An Economic Study About How Responsive Is Poverty to Infrastructure Development: An Insight from Egypt

Dr.Raghda Saied Ahmed Mohammed
Department of Economics
Faculty of Economics & Management
October 6 University

Abstract:

Purpose – The purpose of this study is to estimate the link between poverty alleviation as the first goal of the UN SDGs and infrastructure development in Egypt for the (2000-2022) time span.

Design/methodology/approach – The researcher utilized 4 main independent variables (energy, water and sanitation, transport, and telecommunications) categorized under the wide infrastructure sector and poverty rate ($3.20 per day - share of population below poverty line) as an independent variable using the auto-regressive distributed lag (ARDL) technique.

Findings – The ARDL test results suggest that infrastructure development (basic facilities) and GDP per capita have a positive impact on the poverty rate in Egypt in both the long run and the short run. Although telephone subscriptions reduce the poverty rate, that may occur because they contribute to economic activities and generate income for individuals and firms.

Originality/value – This study is an attempt to investigate the link between infrastructure development and poverty alleviation empirically in Egypt using the auto regressive distributed lag (ARDL) technique.

Keywords: Infrastructure development, sustainable development, poverty reduction, auto-regressive distributed lag (ARDL), economic development.

Introduction:

Sustainable development became a planned target for many economies, which displays the planning capability and the strength of the economy. In this context, ending poverty is the top sustainable development goal. The Egyptian economy is one of these economies that pays more attention to sustainable development. Hence, Egypt has launched its agenda in 2016, including long-term strategies to achieve sustainability. Since the first goal of "Egypt`s Vision 2030" is to increase the standard of living for the Egyptians and raise their quality of life by eradicating all forms of poverty.

So, to reduce the poverty rate in Egypt or any other country, the government should ensure job opportunities with adequate salaries to enable citizens to live a subsistence life, and that cannot happen without generating jobs that are created by investment, even if this investment is public or private, national, or foreign. And these investments cannot be attracted to the market without a strong, established infrastructure.

So, at the final results, infrastructure is the fundamental factor for reducing poverty, whether it effects the rate directly by ensuring the social infrastructure (education, health, networks, etc.) or indirectly through the economic infrastructure that enhances economic growth by supporting the operation and development of other sectors of the economy.

And many studies show that infrastructure is one of the factors that affect economic development and poverty alleviation. So, the lack of infrastructure investment may be responsible for the high poverty rate. Therefore, the impact of infrastructure development, which built the base of sustainable development, creates the importance of focusing clearly on the theoretical and empirical parts of infrastructure development and evaluating the effect of infrastructure in the economy to know whether infrastructure development reduces the poverty rate in Egypt or not.

Many economic papers focus on the paradox of infrastructure theory. Since there are two different theories of infrastructure: the school at the macro-level and the school at the micro-level, The first one supports the idea that increasing public investment in infrastructure, such as transportation and roads, promotes the productivity of businesses and consequently enhances the investment of private capital.

Conversely, the second school relies on case studies and claims that infrastructure development in aspects of social, environmental, and financial performance is unpleasantly poor. However, macro-level school is more common in literature, and the opposite opinions between these two schools have progressively prompted arguments among researchers. And it attracts more attention to the infrastructure and to the need to achieve the SDGs, since the arguments have been moved to the critical effect of infrastructure development on poverty alleviation.

To shed light on the significance of infrastructure development, the World Bank (WB) has helped developing countries develop their infrastructure, which provides comprehensive growth. Additionally, infrastructure investment could generate opportunities. For instance, most developed economies have high levels of infrastructure development, such as China and the USA, which support macroeconomics. Alike, in Sub-Saharan Africa, infrastructure development is associated with economic growth.

According to WB, the inadequate establishment of infrastructure causes a shortage of institutional incentives in most African countries, which means a shortage in productivity and economic growth. Moreover, the Ninth Five-Year Plan in Nepal; the Rural Roads and Markets Improvement and Maintenance Project (RRMIMP) in Bangladesh, financed by the WB; and the Village Road Program in India.

Although many researchers support the idea that poverty reduction is affected by infrastructure development, empirically, the impact significantly differs across countries and even projects. For illustration, studies illustrate that RRMIMP decreased poverty in Bangladesh, whereas rural roads were not effective in reducing poverty in the Philippines. Thus, it is not easy to make a comparison across those investments or even reach a conclusion.

