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An empirical analysis of the relationship between China's direct investment and Benin's economic growth based on VAR model

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Abstract
Against the backdrop of a global economic slowdown and the prevalence of trade protectionism, the world economic recovery faces a more severe test, promoting foreign direct investment as one of the world's most dynamic economic activities. Foreign capital is also known as the "engine" of economic development in developing countries. Benin, as one of the world's Least Developed Countries, is heavily dependent on international aid and capital inflows for its economic development, despite its wealth of resources and its strategic location. With the continuous development of the "Belt and Road" initiative and the deepening of China-Africa economic and trade cooperation, Benin's economic development has been increasingly affected by Chinese direct investment. Based on this background, this paper selects the annual data from 1990 to 2018, and analyzes the impact of Chinese direct investment on Benin's economy by the Var model. The results show that Chinese direct investment has a positive effect on Benin's GDP, employment and total factor productivity. On this basis, the paper puts forward countermeasures and suggestions to promote Benin's attractiveness and utilization of China's direct investment.
Keywords: Chinese Direct Investment; Benin; Economic Impact; Var Model
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1. Introduction

After the independence of Benin in 1960, the government responded to the severe economic situation at home and abroad in order to shake off poverty and backwardness, promote opening up to the outside world and speed up the construction of a market economy, an important approach taken by Benin is to attract Foreign Direct Investment (FDI). At the same time, with China's rapid economic development, the gradual implementation of the "Belt and Road" initiative, and China's rapid transfer of large-scale manufacturing and investment to African countries, the government of Benin has become increasingly focused on attracting Chinese investors. Although China's total direct investment in Benin is not yet high, it has shown a general increasing trend. According to statistics from the Ministry of Commerce of the People's Republic of China, China's direct investment stock in Benin was US $7.7 million in 2003, ranking 15th in terms of Chinese investment in Africa, accounting for 10 per cent of the total global investment in Benin, and reached US $105 million in 2018. This data shows that Benin's economic development is greatly influenced by China's direct investment. Therefore, the study of the impact of Chinese direct investment on Benin's economy has a strong practical significance.

2. Review of relevant literature

In view of the fact that there is little literature on the analysis and research of the economic impact of China's direct investment in Benin, this paper is mainly based on the scholars' research on China's direct investment in other African countries or regions. According to Dunning 's theory of foreign direct investment, foreign investment can bring economic effects to the host country (Dunning, 1982). Chinese scholars have been studying the economic impact of Chinese direct investment in Africa since the early 1990s, with more related researches presently available on African countries GDP, infrastructure construction, employment, trade and on impetus to the economic aspects, etc.

Also, (Adams, 2009) analyzed the effects of foreign direct investment and domestic investment on economic growth by using data from Sub-Saharan African countries for the period 1990 to 2003, and concluded that the foreign direct investment effect was significant and had negative effects on domestic investment. Studies by Atangana Marie Paule shows that economic and trade exchanges between China and Africa have a positive effect on the economic development of African countries (Paule, 2014). This has had a positive impact on areas such as

employment, import and export trade and per capita national income in Africa. (Boakye–Gyasi & Li, 2015) found that Chinese direct investment in Ghana has had a positive impact on local employment through the construction of substantial infrastructure at home, while (Bofela, 2019) estimated the impact of China's direct investment in Africa, and found that the economic development of African countries is affected by China's direct investment. (Doku, Akuma, & Owusu-Afriyie, 2017) reckons that for every 1% increase in China's direct investment stock in Africa, Africa's GDP will grow by 0.607%. (Donou-Adonsou & Lim, 2018) examined the impact of Chinese direct investment on the living standards of people in Africa and found that Chinese direct investment increased the per capita income in the region. Moreover, a study by (Easterly & Schmidt-Hebbel, 1993) on the fiscal deficits and macroeconomic performance in developing countries revealed that attracting OFDI can boost the economic growth of host countries or regions, and this applies equally to African countries that receive Chinese direct investment. (Gohou & Soumaré, 2012) demonstrated that foreign direct investment has a significant positive effect on poverty reduction in Africa. From their study on the employment effect of Chinese investment in South Africa (Huang & Ren, 2013) believes that investment by Chinese enterprises in Africa has brought them sufficient capital and advanced technology, which has made obvious contributions to the economic and social development of African countries. However we have to face up to the fact that China's investment in textiles, clothing and other areas of the local economy has also had a negative impact. (Inekwe, 2013) draws on an analysis of Nigeria's 1990-2009 data on the service and manufacturing industries to show that FDI is positively correlated with economic growth in the repair sector, but negatively affected the manufacturing sector. (Khodeir, 2016) studied the employment effects of China on 38 African countries and found that Chinese direct investment can promote employment in African countries, while (Hyun, 2017) found that although China's direct investment in Africa fluctuates greatly, with the further development of Sino-Africa government-private exchanges and investment, China's direct investment into Africa's economic development and industrial development will be more significant. (Chikova, 2016) believes that China's investment policy towards Africa has changed from focusing on infrastructure, energy and other fields to helping Africa realize vision 2063, and African countries should take corresponding measures to better match it, such as: improving the security situation, improving public health, simplifying the investor approval procedures, and the establishment of a "one-stop" service center. (Michael, 2017) shows that, when China's direct investment stock in Africa grows by 1%, the GDP growth rate of the African countries concerned will rise by 0.607% year-on-year. China’s FDI Stock has a positive effect on the African economy as a whole.

