ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Ngundu, M., Ngalawa, H. (2023), "Causal Relationship between Africa's Growth and Chinese Debt Financing for Infrastructure Development",
Montenegrin Journal of Economics, Vol. 19, No. 1, pp. 127-137.

Causal Relationship between Africa's Growth and Chinese Debt Financing for Infrastructure Development

MARVELLOUS NGUNDU[1] (*Corresponding Author*) and HAROLD NGALAWA[2]

[1] Postdoctoral Research Fellow, School of Accounting, Economics, and Finance, University of KwaZulu Natal, Durban, South Africa. ORCID ID: https://orcid.org/0000-0001-9727-9957, e-mail: marvengundu@gmail.com
[2] Professor, School of Accounting, Economics, and Finance, University of KwaZulu Natal, Durban, South Africa, e-mail: ngalawa@ukzn.ac.za

ARTICLE INFO

Received February 26, 2022
Revised from March 25, 2022
Accepted April 25, 2022
Available online January 15, 2023

JEL classification: E24, E31, F41, F62

DOI: 10.14254/1800-5845/2023.19-1.11

Keywords:

Africa;
Chinese loans;
Endogenous growth models;
Infrastructure Development;
VAR.

ABSTRACT

The contribution of this study is two-fold. First, the study is conducted in response to the growing concerns about the surge of Chinese debt financing for infrastructure development in Africa. Second, while addressing the latter, the study concurrently adds to the ongoing debate on the economic growth-public debt nexus in Africa, typically external public debt. We propose a theoretical argument based on literature that the source of debt and prioritized sectors ought to be explicitly considered when analysing the link between economic growth and public debt. Hence, this study explores the causal relationship between economic growth and Chinese debt financing for infrastructure development in Africa. In general, the literature confirms that optimal external debt investment in productive sectors such as infrastructure development can enhance fiscal stimulus and the growth payoffs are more sustainable to relatively less developed countries. It can, thus, be argued that Chinese debt financing for infrastructure projects can stimulate Africa's economic growth in the long-run. Against the expectation, our results using the VAR technique in the endogenous growth framework for the period (2000-2019) indicate that a one-time shock to Chinese loans on transport infrastructure in the short-run bears a long-run negative impact on Africa's growth, whereas the impact of Chinese loans on power and communication infrastructure is insignificant. These findings suggest a lack of productivity in all Chinese debt-financed infrastructure projects, and government corruption is assumed to be the main cause.

INTRODUCTION

Despite the considerable empirical literature, there is still no consensus on the link between economic growth and public debt in developing countries. Past studies used aggregate public debt in their analysis, assuming that all creditors in the host economy are homogeneous. This assumption may not hold true in Africa, as the priorities of the continent's major financiers appear to differ significantly. Chi-

nese lenders emphasize infrastructure projects, whilst Western lenders favour social development (Morris et al., 2020). The literature indicates that the projects in which the public debt is committed matter in the establishment of growth-public debt nexus (see, for example, Hilton, 2021; Senadza et al., 2018). As a result, the relationship between these variables is likely to vary depending on the prioritized projects. This calls for the need to revisit the growth-public debt nexus using disaggregated public debt data to take account of the source of debt and the prioritized sectors, hence the current study.

Over the last two decades, China has continued to grant billions of infrastructure projects loans to African countries (see Figure 1 below) despite their risk profiles in repayment. Several studies attest to this development, suggesting that China has emerged as a major financier of Africa's infrastructure projects, replacing the United States (US) (see, for example, Gill and Karakülah, 2019; Were, 2018). This surge of Chinese loans in Africa has prompted worries among analysts, researchers and international organizations such as the International Monetary Fund (IMF) about the sustainability of African governments' finances and their reliance on Chinese financiers, which could have geopolitical implications. Although debt trap concerns should not be easily dismissed, for economies such as Africa that are characterized by low levels of domestic investment, the acquisition of external debts is one main governments' technique for raising capital to expand and upgrade prioritized hard infrastructure projects (transport, energy, and communication).

Governments, typically in developing countries, borrow to finance infrastructure projects due to the projects' perceived capacity of generating surplus returns (see, for example Pattillo, et al., 2002; Senadza et al., 2018). Thus, infrastructure development is a crucial factor for stimulating economic growth in developing countries. For Africa in particular, Calderón (2009) and Kodongo and Ojah (2016), provide empirical evidence that infrastructure development is a significant engine of economic growth in Africa, as well as a necessary enabler of productivity and long-term economic growth. Likewise, African Development Bank (AFDB) (n.d.) points that investment in infrastructure contributes to the accomplishment of the Millennium Development Goals (MDGs) and "*accounts for over half of the recent improvement in economic growth in Africa and has the potential to achieve even more*."