The effect of infrastructure development on economic development and poverty has been discussed by many researchers. Since then, many researchers have tried to find the empirical relationship between infrastructure development and aggregate productivity. Through illustrating the empirical research in the literature, the research's limits include different regions such as Europe, South Asia, East Asia, Africa, and American regions.

These researchers pointed out that infrastructure could be a basic to economic development, which goes with the suggestion that infrastructure promotes productivity and thus increases income. Some researchers, consequently, supported the idea that infrastructure development could influence the income level of the poor. And through their support, they found that the link between economic growth and infrastructure investment was significant in less developed countries. Since then, there has been a considerable lack of infrastructure.

Since, back to the study of Duffy Deno et al (1989), which illustrated that public infrastructure such as water and roads has a huge influence on economic development in Kenya. Moreover, in the work of Calderón and Chong (2004), which focuses on the relationship between income inequality and poverty reduction in almost 101 countries, it is found that infrastructure negatively affects income inequality, whereas the effect is greater in low-income countries.

In addition, the study by Kodongo and Ojah (2016) focused on countries in sub-Saharan Africa, and they found that infrastructure spending positively impacts economic growth, while influences are greater in developing or low-income countries. Furthermore, the work of Medeiros et al (2021), which studied the impact of infrastructure development on poverty reduction in Brazil depending on infrastructure indicators such as quality, access, and provision through multilevel logistic models, and they found that there were negative impacts of the infrastructure investment on poverty.

As well as the work of Xiao et al (2022), who estimates the influence of infrastructure on the distribution of households' income empirically in China, focusing on rural households and using their agricultural income. And they found that electricity infrastructure considerably raises the incomes of poor households and that it is distributed equally among them; the infrastructure of agricultural irrigation also considerably increases incomes. And both irrigation and electricity infrastructure increase the possibility of joining agricultural business activities and thus raise income.

Furthermore, the study of Fagbemi et al (2022), which found that infrastructure investment pushes poverty alleviation in Nigeria using the Granger causality test. Additionally, the study of Zhang et al (2023), which estimates the effect of Chinese investment in infrastructure on national poverty reduction in sub-Saharan Africa, They found that infrastructure can uninterruptedly reduce poverty by refining standards of living through the industrial sector and growing the employment rate. And the study by Marinho et al (2017) that focuses on the same thing in Brazil.

And they found an adverse relationship between infrastructure investment and poverty. Plus, the work of Chotia and Rao (2017) that found evidence on the unidirectional positive impact of infrastructure investment on poverty alleviation on both long term and short-term using ARDL. Furthermore, the study of Ari et al (2017), pointed out that infrastructure has a direct impact on the multidimensional poverty in Kasembon District, Indonesia.

On the other side, some researchers pointed out that the influence of infrastructure is mainly dependent on the economic development status of a country. For illustration, in developed countries, economic development is probably not determined by infrastructure. So, economic growth or poverty alleviation are probably not brought out by infrastructure investment. Even in some developing countries, such as Pakistan. For example, the study of Haider et al illustrated that the long-term relationship between increasing productivity and infrastructure does not exist in Pakistan.

As well as the work of Meilvidiri et al (2020), who investigated infrastructure and poverty in eastern Indonesia using panel data from 16 regions. The findings showed that transportation and energy increase poverty levels. And increasing economic growth raises the level of income distribution. Nonetheless, it does not affect poverty reduction.

Generally, studies that investigate the relationship between infrastructure development and poverty are somehow limited. This claim is common in the latest review paper; hence, there are many gaps on different fronts. While there is general agreement in the literature review that infrastructure investment has an adverse effect on inequality, results on the link between infrastructure investment and poverty rates are still inadequate. So, the claim that poverty alleviation is directly influenced by infrastructure could be examined empirically here in this paper by investigating the infrastructure-poverty alleviation link in Egypt as an example of a developing country.

Research methodology:

A.Descriptive statistics

To explore the effect of infrastructure variables on poverty reduction in Egypt between 2000 and 2022, the data were analyzed with different tests and statistical techniques. And most of these statistics come from the World Bank. All the variables in the analysis are described as follows in Table 1.

