Chinese Infrastructure in Africa

Haixuan Yu[1], Hui Yuan[2,3*], Yi Wang[4]

[1] Abbey college, Cambridge，Homerton Gardens, Purbeck Rd, Cambridge, England,   CB2 8EB
[2] Taoyuanju Zhongao experimental school, 138 Qianjin Second Road, Bao'an District, Shenzhen 2889147367@qq.com*
[3] Elite family, 2889147367@qq.com*
[4] Wuhan Britain-China School，10 Gutian Side Road, Qiaokou District, Wuhan,China
+ They are all first authors.

ABSTRACT

In the data analysis part, we first divide the data into transportation project variables, such as transportation services and space transportation, and post and telecommunications project variables, such as computers, communications, and other services. When conducting principal component analysis on the two types of variables by wind, we selected two principal components with 80% characteristics of the original variables, namely, aviation and port transportation project variables and transportation service import ratio variables. New variables replace transportation project variables. In addition, for post and telecommunications variables, we selected two principal components with 96.8% characteristics of the original variables as new variables, namely: Post and telecommunications variables as the proportion of computer communications in commercial services and the proportion of computer communications in the import and export volume of services. The variable in this way is used to replace the post and telecommunications variables. As part of building the model, we built a linear regression model based on the standardized GDP data and the four principal components. We chose to use the linear regression model because of the strong linear correlation between the variables, and the correlation coefficient R reached 0.827. In addition, from the ANOVA results, it can be found that the F value of the fitted linear model is 7.582, indicating that the linear regression model should be used to fit the variables because the test result is significant. We can know that the four variables have a significant impact on GDP through the regression parameters of the linear regression model. At this time, we constructed a linear regression model. Other variables also have a stimulating effect on GDP, and transportation projects composed of aviation and ports have the strongest stimulating effect on GDP. With the increase in infrastructure, South Africa's GDP also means an improvement in living standards.

Keywords: Chinese infrastructure, Africa

1.INTRODUCTION

South Africa owns the mixed system, the second largest in the continent once Nigeria. It also has the relatively higher gross domestic product per person compared to alternative nations in Sub-Saharan Africa ($ 11,750 in surgical procedure as of 2012). Despite that, Republic of South Africa is even burdened by the comparatively higher rate of economic condition and state, and is additionally graded within the high ten nations during this globe for financial gain inequality[1]. Quantified by this Gini coefficient. We in the developed world oftentimes take psychological footage of Africa as very poor and all backward in engineering. Whereas Africa is comparatively bad, it isn't as technologically unintelligent as we have a tendency to imagine. As a matter of fact, there are signs that Africans are leapfrogging from retardation to government of those art applications, all at the only limit. Infrastructure construction refers to the expanded copy of fastened assets allotted by numerous sectors within the economy for the advance of productivity. Infrastructure construction. That is, the overall term for the development, purchase, and installation of these to extend the scope of fixed assets. For example, the construction or growth and restoration of highways, railways, bridges, and various industrial and civil buildings, similarly because the purchases and installation of machinery and equipment, vehicles and ships, and connected work are all known as capital construction. The New infrastructure includes info

construction, innovation construction and integration construction. To be more specific. For instance, 5G construction of base stations, UHV, urban high-speed railways and concrete rail transit, new energy vehicle charging piles, huge information centers, artificial intelligence, industrial web and etcetera China's Belt and Road Initiative (BRI) may be a strategy initiated in 2003 by China's President Xi Jinping, BRI by connecting Asia with continent and Europe via land and maritime networks, BRI aims to improve regional integration, increase trade and stimulate economic growth. South Asia occupies a central place on the map of China's BRI. BRI, the multi-billion-dollar infrastructure investment platform, has positive economic effects for developing countries, however conjointly some threats to the BRI as inflated. Examining the BRI project in the continent reveals the facts of, however the initiative functions within the developing world, wherever infrastructure finance is in imperative need. Economic infrastructure plays a vital role in facilitating the sleek running of all the sectors of the economy. In addition, infrastructure such basic requirements as railways, roads, ships, airways, communication, etcetera They also embrace energy, banking, science, technology, health, education and alternative service concerns. While not the existence and presence of economic infrastructures, the expansion and quick pace of the economy is impossible. Moreover, the infrastructures of an economy are termed as 'social and economic overheads. Despite these edges to people and to the general economy, infrastructure brought some harmful effects because the fight of native Enterprises is mostly low. The help from foreign corporations provided for Republic of South Africa has long been a subject matter to study. Whereas some earlier studies had predominately focus on the sharp increase within the figure of China's trade with continent similarly as FDI increase[2]. Furthermore, the importance of China government participation of bilateral economic and technological cooperation with African countries, as China has been the second-largest commerce partner for Africa for decades. Chinese corporations' presence within the African market prevents African companies from competitory with them in the native market, that spawned issues of Bankruptcy of local industries and over-exploitation of local resources. There are 2 opposing views among economists on the role of multinationals, foreign direct investment (FDI), trade and investments type China. Little or no is recognized relating to the roles opportunities created by multinationals in continent, that thereby stimulates employment rate, that {might be|could be|can be|may be|may we have a tendency toll be} enforced by Chinese enterprises to boost the use rate in Africa to around seventy p.c to ninety five percent. The role of analgesic factors in explaining the contribution of China to its native infrastructure and capital formation, conjointly some drawback encountered with aids, are quite under-researched. Hence, in the study, we specialize in the stimulating effects Chinese investments