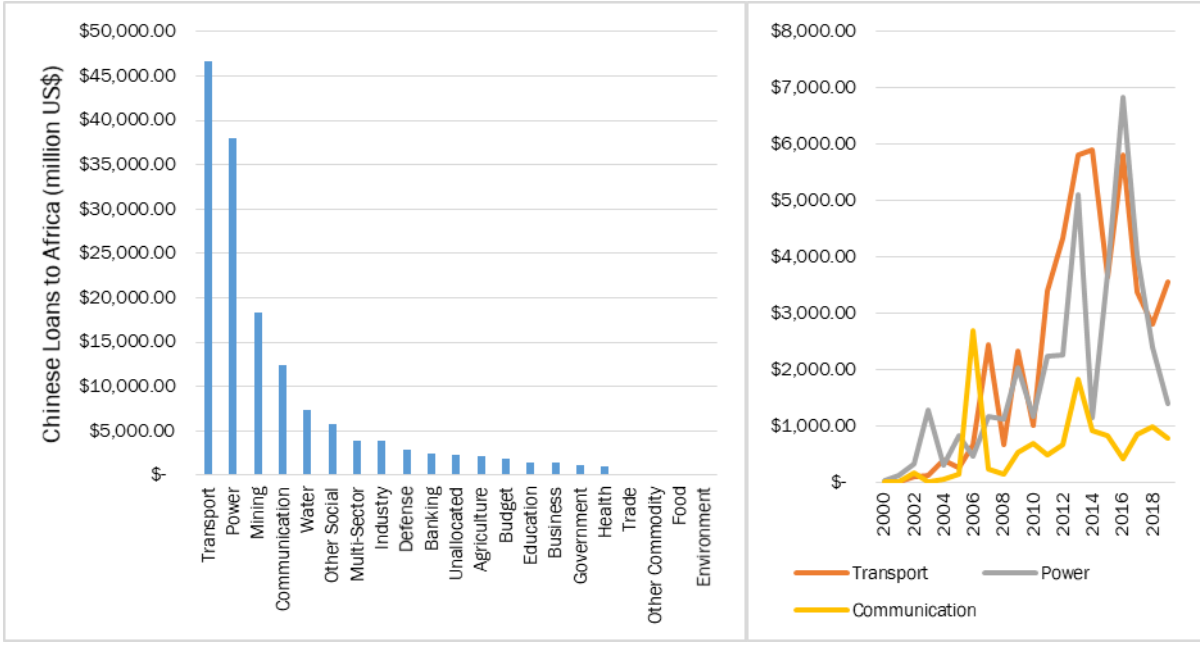


Figure 1: Chinese loans committed to Africa for the period (2000-2019), by sector.

Source: Authors' computation using CARI's dataset on Chinese loans to Africa (CARI, 2021).

However, several studies have focussed on scrutinizing the borrowing spree and overlooked the impact of Chinese debt financing for infrastructure development on economic growth in Africa. Gill and

Karakülah (2019) argued that the lack of reliable data on Chinese loans to Africa has been the major constraining factor to conduct an empirical analysis on China-Africa debt dynamics. The launch of the China Africa Research Initiative (CARI) and the Global Chinese Official Finance Database of AidData has provided a considerable solution to this data problem. As a result, this paper provides an empirically based analysis on the causal relationship between Africa's economic growth rate and Chinese loans provisioned for infrastructure projects using CARI's dataset for the period (2000-2019).

The graph on the left side of Figure 1 summarizes the total amounts of Chinese loans committed to various sectors in Africa from 2000 to 2019 while on the right are periodic trends of Chinese loans provisioned for transport, power, and communication infrastructure projects in Africa. In terms of infrastructure projects, Figure 1 indicates that Chinese creditors prioritize transport and power, respectively, while the amounts committed towards communication are relatively small. In general, the top five sectors in which Chinese loans were committed in the period (2000-2019) are transport, power, mining, communication, and water, respectively.

According to Gill and Karakülah (2019) and Were (2018), Chinese loans to African countries are prioritized for power and transport infrastructure projects to enhance production in their mining activities and transportation of natural resources from Africa to China, respectively. Following the assertion by the aforementioned authors, it can be argued that the loans committed towards communication infrastructure projects are meant to enhance networking mostly for the benefit of Chinese economic activities in Africa. It is also asserted that Chinese loans to some African countries (Angola for example) are backed by natural resources such that repayment is made through extraction enabled by the infrastructure provided (Were, 2018). Infrastructure and mining sectors are characterized by extensive construction activities and Were (2018) suggested that Chinese loans are prioritized for construction-related projects mainly to provide business opportunities for Chinese contractors. This explains why there are few amounts of Chinese loans committed towards social development, agriculture, and service sectors (see Figure 1). While some analysts may criticize the opportunities created for Chinese contractors, it can be argued that the participation of Chinese contractors in Chinese loans-receiving African countries can be accompanied by the transfer of advanced technology and knowledge. Both exogenous and endogenous growth theories confirm that knowledge and technology advancement are essential sources of technological progress in an economy's production function.