In the analysis of the export driving effect of China’s FDI, (Qu, 2017) found that most of the regression coefficients between FL and FCV were within the 1% confidence interval and the regression coefficients were positive, this means that China's direct investment in Africa is beneficial to China's exports to Africa both in the short run and in the long run. (Huang & Ren, 2013) made it clear that most Chinese investment in Africa is concentrated in labor-intensive industries, with the model being mostly greenfield investment, which creates a large number of jobs in African countries. (Samouel & Aram, 2016) utilized the GMM approach in their study on the determinants of industrialization and found that the impact of inward FDI on industrialization differs among the African region examined. For example, the impact of FDI on industrialization was significant only for Southern Africa but not significant for North Africa, Eastern Africa and West African regions, respectively. (Whalley & Weisbrod, 2012) analyzed the impact of Chinese direct investment on African economic growth using the Solow growth model. The results show that in the years following the 2008 financial crisis, the economic growth of African countries can be largely attributed to China's direct investment in Africa. (Zafar, 2007) believes that economic and trade cooperation between China and Africa will improve the welfare of African consumers. (Yanxia, 2015) used empirical data and found that the relationship between direct investment from China and poverty in Africa is inversely u-shaped, meaning that direct investment from China can only reduce poverty in African countries to a certain threshold.

According to growth theories and the correlation between FDI and economic growth, FDI can both directly and indirectly boost a nation's economic growth. Therefore, by increasing capital accumulation, encouraging domestic investment, and producing productivity spillover, FDI can strengthen the economy of the host nation. Thus, in theory, FDI might contribute significantly to economic growth via increasing technical spillovers and capital accumulation (Miao et al, 2021).

On the global perspective, BRICS results indicate that FDI increases economic growth by 0.172. The findings highlight the efficiency of BRICS nations' trade and investment policies in sustaining economic growth in the face of global disruptions, showing that they have shown superior resilience in terms of FDI and trade before and after the COVID-19 epidemic and the Russia-Ukraine war (Maha et al, 2025).

To sum up, it can be noted that although many scholars have studied the economic, trade and investment relationship between China and Africa, these studies in general, at this stage actually have the following problems: Firstly, the relevant studies at this stage are mostly carried out along time series at the national level. However, due to the short period of time between China's opening-up and the start of China’s direct investment in Africa, the available sample size is not enough to reflect the long-term relationship of variables scientifically.

The second problem is that the existing research is mostly from the perspective of China or Chinese enterprises, not from the perspective of African countries, which creates an analysis bias. The third issue is that much of the existing research has focused on Africa as a whole, a continent with a large number of countries, a large poverty gap and a complex environment. Because the goal is not clear, the conclusion of the research also does not have enough pertinence, therefore, this article draws lessons from the former scholars' researches, and on this foundation, uses China to Benin direct investment stock data to test and obtain reliable results, and put forward targeted countermeasures to optimize Benin's investment environment to attract more Chinese investors.

3. An analysis of the current situation of China's direct investment in Benin

China's direct investment in Benin has a history of more than 40 years. Due to the fact that both China and Benin are developing countries, as well as the relatively mature and stable diplomatic relations between the two countries, the convenience of Benin's geographical location and the relatively small size of Benin's market, there are some typical characteristics of the current investment situation between China and Benin. This paper discusses the current situation of China's direct investment in Benin from the perspective of investment stock and investment flow.