wear the African economy and also harmful effects on local enterprises as Chinese enterprises enter the African mining, textile, clothing, and energy sectors. This paper takes advantage of access to the date from International Bank for Reconstruction and Development and a few operating papers from UNDP Human Development report back to investigate whether or not and the way Chinese aids, multinationals and foreign direct investment are delivered to Republic of South Africa to bring jobs, creating a lot of financial gain which may contribute to a multiplier factor impact throughout the past few decades. To urge a much better plan on of whether and how infrastructure-related comes have a pull effect on South Africa's GDP, by grouping data from existing literature and therefore the information of the globe Bank, throughout the information preprocessing, we have a tendency to allotted data standardization and correlation test-through the results, we are able to recognize that the variables and gross domestic product have a precise linear relationship, and therefore the principal element eliminates multicollinearity--the supply information is split into transportation project variables, and a part of it's divided into post and telecommunications Communication project variables for principal component analysis. Whereas building the model, attributable to the sturdy linear correlation among multiple variables, I used the regression parameters of the simple regression model to search out that the transportation variables composed of aviation and ports have the strongest actuation impact on GDP[3]. Foreign countries build high-speed rail for Africa, which may usually scale back the losses caused by Africa's inefficient transport industry, and foreign companies can supply little loans provided to native employees for emergencies. Foreign companies offer wages we have a tendency to toll on top of the economic condition standard. We divided variables into 2 groups—transportation and telecommunications. We analyzed the principal parts to eliminate multiple correlation and utilized the regression parameters of the simple regression model. The result shows that transportation variables composed of aviation and ports have the strongest actuation impact on the gross domestic product of South Africa, as a result of high-speed railways designed by foreign companies typically reduced the losses caused by the inefficient transport industry. It is seen from the model that connected infrastructure comes to have a stimulating impact on South Africa's gross domestic product. Moreover, with the event of domestic infrastructure construction, the national GDP has conjointly increased. The study obtains the subsequent results, that are stable in intensive sturdy analysis. In terms of Chinese aids, which suggests the method of comparatively economically developed country, China provides backing to the economically developing economy, Africa. However, there are downsides with foreign aids as well, which pertains to true wherever the economic development of nations in South Africa, as