The above assertions provide an account of how China cements its 'win-win' economic diplomacy theme; nonetheless, it remains unclear whether the narrative does apply to Africa. Therefore, there is a need to empirically verify if Chinese loans on transport, power, and communication can enhance Africa's growth taking into account that infrastructure access and quality enhance economic growth through trade competitiveness and domestic production (Calderón, 2009; Kodongo and Ojah, 2016). This paper is organized as follows: Succeeding this introduction is the discussion on the relationship between economic growth and external public debt. Section 2 specifies the model and the empirical strategy. The study's findings are presented, interpreted and discussed in section 3 followed by a conclusion.

1. TRANSMISSION CHANNELS OF EXTERNAL PUBLIC DEBT TO ECONOMIC GROWTH

Considering the demand for capital in developing economies, the causal link between their economic growth and external public debt can be theoretically underpinned in the Neo-classical growth theories (exogenous growth model of Solow (1956) and endogenous growth model of Roma (1986), the Classical school of thought (Domar, 1944) and the Ricardian Equivalence Hypothesis (Ricardo, 1951). Neoclassical growth theories stress the critical role of productivity in achieving long term growth, however, their major difference lies in how the productivity parameters are accounted for in each framework. Exogenous growth models posit external debt as additional stock of physical capital in the production function and therefore its hypothetical decisive impact on the economic growth of the host country is transitory in the absence of an exogenous productivity factor. In endogenous growth models, external debt is expected to enhance productivity within the economic system, hence, boosting economic growth in the long-run. External debt may be accompanied by technology and knowledge spillovers. For instance, in the

present study, the participation of Chinese contractors in Chinese loans-receiving African countries can be accompanied by the transfer of advanced technology and knowledge. Thus, following the endogenous growth theories, Chinese debt financing for infrastructure development can serve simultaneously as physical capital and productivity factor in Africa's production function. In view of the Classical school of thought, public debt obstructs economic growth because its repayments curtail savings and therefore crowds out government expenditure. However, Senadza et al. (2018) argue that investing external public debt stock in productive sectors can generate enough returns for repayments and financing other projects. Perhaps it is due to this offset that Saungweme and Odhiambo (2019) found no causality between public debt service and economic growth. Finally, assuming the Ricardian Equivalence Hypothesis, external public debt bears a neutral impact on the host country's economic growth because fluctuations in government expenditure and revenues resulting from external debt are offset by changes in private savings.

1.1 Economic growth and public debt in Africa

Despite the considerable empirical literature on the economic growth-public debt nexus in Africa particularly and developing economies in general (see, for example, Hilton, 2021; Ndoricimpa, 2020, Olamide and Maredza, 2021; Saungweme and Odhiambo, 2019; Senadza et al., 2018), up to date there is still no clear link between these variables. Using the case of Ghana, Hilton (2021) found a unidirectional Granger causality running from public debt to economic growth but in the long-run only. The author, therefore, encouraged developing countries' governments to exercise fiscal discipline in borrowing and invest public loans in productive projects. Fiscal indiscipline resulting in excessive borrowing can be detrimental to economic growth (Ndoricimpa, 2020) while optimal public debt levels (typically external debt) effectively invested in productive projects such as infrastructure development, manufacturing, agriculture and mining can boost economic growth in the long-run (Senadza et al., 2018). In contrast to Hilton's findings, Saungweme and Odhiambo (2019) found that in Zambia's economic growth Granger cause public debt, irrespective of the time frame, and not the other way round. They concluded that the rate of economic growth drives public debt levels. Findings from Olamide and Maredza (2021) reveal that the impact of public debt on South Africa's economic growth shifts from positive in the short run to negative in the long-run. The authors emphasized public institutional reforms as a solution to maintain decisive outcomes even in the long-run. Thus, misuse of public debt or any public funds is most likely when public corruption is high in the host country (Bong and Premaratne, 2018 and Olamide and Maredza, 2021).

Past empirics on growth-public debt nexus assumed homogeneity of creditors in the host economy and therefore utilised aggregate public debt to pursue their analysis. For Africa in particular, this assumption might fail to hold as continent's main creditors (China and the Western lenders) seem to be heterogeneous in several aspects and this could contribute to other pertinent reasons why there is still no consensus on growth-public debt nexus in Africa and other developing economies. First, the Western financiers are concessional while China is less sensitive to institutional quality and pragmatic in its approach (Morris et al., 2020). Second, whereas Chinese lenders prioritize hard infrastructure projects (mainly transport, energy and communication) and mining (see Figure 1), the main focus of Western lenders is social development (mainly water, sanitation, health and education) (Morris et al., 2020). If the projects in which the public debt is committed matter in the determination of growth-public debt nexus as discussed above, it is likely that the growth-public debt nexus can differ subject to the prioritized projects. This calls for the need to revisit this phenomenon using disaggregated public debt data. Hence, the current study seeks to establish a causal relationship between Africa's growth and Chinese debt financing for infrastructure development.