a) Investment Stock: According to the Ministry of Commerce of the People's Republic of China statistics, since 2000, China's direct investment stock in Benin has been in a stable growth trend and maintained a relatively fast growth rate. As a result of the outbreak of the global financial crisis in 2008, the investment environment of all countries in the world deteriorated and their economies were severely impacted. Chinese companies also generally reduced their outbound investment to avoid risks during this period. Nevertheless, China's direct investment stock in Benin increased by 1.62% in 2009 compared to 2008. The year 2016 was the fastest-growing year for Chinese investment in Benin, partly because of the improving economic conditions in various countries after the economic crisis, but more importantly, the successful holding of the fifth China-Africa Forum in 2012 led to the resumption of the growth rate of China's direct investment in Benin, with US $104.37 million and US $103.99 million invested in 2017 and 2018 respectively. With the success of the Forum on China–Africa Cooperation summit in Beijing in 2018, Chinese direct investment in Benin will continue to grow. However, in late 2019, Chinese direct investment stock in Benin fell from US $103.99 million in 2018 to US $91.44 million in 2019 due to the outbreak of the novel corona-virus pneumonia in late December 2019. China's direct investment stock in Benin is shown in Table 1 below:

b)

Table 1: China's FDI stock in Benin, 2000-2018（Unit: Ten thousand dollars）

Year	FDI Stock	Year	FDI Stock
2019	9144	**2009**	5401
2018	10399	**2008**	5315
2017	10437	**2007**	3560
2016	10251	**2006**	2212
2015	8731	**2005**	1900
2014	6917	**2004**	2051
2013	4991	**2003**	771
2012	4760	**2002**	686
2011	4003	**2001**	621
2010	3933	**2000**	577

Source: Statistical Bulletin on China's outbound investment

c) Investment flows: According to the Ministry of Commerce of the People's Republic of China, China's direct investment flows to Benin from 2003 to 2008 showed an overall increase but with a highly volatile trend, and totaled US $14.56 million in 2008. However, the global financial crisis in 2008 also hit China's direct investment in Benin to some extent, for example, in 2009 China's investment flows to Benin fell sharply from $14.56 million in 2008 to US$90,000. After the financial crisis, economic conditions in various countries continued to improve, and China's direct investment flows to Benin also began to grow again, reaching US$14.76 million in 2015. But in 2016 and 2017, China's direct investment flows to Benin fell by US$4.79 million and US$13.43 million, respectively, compared with 2015. This decline can be attributed to the exchange reform of 2015, which led to tightening of domestic capital controls by the relevant departments of the Chinese government, in order to effectively control capital outflow and prevent financial risks. This measure slowed the opening up of domestic financial markets and the pace of Internationalization of the Renminbi. The result of capital control directly affects the international flow of capital and the normal trade and investment, hinders the effective allocation of

resources to a certain extent, and seriously affects the process of China's opening to the outside world. In addition, China's direct investment flows to Benin rebounded in 2018 to US $4.8 million. In late 2019, with the outbreak of the new type of corona-virus pandemic, the flow of Chinese direct investment in Benin dropped from US $4.8 million in 2018 to US $ -19.79 million. China's direct investment flow to Benin is illustrated in Table 2 below:

Table 2: China's FDI flows to Benin ,2000-2018（Unit: ten thousand dollars）

Year	FDI Flow	Year	FDI Flow
2019	-1979	**2009**	9
2018	480	**2008**	1456
2017	133	**2007**	632
2016	997	**2006**	-
2015	1476	**2005**	131
2014	744	**2004**	1377
2013	844	**2003**	209
2012	506	**2002**	175
2011	75	**2001**	187
2010	176	**2000**	200

Source: Statistical Bulletin on China's outbound investment

4. An empirical analysis of the impact of Chinese direct investment on Benin's economy

In order to assess the specific impact of Chinese direct investment on Benin's economy, this paper conducts an empirical test to examine its impact on GDP, employment, technology and tertiary sector of the economy.

4.1 model settings

In the empirical analysis, we consider four economic variables; GDP, labor force, technological level, and industrial structure. Based on the time series data from 1990 to 2018, this paper establishes a VAR model for the China's direct investment stock in Benin, Benin's GDP, Benin's labor force, Benin's technological level, and industrial structure. Industrial structure refers to the composition among and within the industrial sectors of the national economy. Instead, this paper uses the tertiary sector of the economy data. The tertiary sector of the economy reflects the degree to which the economy has modernized. The greater the proportion of the tertiary sector, the greater the degree of development, and the more jobs it can provide. In terms of technological progress, this article uses Total factor productivity as an indicator to measure the level of technology. The measure of economic growth chosen in this paper is Benin's gross domestic product (GDP). In addition, this paper selects the number of employments in Benin as an indicator of the labor force population and the Chinese direct investment stock in Benin as an indicator of foreign direct investment.