well as includes Angola, Zambia, Malawi, Mozambique, Zimbabwe, Namibia, Botswana, South Africa, Eswatini, Lesotho, Madagascar, land and Mauritius is hindered by its relationship with China. Initial and foremost, some aid has been utilized in investments that became comparatively unsuccessful in Republic of South Africa, for instance, the doorway of textile and industry from China ends up in bankruptcy of comparable companies in Africa with weak comparative competitiveness. Besides, a number of the helps has been 'tied' in some way--that is, there are conditions hooked up to the aid then the receiving countries in South Africa has not been all absolve to decide the way to pay the money, which refers to restricted client selection in Africa, for example, customers in Africa can keep on with the product with its bound whole as there are not any selection provision for them to hunt for one more choice even the merchandise can't deliver satisfactory demand for them. Moreover, in some cases, there has been corruption in South Africa, that the result that a lot of the money has unbroken within the hands of a few, instead of unfolding across the entire economy. With the increasing trade and investment between China and Africa, the output increase. The speculation of comparative advantage indicated that each one country will edge from international trade as long as there are variations in cost on producing one explicit product, to be a lot of specifically, the cost, wage within the marketplace and technology in South Africa. International trade between the countries will thus result in a rise in the world output and this can ultimately lead to an improvement in the living customary and development level altogether countries in Africa. On the opposite hand, there are also facet effects. Whereas developed economies have cared-for concentrate on the assembly of factory-made goods, the developing economy, Africa, have tended to concentrate on the production of primary products, some developing economies trust one artifact for over half their export earnings. The matter is the cost of primary product have, on the whole, declined relative to the prices of factory-made goods, though several developing economies are currently a lot of less smitten by the exports of primary products than accustomed to be the case. In terms of primary production, it's a lot of doubtless to be more volatile in terms of supply conditions, with the impact that price for primary products is typically less stable than for manufactured goods, a key issue is that the demand for, and provide of primary products is more price nonresilient than is the case with secondary products. It's conjointly the case that the demand for several promary products, appreciate differing types of food, is a lot of financial gain nonresilient than the demand for factory-made goods. Once the multinationals and foreign direct investments from China flows in Africa, on the one hand, they'll produce more job opportunities and supply more selection for consumers, resulting in a better customary of living. Also, they can bring technical information that might result in higher levels of native

productivity, thus stimulates economic growth. Moreover, if the output created is exported, this might lead to an improvement in the accounting of the balance of payments. From the information collected, the highest product foreign by continent are Motor cars for persons (worth seventeen billion USD), medicament (worth 11.4 billion USD), phone phone sets (worth 11.2 billion USD), wheat (worth 10.6 billion USD), cars for the transport of products (worth 6.3 billion USD), rice (worth 6.3 billion USD), and elements & accessories for motor vehicles (worth 6.1 billion USD). On the opposite hand, multinationals might use capital-intensive ways of production, which implies that not several native jobs are created. Besides, the roles that are created are also comparatively unskilled, appreciate line operator and construction laborer. What's more, a lot of the profits is also repatriated back to the house country and not re-invested within the native economy. The flux of multinationals, that ends up in construction of factories and depletion in Africa, may additionally injury the local atmosphere in Africa. What's more, they'll attempt to influence the govt. of the countries in Africa, resulting in the chance of corruption. It's going to undermine the method of development in South Africa, leading to lower levels of economic process than would well be the case. Findings from this analysis contribute to the understanding of each the positive sides and negative sides of Chinese investment within the African economy {and the|and thus the|and also the} reasons why China insisted on supplying aid, partaking in trade and investment in Republic of South Africa throughout the past decade. The results uncover that firstly, despite all the very fact that China has long maintained quite $3 trillion in interchange reserves, the money cannot be used domestically, therefore China favor to facilitate boosted 1673 comes in fifty-one African countries. Secondly, Africa has its own advantage, that refers to its wealthy natural resources, especially, energy and mineral resources. The last reason is that because the BRI project implemented, China engaged in providing aid for foreign corporations and international trade to assist determination the difficulty of state and their poor living standard. This remainder of this paper is structured as follows, the subsequent half is literature review and model, information description, economic science model and its results and conclusion.

2.LITERATURE REVIEW

This article describes the growth of China's total trade with Africa. At the same time, Chinese investment in Africa has increased (from $4,900 in 1190 to $2.6 billion), and China is a major investor in Africa. According to some data in the literature, China and Africa are interdependent. Explain that if China's economy grows, it may increase trade with Africa, or it may increase investment in African infrastructure. As FDI increases, Africa will have more money to invest in

construction. Thus, the development of the African economy [4].

This document shows that China has played a very important role in the economic growth and development of African countries. China is Africa's second largest trading partner, and the amount of trade between them has grown very rapidly in more than a decade. In recent years, China's assistance in bilateral economic and technological cooperation with the African continent has also increased significantly. China's growth in FDI in Africa has also contributed to Africa's economic development. For example: China's Belt and Road Policy, China's possible construction of public sectors in Africa, roads, oil research, and cooperation in the fields of health, education, culture, and the military, all of which can boost economic development. When it comes to China's foreign aid, it is worth noting that the proportion of aid received by the African continent is also rising [5].

This paper mainly describes the use of autoregressive lag models to assess the pull effect of infrastructure construction on Economic Development in Africa. Using this model, the literature identifies the short- and long-term impact of selected indicators of infrastructure stock and quality on economic growth. The model identifies power generation capacity as a major factor that primarily contributes to the economic development of the region. However, after we searched for some data models of infrastructure development in Africa, we formed our linear regression model and learned that the positive pull effect on Africa's over-GDP in terms of transportation is the strongest [6].