2. MODEL SPECIFICATION

In light of the background provided in the introduction and literature, Chinese loans committed towards transport, power, and communication are considered for examination. The study follows the endogenous growth model (equation 1) pioneered by Romer (1986), whereby physical domestic capital

accumulation (*K*) and technological progress (*A*) are not explicitly differentiated in the production function. Suidarma and Yasa (2021) followed the same model to analyze the external debt-growth nexus in Indonesia arguing that external debt is a capital factor that can enhance the productivity of domestic investment and subsequently lead to economic growth in the long-run.

$$Y = AK \quad (1)$$

Both *A* and *K* enter the model as endogenous variables. *A* is constant.

In line with Barro (1990) and Suidarma and Yasa (2021), we argue that additional capital towards productive sectors such as infrastructure development can enhance constant returns to scale and counteract growth-destroying forces of diminishing returns in the long-run. In other words, infrastructure development is a critical enabler for productivity. Moreover, since Chinese contractors' participation in infrastructure projects can facilitate knowledge and technology transfer in Africa, Chinese loans can be thought of as serving simultaneously as physical capital (*K*) and technological progress (*A*) input in the production function of Africa.

Chinese loans on transport, power, and communication are expected to promote economic growth in Africa because they enhance the region's infrastructure in terms of stock and quality. Calderón (2009) found that infrastructure development in terms of stock and quality boosts economic growth in Africa with significant contributions from telephone density, electricity-generating capacity, road network length, and road quality. Likewise et al. (2016) found that spending on infrastructure development enhances economic growth in sub-Sahara Africa and the growth payoffs are more crucial to relatively less developed countries. This paper, therefore, models Africa's output growth (*Y*) as a function of domestic investment (*k*), Chinese loans on transport (*clt*), power (*clp*), and communication (*clc*) over the 2000 – 2019 period.

$$Y(t) = k(t)^{\emptyset}, clt(t)^{\vartheta}, clp(t)^{\gamma}, clc(t)^{\varphi} \quad (2)$$

where *t* represents the time dimension.

2.1 Estimation Technique

To establish a causal relationship between Africa's growth and Chinese loans on infrastructure development, equation (2) is estimated using the vector autoregression (VAR) model. Using the VAR model also allows us to simulate shocks of Chinese loans on infrastructure projects to the system and measure their effects on Africa's growth over time (Brandt and Williams, 2007). The model is 'vector' because it assumes a multivariate system, and it is 'autoregressive' because it contains lagged values of the dependent variable on the right side of the model (Alzyadat and Al-Nsour, 2020; Chapman et al., 2015). Hence, the linear function of equation (2) can be decomposed into five (5) econometric equations with each variable modelled as a function of other variables in the model. Since this paper is interested in the causal relationship between Africa's growth and Chinese loans on infrastructure projects, attention is given to a function with Africa's growth rate (*Y*) as a dependent variable. The function is specified below.

$$\ln(y_t) = \alpha + \sum_{g=1}^{k} \beta_g lny_{t-g} + \sum_{h=1}^{k} \emptyset_h lnk_{t-h} + \sum_{i=1}^{k} \vartheta_i lnclt_{t-i} + \sum_{j=1}^{k} \gamma_j lnclp_{t-k} + \sum_{m=1}^{k} \varphi_m lnclc_{t-m} + \mu_{1t} \quad (3)$$

In line with Barro (1990) and other endogenous growth theorists, we expect Chinese debt financing for infrastructure to enhance productivity in Africa's production function and promote growth in the long-run.

The data for Chinese loans on infrastructure projects in Africa was extracted from CARI's database (CARI, 2021) and the variables were normalized as a percentage of Africa's GDP. We quantified Africa's growth using the GDP growth rate (UNCTAD, 2021) while domestic capital investment was measured using gross fixed capital formation as a percentage of GDP (AFDB, 2021). All variables are in logarithms.

3. ESTIMATED RESULTS

As a preliminary check, we verify the stationarity of all variables. To be cautious, we include one lagged difference to eliminate serial correlation in the Dickey-Fuller regression error term. The results are presented in Table 1 below.

Table 1: Augmented Dickey-Fuller (ADF) test for unit root

	Level		*First Differences*	
Variables	*Test Statistic*	*5% Critical Value*	*Test Statistic*	*5% Critical Value*
GDP growth rate	-1.000	-3.000	-4.995	-3.000
Gross Fixed Capital Formation, % GDP	-2.017	-3.000	-3.212	-3.000
Chinese loans on transport infrastructure, % GDP	1.351	-3.000	-3.111	-3.000
Chinese loans on power infrastructure, % GDP	-0.116	-3.000	-5.490	-3.000
Chinese loans on communication infrastructure, % GDP	-2.883	-3.000	-3.714	-3.000

Source: own

Notes: H_0: The variable has a unit root. H_0 is rejected if the 5% critical value < the test statistic's value in absolute terms.