Table 1. Description of the variables

	AIR	BASIC_FACILITIES	FIXED	INFALTION	MOB	PERCAPITA _CURRENT	PORT	POVERTY
Mean	4.839	1.989	0.058	0.898	1.603	3.328	6.678	1.435
Median	4.896	1.990	0.315	0.969	1.948	3.381	6.788	1.446
Maximum	5.063	1.995	0.997	1.469	2.028	3.568	6.897	1.548
Minimum	4.616	1.981	-1.164	0.355	0.279	3.007	6.125	1.282
Std. Dev.	0.173	0.004	0.778	0.271	0.541	0.191	0.2463	0.083

From the above table, it is illustrated that the statistical description for the factors uses the maximum value, mean, minimum value, and standard deviation. So, it illustrates that the poverty rate in Egypt is a dependent variable, and it hypothetically depends on the remaining variables, which are illustrated as follows:

- Fixed -line telephone subscription (per 100 people).
- Mobile cellular subscription (per 100 people).
- Air transport registered carrier departures worldwide.
- Container port traffic.
- Basic facilities (access to water- access to sanitation- access to electricity).
- GDP per capita (current US$).

And this research employs the autoregressive distributed lag (ARDL) bound testing methodology (Pesaran and Shin 1995, Pesaran and Shin 1999, Pesaran et al. 1996, Pesaran 1997) to investigate the error correction mechanism (ECM) for the annual data during the period (2000–2022). Autoregressive (dependent variables` lag values) and distributed lag (independent variables lag values) are both included in the ARDL model.

Once the variables are integrated in order one I(1) or even order zero I(0), the ARDL cointegration is utilized to determine if there is a long-run relationship among the variables of the model under consideration or not.

According to Pesaran et al. (2001), the approach of ARDL to cointegration is depicted in Equation (I) as follows.

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta Y_{t-i} + \sum_{i=1}^{p} \beta_2 \Delta X_{1t-i} + \cdots + \sum_{i=1}^{p} \beta_k \Delta X_{kt-i} + +\beta_{k+1} ECT_{t-1} \qquad (1)$$

Where Y and X are the dependent variables and k is the total number of the remaining variables, the error correction term is described through ECT_{t-1} (and all other things being the same), p is the optimal lag length, and Δ is the operator of the first difference.

F-statistics are obtained by doing Wald tests on the unrestricted ECT variables' coefficients and then used to assess whether a long-term relationship exists. The I(0) or I(1) status of the model's variables, the total number of regressors, and the presence of an intercept and/or a temporal trend all affect the F-test's non-standard distribution. At the 5% level of significance, Pesaran's critical value is compared with the F-statistics.

If the variables are I (0), I (1), or a combination of both, the test requires asymptotic critical value boundaries. The series of I (1) and I (0) provides the upper and lower bound critical values, respectively. The null hypothesis that there is no cointegration between the variables is rejected when an F-statistic rises beyond the upper bound value. As a result, regardless of the variables' integration order, the researcher draws the conclusion that there is evidence of a long-term relationship between the variables.

If it is less than the lower bound number, the researcher does not rule out the null hypothesis that there is no cointegration; nevertheless, if it is between the bounds, the conclusion cannot be drawn. When it is proven that two variables are co-integrated (i.e., they have a long-run or equilibrium connection), there may be disequilibrium in the short term. The disequilibrium is corrected using an error correction method. As stated in Equation (2), the short-run dynamics can be obtained by estimating the Error Correlation Term (ECT) with the given lags.

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta Y_{t-i} + \sum_{i=1}^{p} \beta_2 \Delta X_{1t-i} + \cdots + \sum_{i=1}^{p} \beta_k \Delta X_{kt-i} + +\beta_{k+1} ECT_{t-1} \quad (2)$$