Chinese investment stimulated the African economy and bridged the widely recognized infrastructure gap. The first advantage brought to Africa is that there is more work opportunity for the local people. Employ and training workers for the work that requires high efficiency can cultivate the worker's skills, attract more investment, and promote economic growth. According to the evidence from DEGRP, there is a good deal of jobs created by Chinese firms in Africa and the average proportion of Africa employment is around 70% to 95%. By providing jobs, the unemployment rate in Africa will decrease, and the average income can increase. Moreover, Chinese firm provides accommodation and board and some extra benefits, which add to Africa's recognized income based on the local economic situation. Huawei and some other high-tech companies have offered competitive salaries to attract local talent, and some Chinese companies have adopted performance-based pay to encourage African employees, which can make sure the productivity is high. For example, Huawei has 3 regional departments, more than 20 representative offices, 3 R&D centers, and 6 training centers in Africa. Every year, many trainees from the Huawei training center finish their training and join the ranks of communication construction and service in Africa. After

that, the technology industry in Africa can be developed in the long run. Some Chinese firms will offer small loans are provided to local workers for emergencies, and Chinese companies offer wages that are well above the poverty standard.

Second, investment in Africa contributes to the formation of capital. Most countries in Africa are lack capital which will limit the local economic development. The inflow of FDI from China not only makes up for the domestic savings in Africa but also enables Chinese enterprises to rapidly form production capacity with economies of scale and promote the rational allocation of production factors. By investing capital and technology in local areas, enterprises can break the barriers hindering production development caused by the lack of production factors in African countries. In this way, African economic development can be promoted by giving full play to factors that it is not capable of utilizing and making full use of superior resources to create new production capacity.

Third, Chinese investment can make up for the lack of local infrastructure. According to the World Bank's 2007 African Competitiveness Report, eight percent of sales lost by African firms are due to power outages and three percent are due to transport delays. However, as China builds high-speed rail for Africa, which can generally reduce the losses caused by Africa's inefficient transport industry. Nowadays, more and more Chinese enterprises are involved in infrastructure and manufacturing investment in Africa. China's investment in Africa has greatly compensated for the lack of local infrastructure. China has a strong comparative advantage in Africa's infrastructure field by which Africa's communications, transportation, water supply, telecommunications, and electricity can all be replenished by Chinese investment. For example, ZTE has helped many local telecom operators in Africa to establish their communication networks, breaking the long-term monopoly of multinational operators in Europe and the United States, enabling people to "afford and use telephones," and continuously improving the speed of data networks to 3G and 4G. The public security system provides guarantees for the daily life of some African people; Its deployment of solar power systems provides electricity needs for residents in remote areas; Zte also cooperates with other Chinese enterprises to equip the oil fields, railways, roads, and industrial parks invested in by ZTE with the latest information and communication equipment and services to accelerate the transformation of Informatization and modernization in African countries. By doing this, economic development and poverty relief can improve a lot. Then, Chinese investment can help Africa increase the added value of its products. Africa is rich in all kinds of raw materials, but it cannot process them because it has no corresponding technology. Hence, For a long time, Africa can only export primary raw materials to the world market, and the

drastic fluctuation of world market prices has seriously affected the economic development of Africa. By investing in Africa, Chinese enterprises have brought local production and management technologies as well as their own development experience, which will help build production capacity, transfer technology, optimize the mix of export products and increase the added value of African exports. OECD believes that China can provide Africa with opportunities to participate in the global value chain, especially in the textile and clothing industry. African countries can take advantage of the economic and trade activities of Chinese enterprises in Africa to increase the size, diversity, and added value of the continent's exports.