Table 1 indicates that the null hypothesis cannot be rejected if the variables are tested for stationarity at level; however, they become stationary after first differencing. These results suggest that all the variables satisfy the stationarity condition required to perform VAR analysis; we thus estimate the VAR regression as specified in equation (3).

Table 2: VAR Results

Dependent variable: *ln* (GDP growth rate)	
Lagged Dependent Variable	-0.052
	(0.266)
L1 *ln*(Gross Fixed Capital Formation, % GDP)	2.234
	(1.954)
L1 *ln*(Chinese loans on transport infrastructure, % GDP)	-0.224*
	(1.133)
L1 *ln*(Chinese loans on power infrastructure, % GDP)	-0.164
	(0.175)
L1 *ln*(Chinese loans on communication infrastructure, % GDP)	0.072
	(0.102)
Constant	-6.175
	(6.066)
Number of observations	18

Source: own

Notes: The VAR model was estimated with one lag.*significant at 10% level. Standard errors are in parentheses.

Table 2 above shows that the 1st lag of *ln*(Chinese loans on transport infrastructure, % GDP) has a negative impact on *ln*(GDP growth rate) at a 10% significant level, *ceteris paribus*. The estimated coefficients of other variables are statistically insignificant; this implies that only Chinese loans on transport infrastructure have a causal relationship with Africa's economic growth rate. We perform Granger causali-

ty tests using the VAR results in Table 3 above to confirm the causal direction between these variables. The results are presented in the subsequent table below.

Table 3: Granger causality Wald tests

Equation	*Excluded*	*chi²*	*df*	*Prob>chi²*
ln(GDP growth rate)	*ln*(Gross Fixed Capital Formation, % GDP)	1.308	1	0.253
	ln(Chinese loans on transport infrastructure, % GDP)	2.817	1	0.093
	ln(Chinese loans on power infrastructure, % GDP)	0.876	1	0.349
	ln(Chinese loans on communication infrastructure, % GDP)	0.490	1	0.484
	All	7.839	4	0.098
ln(Chinese loans on transport infrastructure, % GDP)	*ln*(GDP growth rate)	0.182	1	0.670
	ln(Gross Fixed Capital Formation, % GDP)	0.999	1	0.318
	ln(Chinese loans on power infrastructure, % GDP)	0.397	1	0.529
	ln(Chinese loans on communication infrastructure, % GDP)	1.143	1	0.285
	All	3.196	4	0.526

Source: own

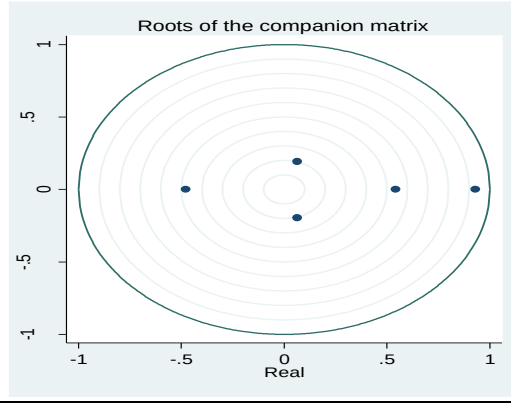
Notes: Since we only have one lag in our VAR, the Granger causality tests only have one degree of freedom and match the single-coefficient tests in the VAR regression table.

Table 3 shows that the causal relationship between Africa's GDP growth rate and Chinese loans on transport infrastructure is unidirectional: Chinese loans on transport infrastructure granger cause Africa's GDP growth rate (the *p*-value is 0.093) and not vice versa (the *p*-value is 0.670). Thus, it can be argued that the negative correlation between Africa's growth rate and Chinese loans on transport infrastructure results from the negative impact of Chinese debt financing for transport infrastructure on Africa's growth rate, rather than the opposite. These results provide evidence that Chinese loans on transport infrastructure can help predict the GDP growth rate in Africa.

To assess our VAR results' validity, we test the dynamic stability of the system using the Eigenvalue stability test, and the results are presented in Table 4 below.

Table 4: Stability test

Eigenvalue	*Modulus*
0.910	0.910
0.543	0.543
-0.478	0.478
0.0632 + 0.194i	0.204
0.0632 + 0.194i	0.204



Notes: All the eigenvalues lie inside the unit circle. VAR satisfies stability conditions.

Table 4 indicates that all the calculated eigenvalues (which can be complex) are less than one (in modulus if they have imaginary parts). This implies that our model is stable and therefore we can proceed to compute orthogonalized impulse response functions (OIRFs). OIRFs trace the dynamic impacts of changes in each of the endogenous variables over time, taking into account the contemporaneous correlations between them (Hoenders et al., 2011). Based on the VAR results presented in Table 2, this study traces the response of Africa's GDP growth rate to Chinese loans on transport infrastructure shock, and the results are illustrated in Figure 2 below.