The above five variables are selected for the period 1990-2018. In addition to the data compiled and calculated by the Total factor productivity, other data are obtained from the National Bureau of Economic Statistics of Benin, the bulletin of Statistics on China's external investment and the World Bank. The mathematical expression of the Var model used in this paper is shown in equation (1):

$$y_{i,t} = \sum_{j=1}^{p} \beta_j y_{i,t-j} + \varepsilon_{i,t} \qquad (1)$$

where, $y_{i,t}$ is a vector containing five variables {INVEST，GDP，LABOR，THIRD，TFP}; INVEST is China's direct investment stock in Benin, GDP is Benin's gross domestic product, LABOR is Benin's labor force, THIRD is tertiary sector of the economy, and TFP is Total factor productivity, to test the impact of direct investment on technical efficiency in Benin. In order to avoid the possible heteroscedasticity, the variables are treated with natural logarithms, and the logarithms do not change the original trend of the original data sequence. The logarithmic variables are LnINVEST，LnGDP，LnLABOR，LnTHIRD，LnTFP.

4.2 descriptive statistics of variables

Statistical description of the variables is firstly done to observe the scope of variables, the average level and volatility. From 1990 to 2018, China's investment stock in Benin and Benin's economic variables are analyzed, and the minimum maximum, mean, median and standard deviation of each variable are obtained. The output is shown in table 3.

Table 3: Descriptive Statistics

Result / Variable name	Sample size	Mean value	Median value	Maximum value	Minimum value	Standard deviation
LnINVEST	29	7.3718	7.5496	9.2591	5.7526	1.2652
LnGDP	29	8.3441	8.4165	9.1806	7.3765	0.6218
LnLABOR	29	5.7220	5.7301	6.1506	5.2730	0.2611
LnTHIRD	29	3.8792	3.9289	3.9956	3.6998	0.1021
LnTFP	29	4.5997	4.5911	4.6849	4.4987	0.0522

4.3 model checking

4.3.1 Stationary test

Time series data are dominated by non-stationary variables. If the non-stationary variables have the same trend of change between them, the regression can get a high decisive coefficient, but the result is of no practical significance. This regression does not truly reflect the internal logical relationship between the explanatory variable, which is known in econometrics as "pseudo-regression". In order to prevent "pseudo-regression", it is necessary to test the stationarity of variables in the model before analyzing based on Var method. In this paper, we use ADF test to test the smoothness of the data. Table 4 shows the results of Lninvest, LnGDP, Lnlabor, LnTHIRD, LnTFP and their first-order differences from 1990 to 2018.

Table 4: ADF Test

Variable	Types	T value	P value	Conclusion
LnINVEST	(C,T,0)	-2.542089	0.3072	Non stationary
DLnINVEST	(C,0.0)	-5.540146	0.0001	stable***
LnGDP	(C,T,0)	-2.720462	0.2365	Non stationary
DLnGDP	(C,0.0)	-7.742758	0.0000	stable***
LnLABOR	(C,T,0)	-2.542089	0.3072	Non stationary
DLnLABOR	(C,0.0)	-3.016129	0.0460	stable***
LnTHIRD	(C,T,0)	-1.116007	0.9082	Non stationary
DLnTHIRD	(C,0.0)	-4.930112	0.0005	stable***
LnTFP	(0,0,3)	-0.155519	0.6199	Non stationary
DLnTFP	(0,0,2)	-6.966039	0.0000	stable***

Note: * * * ,* * , * Indicate 1% , 5% , 10% significance level respectively, and C, T, L in test type indicate constant term, trend term and lag order respectively.

According to the ADF test, LnINVEST test value is -2.542, and the corresponding p value is 0.3072, which is higher than 0.05. Therefore, we should accept the assumption that there exists unit root to explain that China's direct investment in Benin is a non-stationary series. The P value of DLnINVEST is 0.0001, less than 0.05, which indicates that the sequence after the first order difference is stable. In the same way, LnGDP, Lnlabor, LnTHIRD, LnTFP are all non-stationary sequences, and are all stable after the first order difference.

4.3.2 Co-integration tests

From the ADF test, we know that the above five variables are all single integral of the same order, so there may be co-integration relationships. In this paper, the Var model is constructed according to AIC and SC criteria and LR test. The results are shown in Table 5.