However, every coin has two sides. China's infrastructure in Africa has both positive and negative impacts

Firstly, as Chinese enterprises enter much African mining, textile, clothing, and energy sectors, due to their comparative advantages in terms of costs，wages, and technology, they will cause a huge impact on similar local enterprises. Firstly, the local African country will be affected by Chinese investment. This is because the competitiveness of Native Enterprises is generally low. The influx of Chinese enterprises makes African enterprises unable to compete with them in the local market, which inevitably leads to the bankruptcy and bankruptcy of similar enterprises with weak local competitiveness. As we all know, the Textile and garment industry is the pillar industry of many African countries, but compared with China, the textile and garment industry of Africa still look very immaturity, as a result, Investment by The Chinese textile and garment companies in Africa has impacted some of the pillar industries in a few African countries and even led to the bankruptcy of local enterprises. Moreover, Other industries in Africa, such as oil and mining, face the same situation because of the lack of high quality and low cost compared to Chinese firms. Secondly, as more and more countries invest in Africa, the environment of Africa has been greatly affected. According to the UNCTAD, Asia's growing demand for oil, gas and metallic minerals has led to a rapid expansion of investment in the development and refining of mineral resources around the world, especially in mineral-rich African countries. Some enterprises, eager for quick success and immediate profits, ignore international cooperation rules and practices and local laws and regulations on environmental protection, ignore the concept of environmental protection and sustainable development, and illegally exploit and exploit the natural resources of African countries, damaging the environment in the process of resource exploitation and putting heavy pressure on the local environment.

We all know that despite China's rapid development, western China is still lagging behind, and by 2020, there will still be more than 600 million people in China earning only 1,000 yuan (£100) a month. However, from 2000 to 2011 alone, China helped build 1673 projects in 51 African countries, costing approximately $75 billion. Some may wonder why China doesn't use the money to build the west. Is China a philanthropist?

there are 4 reasons for why china understake the infrastructure project in Africa. Firstly, In fact, the money spent on improving people's livelihood and aid to Africa is different. The money to improve people's livelihood at home comes from the state's fiscal revenue. Money invested in Africa comes from countries' foreign exchange reserves。Although China has long maintained more than $3 trillion in foreign exchange reserves, the money cannot be used in domestic. For example, If a Chinese enterprise receives a foreign order and exports equipment worth US $20 million to the United States, this US $20 million in foreign exchange. Since the US dollar cannot be used directly at home, it will convert us $20 million into 140 million yuan in the bank, and then the bank will get us $20 million, which is foreign exchange reserves. since foreign exchange cannot be directly used for domestic construction, then we have to convert it to RMB again. that is, another 140 million yuan will flow into the domestic market. In this way, US $20 million will always be in the bank, but the shortage of RMB in the market is increasing. Consequently, this issue will cause inflation and the domestic price level will increase China will become the next Zimbabwe.

Secondly, Because Africa is very rich in energy and mineral resources, it has two-thirds of the world's mineral reserves, and more than half of the gold and diamonds are opened. The raw material supply channels here allow China to calmly respond to the threat of embargoes and supply disruptions

Thirdly, China's "Belt and Road" infrastructure construction in many countries can solve many local employment problems and increase the income of local people. Along the way, in Africa, the Middle East, and Eastern Europe, there are about two billion people. Moreover, Africa is the continent with significant population growth in the middle and second half of this century. It is estimated that by 2040 Africa will have more babies born each year than in Asia, and by 2100 half of the world's babies will be born in Africa. According to the Datum of the World Bank, the per capita GDP of sub-Saharan African countries was us $1,585 in 2019. By 2050, even if the development level is only about the US $4,500 that of Southeast Asia today, it will bring huge consumption potential to China. Thus, the huge consumer market can solve China's overcapacity problem. Indeed, over the past 16 years, China-Africa trade has continued to grow. China-Africa trade stood at $192 billion in 2019, up from $185 billion in 2018. Angola is the largest African exporter to China. Nigeria is the biggest buyer of Chinese goods, followed by South Africa and Egypt.

Lastly, In the context of China's massive investment in infrastructure energy in Africa, there are about 200000 registered and expatriate Chinese workers in Africa. These flying jobs have alleviated the problem of talent training and surplus in some disciplines in China. The increasing bilateral trade and infrastructure orders have stimulated a number of Chinese people doing business to go to Africa. At present, it is roughly estimated that there are millions of Chinese people, For a long time in Africa, this has alleviated the employment pressure in China to a certain extent the reason why China does the infrastructure in Africa.

3.METHODOLOGY

3.1. *The linear regression model of south Africa infrastructure*

South Africa includes Angola, Zambia, Malawi, Mozambique, Zimbabwe, Namibia, Botswana, South Africa, Eswatini, Lesotho, Madagascar, Comoros and Mauritius.

3.2. *Data Analysis section*

3.2.1. Data preprocessing

Because the source data variables have different (inconsistent units), to eliminate the resulting differences caused by the scale, the source data is standardized before the data is processed (in this case, the source data is processed as data with a mean of 0 and a variance of 1).