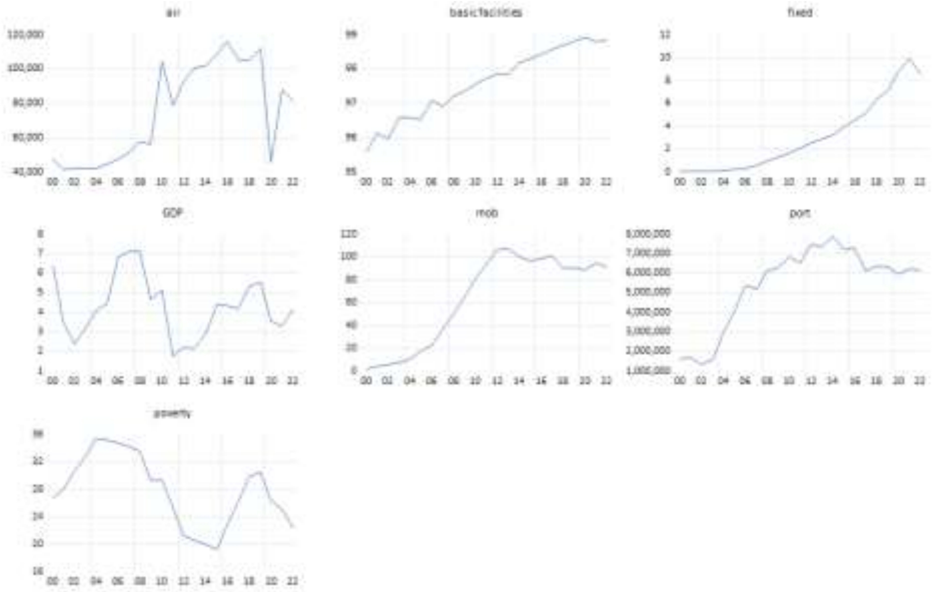
Where β_{k+1} represents the speed of adjustment.

And the logarithmic form of the model is:

$$\Delta logY_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta \log Y_{t-i} + \sum_{i=1}^{p} \beta_2 \Delta \log X_{1t-i} + \cdots + \sum_{i=1}^{p} \beta_k \Delta \log X_{kt-i} + +\beta_{k+1} EC_{t-1} \quad (3$$

"Take in Figure"

Figure 1. data charts of the variables



Source: it made by the researcher based on data from the world bank.

B. Time Series Stationarity test

Phillips-Perron (PP) unit root tests were used to examine the stationarity of the time series of the variables. The integration levels of the variables are shown in the next section:

Table 2. Integration levels

Variables	
Poverty rate	I(1)
GDP per capita (current US$)	I(1)
basic facilities (access to water- access to sanitation- access to electricity).	I(1)

Fixed -line telephone subscription (per 100 people).	I(1)
Mobile cellular subscription (per 100 people).	I(1)
Air transport registered carrier departures worldwide.	I(1)
Container port traffic	I(1)

All the variables in Table 2 are non-stationary at the level, with a p-value > 0.05. To eliminate the unit roots, the initial difference for the time series was chosen for these variables. Therefore, it became stationary, whereas the p-value < $\alpha = 0.05$ except for the variable of fixed-line telephone subscription (per 100 people), whose p-value < $\alpha = 0.10$.

C.Correlation Matrix

Table 3 shows a correlation coefficient matrix between variables using Pearson's correlation coefficient.

Table 3. Correlation matrix between variables

	AIR	BASIC_ FACILITIES	FIXED	MOB	PERCAPITA_ CURRENT	PORT	POVERTY
AIR	1.000	0.7564	0.8040	0.7919	0.8094	0.7429	-0.6517
BASIC_ FACILITIES	0.756	1.0000	0.9723	0.8997	0.8747	0.8061	-0.5069
FIXED	0.804	0.9723	1.0000	0.9347	0.9367	0.8652	-0.5648
MOB	0.791	0.8997	0.9347	1.0000	0.8604	0.9459	-0.4970
PERCAPITA _CURRENT	0.809	0.8747	0.9367	0.8604	1.0000	0.7980	-0.7675
PORT	0.742	0.8061	0.8652	0.9459	0.7980	1.0000	-0.4374
POVERTY	-0.651	-0.5069	-0.5648	-0.4970	-0.7675	-0.43743	1.0000

D.Regression model:

The first hypothesis has been put to the test using the ARDL model. The application of the error correction model

(ECM) is demonstrated in Equation (3); take note that the logarithm of each variable will serve as the foundation for the creation of the quantitative model.