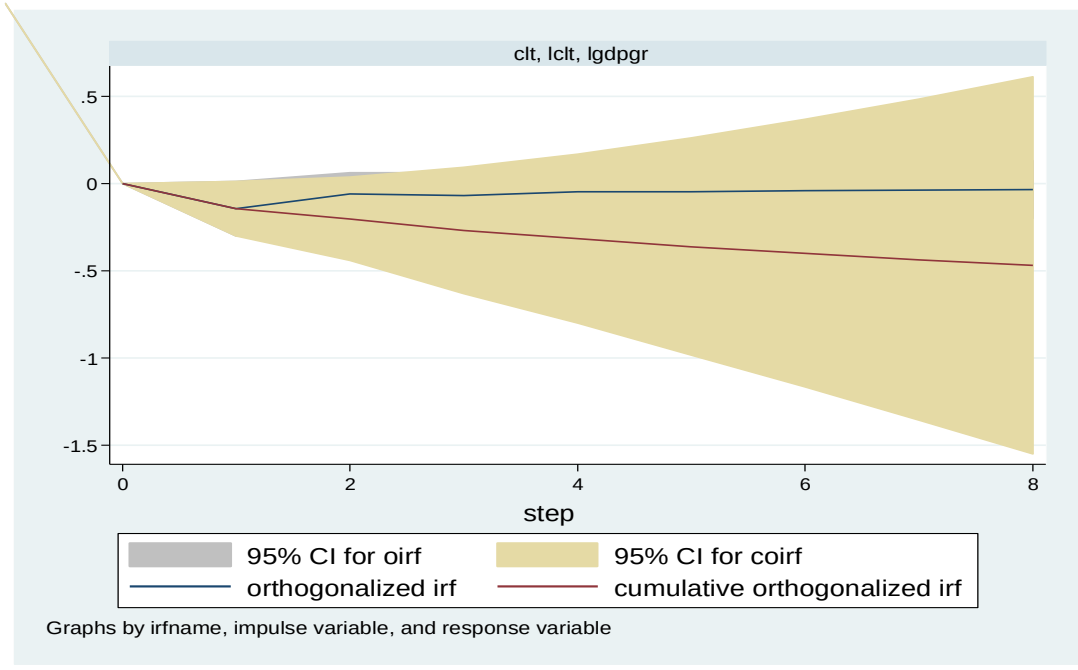


Figure 2: OIRF graph

Source: own

Notes: irf name: Chinese loans on transport infrastructure (*clt*), impulse variable: *ln*(Chinese loans on transport infrastructure, % GDP), and response variable: *ln*(GDP growth rate).

Figure 2 illustrates the response of *ln*(GDP growth rate) to *ln*(Chinese loans on transport infrastructure, % GDP) shock for eight (8) years. The OIRF graph shows that a one-standard-deviation shock to *ln*(Chinese loans on transport infrastructure, % GDP) decreases *ln*(GDP growth rate) by approximately 0.2 percentage points in the first year. Between the first and second year, *ln*(GDP growth rate) recovers gradually by approximately 0.1 percentage point then remains constant up to the 8th year. This trend indicates that the impact of Chinese debt financing for transport infrastructure on Africa's growth rate is negative both in the short and long-run. A one-time shock to Chinese loans on transport infrastructure in the short-run bears a long-run negative impact on Africa's growth. Similarly, the cumulative OIRF graph shows that Africa's GDP growth rate is negatively affected by one-standard-deviation Chinese loans on transport infrastructure shock upon impact and that as time goes on Africa's GDP growth rate continues to be negatively affected by this one-time shock.

3.1 Discussion of research findings

Various studies (see, for example, Pattillo et al., 2002; Senadza et al., 2018; Suidarma and Yasa, 2021) attest that optimal levels of external debt financing for productive investments can boost developing countries' economic growth in the long-run. The literature acknowledges that infrastructure develop-

ment is among the productive investments that can enhance economic growth in developing countries. In Africa, particularly, Calderón (2009) showed that the infrastructure stock and quality enhance the continent's economic growth. Likewise, Kodongo and Ojah, (2016) found that government spending on transport, power, and communication infrastructure boosts the economic growth in sub-Sahara Africa and the growth payoffs are more vital to relatively less developed countries. In contrast, this study found that Chinese debt financing for transport infrastructure is deleterious for Africa's economic growth, while Chinese debt financing for power and communication infrastructure does not bear a significant impact. Generally, our findings indicate that generalizing the causal relationship between economic growth and external public debt can mislead policy developments, the relationship is subject to various factors including the source of debt and the prioritized sectors.

Some analysts might interpret the finding on Chinese loans invested in power and communication based on the Ricardian Equivalence Hypothesis. However, in light of the endogenous growth models utilized in the current study, sustainable growth is most likely where the optimal level of external debt is committed in prioritized projects such as infrastructure development. This finding, therefore implies one or both of the following scenarios. First, there was a lack of productivity in energy and communication infrastructure projects. Second, Chinese loans committed towards these sectors were below the optimal level; low public debt is growth neutral according to Ndoricimpa (2020).