3.2.2. Correlation test

The correlation test is carried out on the variables and the correlation between the variables is observed. From the test results, the correlation between each variable and GDP is significant, indicating that there is a certain linear relationship between variables and GDP, in addition, the correlation between variables is also more significant, indicating that the linear relationship between variables is strong, in order to eliminate the adverse effects of multivariate multi-collinearity, we will reduce the dimension of its principal components (eliminating the effects of Multicollinearity).

3.2.3. The principal components eliminate multiple collinearity

We divided the source data into two categories, one is the transportation project variables, the other is the post and telecommunications project variables, and the two types of variables are analyzed as the principal components.

For transport project variables, we select the first two principal components with 80% of the original variable characteristics as the new variables to replace the transport project variables. The first principal component mainly represents the transport project variables of aviation and ports, and the second principal component mainly represents the import ratio variable of transportation services.

(The characteristic values of components 1 and 2 are known to be greater than one, so the two components are selected for analysis; the rotating composition map shows that the main component I air transport passenger volume is 94.6%, air transport volume registered carrier global port volume is 92.2%, container terminal throughput TEU90.1%; component II transport services account for 97.0% of commercial services exports, transportation services account for 97.0% of the balance of payments statistics caliber of service imports.) so that we know that the amount of information obtained by these factors is relatively large)
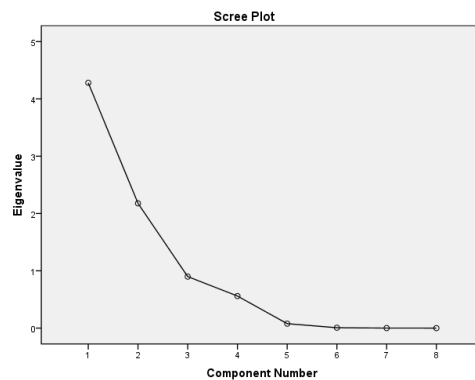

Figure 1: Component Number

Table 1: Rotating composition matrix[a]

	composition	
	1	2
Zscore(Transport services account for the proportion of commercial services exported)	-.896	.011
Zscore(Transport services account for the proportion of imports of commercial services)	-.024	.970
Zscore(Transport services account for the proportion of services exported in the statistical caliber of the balance of payments)	-.898	.015

Zscore(Traffic services account for the proportion of service imports of the statistical caliber of the balance of payments)	-.028	.970
Zscore(Air transport passenger volume)	.946	-.168
Zscore(Air transport cargo volume of millions of tons km))	-.096	.568
Zscore(Global departures of registered carriers of air traffic)	.922	-.213
Zscore(Container terminal throughput TEU)	.901	.033
Extraction method: The main ingredient。 Rotation: Has Kaiser standardized orthogonal rotation。		
a. Rotation converges after 3 iterations。		

For the post and telecommunications variables, we select the first two principal components with the original variable 96.8% characteristics as the new variables, used as an alternative to the postal and telecommunications variables. The first principal component mainly represents the computer communication as a proportion of commercial services of the postal and telecommunications variables, the second principal component mainly represents the computer communications as a proportion of the import and export of services variables.

(The main components 1 and 2 are characterized by a graph of gravel that are greater than one, so select these two components for analysis.) According to the rotary composition matrix, computer communications and other services account for 97.1 per cent of exports of commercial services and computer communications and other services as a percentage of imports of commercial services, both of which account for a relatively large proportion of component I In Component II, it was learned that the percentage bod of export services, such

as communication computers, was 98.5 per cent, and that the percentage of services imported, such as communications computers, was 93.4 per cent. To know that these factors to obtain a relatively sufficient amount of information. ）
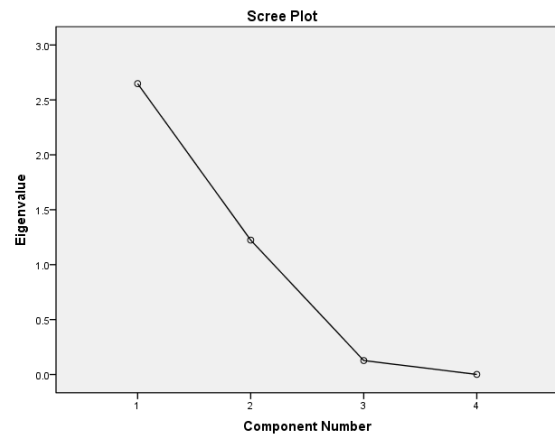