To determine the best lag length for the variables, the first step is to estimate it and run a lag length test. The Akaike information criterion (AIC) was used to calculate the ideal lag length to be included in the unrestricted ECM, and the maximum order of lags was set to three in the ARDL choices. The findings imply that a lag duration of (4,4) is the ideal one. The following step is to calculate and look at the long-term relationships between the variables. An F-Bounds test is derived for the joint significance of the lagged levels after doing a Wald test on the unconstrained ECM variable`s coefficients.

So, with a constrained constant and no trend, and at the 5% level of significance, the estimated F-statistic of the Bounds test (3.11) is greater than the upper bound critical value. So, it is possible to rule out the null hypothesis (H0) that there is no cointegration among the series. This suggests that all the factors have a long-term link. To put it another way, the model variables move together over time. So, as indicated in Table 4, we estimate the ECM short-run model.

E. Error correction model

Table 4. Error correction model

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(POVERTY(-1))	0.797421	0.203198	3.924358	0.0172
D(POVERTY(-2))	0.584765	0.205037	2.851995	0.0463
D(POVERTY(-3))	1.025599	0.284775	3.601440	0.0227
D(PERCAPITA_CURRENT)	-0.005612	0.158927	-0.035310	0.9735
D(PERCAPITA_CURRENT(-1))	0.319073	0.155436	2.052754	0.1093
D(PERCAPITA_CURRENT(-2))	0.723400	0.158505	4.563895	0.0103
D(PERCAPITA_CURRENT(-3))	0.273013	0.197183	1.384571	0.2384
BASIC_FACILITIES	17.29184	5.080723	3.403420	0.0272
AIR	0.181110	0.110546	1.638324	0.1767
PORT	-0.196655	0.203579	-0.965989	0.3888
MOB	0.139395	0.127059	1.097088	0.3342
FIXED	-0.103758	0.039991	-2.594540	0.0604
CointEq(-1)*	-1.174084	0.313779	-3.741751	0.0201

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	3.111267	10%	3.02	3.51
K	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

R-squared	0.951851	Mean dependent var	-0.008822
Adjusted R-squared	0.855553	S.D. dependent var	0.042732

Findings:

Despite the model's good goodness of fit ($R^2 = 0.85$, which indicates that the model's variables can account for 85% of variations in the poverty rate), the ECM's findings, which are shown in Table 4, indicate that:

- There is no statistically significant influence of the variables mobile cellular subscription (per 100 people), air transport registered carrier departures worldwide, and container port traffic individually on the poverty rate at the 5% significance level, whereas p-value < α = 0. And this means that those factors cannot affect the poverty rate because they cannot contribute intensively to attracting investment, creating job opportunities, or generating incomes. So, the results show there are no relationships between the poverty rate and any of these factors.

- Whereas there is a statistically insignificant relationship between GDP per capita and poverty rate at a 5% significance level, whereas *p–value* < α = 0.05 for the one-year lag and the two-year lag, but for the three-year lag GDP per capita has a positive impact on poverty rate at a 5% significance level, whereas *p–value* < α = 0.05. So, the effect of GDP per capita is generally insignificant, and even if it has an effect, this effect is positive. This means that when the GDP per capita increases, the poverty rate also increases. And this may occur because of the income inequality, which may increase the gaps among people; this does not let increasing GDP per capita decrease the poverty rate in Egypt, as can be clearly seen in Figure 1 since the tendency of the relationship between GDP and poverty rate seems positive.

- There is a statistically significant positive impact of the basic facilities on the poverty rate at the 5% significance level, whereas the *p–value* < α = 0.05. And that means that increasing the investment in basic facilities may increase the satisfaction of the poor, but it cannot increase their standards of living or even generate income. On the other hand, this investment decreases the amount of investment directed to the other channels that affect the incomes of the poor, so it ends up increasing the poverty rate.
- Where is the statistically significant impact of a fixed-line telephone subscription (per 100 people) on poverty rates at the 10% significance level, whereas the *p–value* < α = 0.10. And this means that fixed-line telephone subscriptions may contribute directly to the operations of economic activities, which generate income for individuals and firms. So, it negatively impacts the poverty rate in Egypt.