The outcome on Chinese loans invested in transport infrastructure can be discussed in three dimensions. First, in light of the OIRF graph (Figure 2) and the endogenous growth models, Chinese debt financing for transport infrastructure tends to have the potential to enhance Africa's economic growth in the long-run, but productivity appears to be constrained. Considering the deteriorating quality of Africa's institutions and the notion that Chinese loans in Africa are relatively less concessional, chances are that Chinese loans are misused and not effectively utilized for the provisioned purpose. Thus, it is logical to assume that productivity in all the infrastructure projects financed using Chinese loans is constrained due to a lack of accountability and government corruption. As indicated in Bong and Premaratne (2018) and Olamide and Maredza (2021), government corruption is toxic to capital allocation and economic growth.

Second, one can discuss the cumulative OIRF graph (Figure 2) based on the Classical school of thought that servicing of Chinese loans on transport infrastructure is straining Africa's economic growth rate. According to classicalists, external debt servicing reflects capital outflows, and thus external debt financing may be expected to negatively affect Africa's growth. However, following Neo-classical growth theories, Senadza et al., (2018) and Suidarma and Yasa (2021) argued that investing external debt in productive projects such as infrastructure development can generate enough returns to service the debt, reinvest and invest in other projects consequently contributing positively to economic growth in the long-run. Thus, in this study, the unsustainability question of Chinese loans can be argued away because a larger share of Chinese loans in Africa is provisioned for infrastructure development (see Figure 1). It follows that Africa is not generating sufficient returns from the infrastructure projects financed by Chinese loans due to a lack of productivity and fiscal discipline. If Chinese loans are misused then obvious repayment will be strenuous to the economy.

The third dimension is linked to the assertions that Chinese loans for infrastructure projects are offered on conditions and motives to benefit their economic activities in Africa (Gill and Karakülah, 2019; Were, 2018). Could this be the case, our results provide evidence that Chinese debt financing conditions might be deliberated to benefit the financier at the borrower's expense. In this respect, debt trap worries are justified; nonetheless, it remains Africa's responsibility to negotiate for fair debt financing conditions that can effectively lead to a 'win-win' outcome.

CONCLUSION

Using CARI's dataset for the period (2000-2019) and the VAR model in the endogenous growth framework, this study provides an empirical analysis of the causal relationship between Chinese debt financing for infrastructure projects and Africa's economic growth. VAR model was considered as an appropriate tool to simulate shocks of Chinese loans on infrastructure projects and measure their effects

on Africa's growth over time. Our results indicate that only Chinese loans on transport infrastructure can help predict GDP growth rate in Africa albeit with a negative impact both in the short and long-run, whereas the impact of Chinese loans on power and communication is insignificant. The trend derived from the OIRF and cumulative OIRF graphs shows that a one-time shock to Chinese loans on transport infrastructure in the short-run bears a long-run negative impact on Africa's growth. Some analysts may link these findings to the unsustainability notion of Chinese loans. However, Chinese loans are mainly provisioned for infrastructure development as depicted in Figure 1, and there are considerable literature justifications that external debt financing for infrastructure development can generate enough returns to repay the debt and save for other investments. Therefore, following the endogenous growth theories, our perspective is that productivity is constrained in all infrastructure projects financed using Chinese loans, and lack of accountability as well as government corruption at home is assumed to be the leading cause. In light of this conclusion, we suggest the following policy recommendations:

i) Chinese debt financing for infrastructure projects should be effectively utilized for the provisioned purpose.
ii) It remains Africa's responsibility to negotiate for Chinese debt financing conditions that can lead to a 'win-win' outcome and create productivity-enhancing economic externalities in Africa.

These initiatives should be complemented by reforms of institutions involved in the Chinese debt acquisition, investing, and servicing. Future studies are recommended to develop an optimal threshold level/(s) of Chinese debt financing for infrastructure projects required to enhance economic growth in Africa.

REFERENCES

AFDB (2021), *"AFRICA-Gross fixed capital formation",* https://dataportal.opendataforafrica.org/nbyenxf/afdb-socio-economic-database-1960-2021 (accessed 20.09.2021).

AFDB (n.d.), "*Infrastructure Development*", https://www.afdb.org/en/knowledge/publications/tracking-africa%E2%80%99s-progress-in-figures/infrastructure-development (accessed on 29.09. 2021).

Alzyadat, J.A., Al-Nsour, I.A. (2021), "The fiscal policy instruments and the economic prosperity in Jordan", *Journal of Asian Finance, Economics, and Business,* Vol. 8, No. 1, pp. 113–122. https://doi.org/10.13106/jafeb.2021.vol8.no1.113.

Barro, R.J. (1990), "Government spending in a simple model of endogenous growth", Journal of Political Economy, Vol. 98, No. 5, pp. S103–S125. https://doi.org/10.1086/261726.