Figure 2: the post and telecommunications variables

Table 2: Rotating composition matrix[a]（the post and telecommunications variables)

	Composition	
	1	2
Zscore(Computer communications and other services as a percentage of exports of commercial services)	.971	.097
Zscore(Computer communications and other services as a percentage of imports of commercial services)	.946	.265
Zscore(Communications computers, etc. as a percentage of service exports BoP)	.063	.985
Zscore(Communications computers, etc. as a percentage of service imports BoP)	.327	.934
Extraction method: The main ingredient。 Rotation: Has Kaiser standardized orthogonal rotation。		
a. Rotation converges after 3 iterations。		

Note: After two main components to get four variables, these four variables can replace the previous eighteen variables to form a linear regression model.

3.3. Build a model

Based on the pre-processing results of the data, a linear regression model is constructed from the standardized GDP data and the four principal components.

From the results of the regression model, the linear regression model R (correlation coefficient) constructed from the GDP data of South Africa and the four main components reaches 0.827, which shows that the linear correlation between the multi variates is strong, and it is

more appropriate to use the linear regression model. Testing for correlations between arguments and arguments based on Durban-Watso indicates that there is no self-correlation between arguments when The value of Durban-Watso (0.491) tends to be one-time or greater than 0.05.

Table, 6 rows, 11 columns, From the results of the regression model, the linear regression model R (correlation coefficient) constructed from the GDP data of South Africa and the four principal components reaches 0.827, which shows that the linear correlation between the multi variates is strong, and it is more appropriate to use the linear regression model.

Table, 6 rows, 11 columns,

Table 3 : Model summary[b]

model	Multiple R	R Square	Adjusted R	Standard E	Change the statistics					Durbin-Watson
					Adjusted R square	Adjusted F	df1	df2	Adjusted Sig. F	
1	.827[a]	.684	.594	.63722289	.684	7.582	4	14	.002	.491
a.Predictors : (constant quantity), REGR factor score 2 for analysis 2, REGR factor score 1 for analysis 2, REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1。										
b.Dependent variable: Zscore(GDP the current price is US dollars)										
ANOVA is used for significance testing, because the F value of 7.582 is more difficult to determine whether the test results are significant, so the test should be combined with Sig. In this data Sig is 0.002 The result is less than 0.05, so the test results are significant. The test results indicate that it is appropriate to use a linear regression model.										

Table 4 : Anova[a]

Model		The sum of squares	df	Mean square	F	Sig.
	regression	12.315	4	3.079	7.582	.002[b]
	residual	5.685	14	.406		
	total	18.000	18			
a. Dependent variable: Zscore(GDP the current price in US dollars)						

It can be seen from the regression parameters of the linear regression model that all four parameters are significant (5%), indicating that the four variables have a significant effect on GDP, and the multiple collinearity between the variables has been eliminated (VIF<10). This allows you to build a linear regression model as follows:

GDP=0.581*FAC1-1+0.137*FAC1-2+0.261*FAC2-1+0.240*FAC2-2

The coefficients of these variables are positive, indicating that the arguments are positively correlated with the dependent variable GDP, and when investment in infrastructure construction increases, the greater the pull on economic growth. Among them, the transportation project variables composed of aviation and ports have the strongest pull effect on GDP, and the other variables have the strongest pull effect on GDP. That is, with the development of infrastructure investment, South Africa's GDP will also develop.

Table 5: coefficient[a]