Conclusion:

This relationship between poverty alleviation and infrastructure development in Egypt is estimated in this paper using four main independent variables: infrastructure, poverty rate, and the auto-regressive distributed lag (ARDL) technique. And the results show that infrastructure development (basic facilities) and

GDP per capita have positively affected the poverty rate. Although telephone subscriptions affect it negatively. So, the government should focus on the investment in fixed-line telephone subscriptions because it has a positive impact on poverty reduction, and eliminating the gap between income classes is necessary because it cannot allow the economic growth rate to decrease the poverty rate in Egypt. In addition to paying more attention to the public investments that create an attracting atmosphere for private investment than the kind of investment that cannot generate incomes or promote the lives of the poor.

Additionally, further research can focus more on the other channels of infrastructure, especially all infrastructure that is related to technology, because it may affect the poverty rate in a country more than other kinds of infrastructure and because investors need it for their investment to provide a competitive advantage over their competitors. And this point is considered a limitation of the research as these factors were not easily available at the time of the research, so the researcher did not use them in this paper except for the variable of telecommunications. By and large, it can be said that the infrastructure cannot affect poverty alleviation positively in Egypt, according to most variables of infrastructure used in this paper.

References:

1. Ari, I. R. D., Hasyim, A. W., Pratama, B. A., Helmy, M., & Sheilla, M. N. (2017, June). Infrastructure and social tie: Spatial model approach on understanding poverty in Malang regency, Indonesia. In IOP Conference Series: Earth and Environmental Science (Vol. 70, No. 1, p. 012017). IOP Publishing.
2. Calderón, C., & Chong, A. (2004). Volume and quality of infrastructure and the distribution of income: An empirical investigation. Review of Income and Wealth, 50(1), 87-106.
3. Chotia, V., & Rao, N. V. M. (2017). An empirical investigation of the link between infrastructure development and poverty reduction: The case of India. International Journal of Social Economics.
4. Duffy-Deno, K., & Eberts, R. (1989). Public infrastructure and regional economic development: A simultaneous equations approach (No. 89-09).
5. Fagbemi, F., Osinubi, T. T., & Adeosun, O. A. (2022). Enhancing sustainable infrastructure development: a boon to poverty reduction in Nigeria. World Development Sustainability, 1, 100006.
6. German-Soto, V., & Bustillos, H. A. B. (2014). The nexus between infrastructure investment and economic growth in the Mexican urban areas. Modern Economy, 5(13), 1208.
7. Haider, M., & Badami, M. (2004, June). Public transit for the urban poor in Pakistan: Balancing efficiency and equity. In Proceedings from the Forum on Sustainable Infrastructure and Service Delivery for the Urban Poor. New Delhi, India: Woodrow Wilson International Center for Scholars.
8. Kodongo, O, & Ojah, K. (2016). Does infrastructure really explain economic growth in Sub-Saharan Africa?. Review of Development Finance, 6(2), 105-125.

9. Marinho, E., Campelo, G., França, J., & Araujo, J. (2017). Impact of infrastructure expenses in strategic sectors for Brazilian poverty. EconomiA, 18(2), 244-259.
10. Medeiros, V., Ribeiro, R. S. M., & do Amaral, P. V. M. (2021). Infrastructure and household poverty in Brazil: A regional approach using multilevel models. World Development, 137, 105118.
11. Meilvidiri, W., Jafar, R., Nahumury, M. A. I., & Akbar, M. (2020, March). The development of infrastructure and the level of poverty in the eastern part of Indonesia. In IOP Conference Series: Earth and Environmental Science (Vol. 473, No. 1, p. 012134). IOP Publishing.
12. Saied Ahmed, R. (2022). Measuring the effect of empowering women on Alleviating poverty in Egypt. Scientific Journal for Economic& Commerce, 52(3), 63-114.
13. Xiao, H., Zheng, X., & Xie, L. (2022). Promoting pro-poor growth through infrastructure investment: Evidence from the Targeted Poverty Alleviation program in China. China Economic Review, 71, 101729.
14. Zhang, L., Zhuang, Y., Ding, Y., & Liu, Z. (2023). Infrastructure and poverty reduction: Assessing the dynamic impact of Chinese infrastructure investment in sub-Saharan Africa. Journal of Asian Economics, 84, 101573.