legal theory of finance. *Journal of Comparative Economics*, *41*(2), pp.315-330.

Qizilbash, A., 2011. Public-Private Partnerships and the Value of the Process: The Case of Sub-Saharan Africa. *International Public Management Review*, *12*(2), pp.38-54.

Rosnes, O. and Shkaratan, M., 2011. *Africa's power infrastructure: investment, integration, efficiency*. World Bank Publications.

Saghir, J., 2017. Sustainable Infrastructure Development in Sub Saharan Africa: A View from the Ground.

Su, X., 2017. Why Chinese Infrastructure Loans in Africa Represent a Brand-New Type of Neocolonialism. Data retrieved from http://thediplomat.com/2017/06/why-chinese-infrastructural-loans-in-africa-represent-a-brand-new-type-of-neocolonialism/ [Accessed on 19 Sep. 17].

Sy, A. and Copley, A., 2017. CLOSING THE FINANCING GAP FOR AFRICAN ENERGY INFRASTRUCTURE: TRENDS, CHALLENGES, AND OPPORTUNITIES.