| Model		Non-standardized coefficient		Standardized coefficient	t	Sig.	Correlation			Collinear statistics	
		Beta	Standard error	Beta						Residual	VIF
1	(constant)	-4.341E-017	.146		.000	1.000					
	FAC1-1	.581	.370	.581	1.572	.0028	.776	.387	.236	.165	6.057
	FAC1-2	.137	.193	.137	.712	.048	.050	.187	.107	.605	1.652
	FAC2-1	.261	.387	.261	.675	.051	.717	.177	.101	.151	6.625
	FAC2-2	.240	.156	.240	1.533	.0038	.165	.379	.230	.923	1.084
a. Dependent variable: Zscore(GDP the current price in US dollars)											
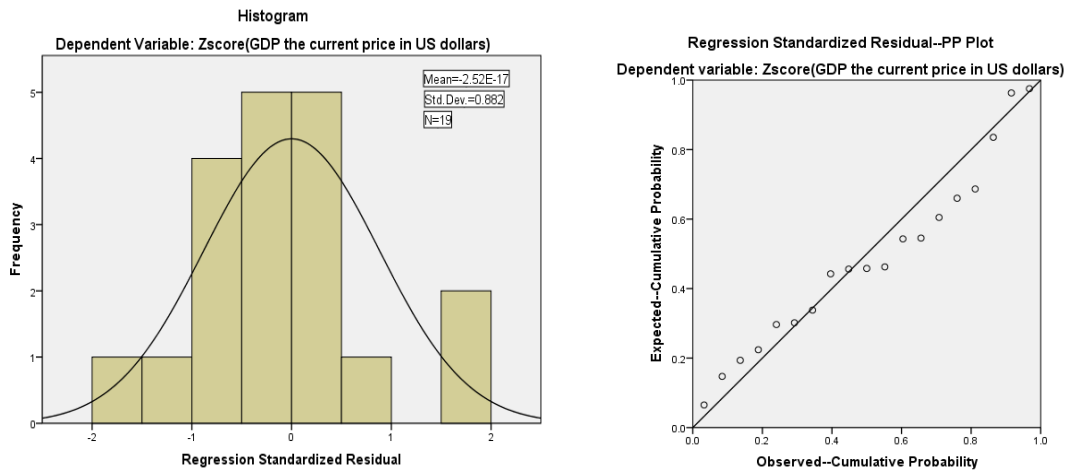
Figure 3: The histogram

The histogram gets a standard normal distribution. The residuals meet the standard normal distribution, which indicates that the data are reasonable. It can also be seen from the scatter plot that the point around the line is to meet the standard normal distribution. It is reasonable to use the regression model.

4.CONCLUSION

From the model, it can be seen that infrastructure-related projects have a pull effect on South Africa's GDP. With the development of domestic infrastructure construction, the country's GDP will also grow. However, linear regression models also have some limitations. Although from the model correlation coefficient, it shows that there is a strong positive correlation between GDP and several variables. This shows that the linear relationship is not very prominent due to the low correlation coefficient (only 0.6). There may be a better model to improve this. In addition, because the data collected is limited and does not fully contain all the variables that affect infrastructure, the results may deviate from the real results.

REFERENCES

[1] Sylvaire Debongo Devincy Yanne, Fatoumata Traoré,and Aimée Umutoniwase Marie."Infrastructure Development: China's Investment Aid and Subsidy Projects in Africa: Case of the Central African Republic." American Journal of Industrial and Business Management 10.12(2020): doi:10.4236/AJIBM.2020.1012117. https://www.scirp.org/pdf/ajibm_20201230140446 32.pdf

[2] De Graft Owusu Manu, et al."The impact of infrastructure development on economic growth in sub-Saharan Africa with special focus on Ghana." Journal of Financial Management of Property and

Construction 24.3(2019):doi:10.1108/JFMPC-09-2018-0050. https://www.emerald.com/insight/content/doi/10.1108/JFMPC-09-2018-0050/full/html. Namratha Reddy May 31st, 2018, Economic Infrastructure – Intro, Types, Significance

[3] Hany Besada, et al."China's growing economic activity in Africa."National bureau of economic research working paper No.14024 5(2008): doi:https://www.nber.org/system/files/working_papers/w14024/w14024.pdf

[4] Hany Besada，et al. CHINA'S GROWING ECONOMIC ACTIVITY IN AFRICA.National bureau of economic research working paper No.14024 5(2008): https://www.nber.org/system/files/working_papers/w14024/w14024.pdf

[5] Sylvaire Debongo Devincy Yanne, Fatoumata Traoré,and Aimée Umutoniwase Marie."Infrastructure Development: China's Investment Aid and Subsidy Projects in Africa: Case of the Central African Republic." American Journal of Industrial and Business Management 10.12(2020): doi:10.4236/AJIBM.2020.1012117. https://www.scirp.org/pdf/ajibm_2020123014044632.pdf

[6] De Graft Owusu Manu, et al."The impact of infrastructure development on economic growth in sub-Saharan Africa with special focus on Ghana." Journal of Financial Management of Property and Construction 24.3(2019): doi:10.1108/JFMPC-09-2018-0050.https://www.emerald.com/insight/content/doi/10.1108/JFMPC-09-2018-0050/full/html