Bong, A., Premaratne, G. (2019), "The impact of financial integration on economic growth in Southeast Asia", *Journal of Asian Finance, Economics, and Business*, Vol. 6, No. 1, pp. 107-119. https://doi.org/10.13106/jafeb.2019.vol6.no1.107.

Brandt, P., Williams, J. (2007), *Multiple time series models*, SAGE, Thousand Oaks, CA, https://doi.org/10.4135/9781412985215.

Calderón, C. (2009), "Infrastructure and growth in Africa", *Policy Research Working Paper* No. 4914, The World Bank, Washington DC, https://doi.org/10.1787/225682848268

CARI. (2021), *Loan data: Aggregate loan data* (excel file), http://www.sais-cari.org/data. (accessed on 20.09.2021).

Chapman, D., Cane, M.A., Henderson, N., Lee, D.E., Chen, C. (2015), "A vector autoregressive ENSO prediction model", *Journal of Climate*, Vol. 28, No. 21, pp. 8511–8520, https://doi.org/10. 1175/JCLI-D-15-0306.1.

Gill, I.S., Karakülah, K. (2019), "Is China helping Africa ? Growth and public debt effects of the subcontinent's biggest inventor", *Duke Global Working Paper* No. 3, Duke University, Durham, NC.

Domar, E.D. (1944), "The burden of the debt and the national income", *American Economic Review*, Vol. 34, pp. 798–827.

Hilton, S.K. (2021), "Public debt and economic growth: contemporary evidence from a developing economy", *Asian Journal of Economics and Banking,* Vol. 5, No. 2, pp. 173–193, http://dx.doi.org/10.1108/AJEB-11-2020-0096.

Hoenders, H.J.R., Bos, E.H., De Jong, J.T.V.M., De Jonge, P. (2011), "Unraveling the temporal dynamics between symptom and treatment variables in a lifestyle-oriented approach to anxiety disorder: A time-series analysis", *GGzet Wetenschappelijk*, Vol. 15, No. 2, pp. 11–30.

Kodongo, O., Ojah, K. (2016), "Does infrastructure really explain economic growth in Sub-Saharan Africa?', *Review of Development Finance*, Vol. 6, No. 2, pp. 105–125, https://doi.org/10.1016/j.rdf.2016.12.001.

Morris, S., Parks, B., Gardner, A. (2020), *Chinese and World Bank Lending Terms: A Systematic Comparison Across 157 Countries and 15 Years*, Center for Global Development.

Ndoricimpa, A. (2020), "Threshold effects of public debt on economic growth in Africa: a new evidence", *Journal of Economics and Development*, Vol. 22, No. 2, pp. 187–207, http://dx.doi.org/10.1108/JED-01-2020-0001.

Olamide, E.G., Maredza, A. (2021), "Pre-COVID-19 evaluation of external debt, corruption and economic growth in South Africa", *Review of Economics and Political Science*, http://dx.doi.org/10.1108/REPS-03-2021-0019.

Pattillo, C., Poirson, H., Ricci, L. (2002), "External debt and growth", *IMF Working Paper* No./02/69, IMF, Washington, DC.

Ricardo, D. (1951), "On the principles of political economy and taxation", in Sraffa, P. (Ed.), *The Works and Correspondence of David Ricardo*, Vol. 1, Cambridge University Press, Cambridge, with the collaboration of M. Dobb.

Romer, P. (1986), "Increasing returns and long-run growth", *Journal of Political Economy*, Vol. 94, pp. 1002–1037. https://doi.org/10.1086/261420.

Saungweme, T., Odhiambo, N.M. (2019), "Government debt, government debt service and economic growth nexus in Zambia: A multivariate analysis", *Cogent Economics and Finance*, Vol. 7, No. 1, pp. 1–17, http://dx.doi.org/10.1080/23322039.2019.1622998.

Senadza, B., Fiagbe, A.K., Quartey, P. (2018), "The effect of external debt on economic growth in Sub-Saharan Africa", *International Journal of Business and Economic Sciences Applied Research* (IJBESAR), Vol. 11, No. 1, pp. 61–69. https://doi.org/10.25103/ijbesar.111.07.

Solow, R. (1956), "A contribution to the theory of economic growth", *Quarterly Journal of Economics*, Vol. 70, pp. 65–94.

Suidarma, I. M., Yasa, I. N. A. (2021), "The contribution of external debt to economic growth: An empirical investigation in Indonesia", *Journal of Asian Finance, Economics, and Business*, Vol. 8, No. 10, pp. 11–17. https://doi.org/10.13106/jafeb.2021.vol8.no10.0011.

UNCTAD. (2021), "Economic trends: National accounts", https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx, (accessed on 20 September 2021).

Were, A. (2018), "Debt trap? Chinese loans and Africa's development options", *Policy Insights* 66, South African Institute of International Affairs.