Table 5: Optimal Delay Order Test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	85.46073	NA	1.78e-09	-5.960054	-5.720084	-5.888698
1	253.7847	261.8373*	4.52e-14*	-16.57665*	-15.13683*	-16.14851*
2	276.5079	26.93114	6.62e-14	-16.40799	-13.76832	-15.62308

*indicates lag order selected by the criterion

According to AIC and SC criteria, the number of asterisks is the most when the first order is chosen. Therefore, the optimal lag order is of the first order.

Table 6: Johansen cointegration test

Hypothesized	Trace	
No. of CE(s)	Statistic	Prob.**
None *	93.84487	0.0002
At most 1	42.17274	0.1539

Note: Trace test indicates that there is at most 1 cointegration equation.

As can be seen from table 6, the original hypothesis P value of no cointegration relationship is less than 0.05, so the original hypothesis should be rejected, since it shows that there is a cointegration relationship between China's direct investment in Benin and Benin's macroeconomic variables, that is, there is a stable equilibrium relationship in the long run.

4.3.3 The construction of the Var equation

This paper examines the impact of Chinese direct investment on Benin's economy using the Vector autoregression (Var) model. Each entry variable in the Var model is regarded as an endogenous variable, and each endogenous variable can be expressed by the lag variable of other endogenous variables. The Var model is very important to determine the optimal lag order. We know that the optimal lag order is the first order. Therefore, this paper constructs a Var (1) model with five variables Lninvest, LnGDP, Lnlabor, LnTHIRD and LnTFP; the results are shown in Table 7 below.

Table 7: Parameter Estimation for VAR Equation

	LnINVEST	LnGDP	LnLABOR	LnTHIRD	LnTFP
LnINVEST(-1)	0.560948	0.035778	0.004442	0.050916	0.025421
	(0.19822)	(0.10482)	(0.00285)	(0.04095)	(0.04099)
	[2.82987]	[2.34131]	[2.15580]	[2.24344]	[1.62013]
LnGDP(-1)	0.436201	0.518187	-0.000549	0.026242	-0.124145
	(0.42830)	(0.22649)	(0.00616)	(0.08848)	(0.08857)
	[1.01844]	[2.28788]	[-0.08922]	[0.29660]	[-1.40159]
LnLABOR(-1)	1.102911	0.940564	0.994398	-0.260454	0.116223
	(0.72289)	(0.38227)	(0.01039)	(0.14933)	(0.14950)
	[1.52570]	[2.46045]	[95.7069]	[-1.74416]	[0.77743]
LnTHIRD(-1)	-0.311550	-0.264356	0.008646	0.815804	-0.076126
	(0.47231)	(0.24977)	(0.00679)	(0.09757)	(0.09768)
	[-0.65963]	[-1.05841]	[1.27360]	[8.36142]	[-0.77937]
LnTFP(-1)	-1.547027	-1.005924	0.011006	0.036710	-0.555024
	(0.81820)	(0.43268)	(0.01176)	(0.16902)	(0.16921)
	[-1.89077]	[-2.32489]	[0.93586]	[0.21719]	[-3.28014]
C	1.726677	4.084803	-0.019494	1.441426	7.632695
	(5.80241)	(3.06840)	(0.08340)	(1.19863)	(1.19996)
	[0.29758]	[1.33125]	[-0.23375]	[1.20257]	[6.36078]
R-squared	0.975013	0.970776	0.999870	0.839266	0.384631
Adj. R-squared	0.969334	0.964134	0.999841	0.802736	0.244775
AIC	-16.80263				
SC	-15.37527				

Note: In Parentheses () is the standard error, and square brackets [] is the t statistic.

According to the equation, in the LnGDP equation, at the significant level of 0.05, the lag period of investment has a significant positive relation to the economic growth of Benin in the current period. The estimated coefficient shows that Lninvest (- 1) increases by 1%, and LnGDP increases by 0.036% . At the same time, the lagging GDP and employment level have a significant positive impact on the current economic growth. In the employment equation, at the significance level of 0.05. The investment stock of the lag period has a significant

contribution to the employment in Benin in the current period, and the estimation coefficient shows that the investment stock of the lag period has a weak contribution to employment in Benin in the current period. At the same time, the employment level of the previous year has a significant positive impact on the employment level. In the LnTHIRD equation, the level of employment in the lag period had a positive effect on the adjustment of the industrial structure of Benin and promoted the development of the tertiary sector of the economy. The Coefficient of estimation shows that for every 1% change in LnINVEST (- 1), the relative change in LnGDP is 0.051%, and the proportion of the previous tertiary sector of the economy has a positive impact on the current industrial restructuring. In the equation of LnTFP, at a significant level of 0.1, the investment stock of one lag period has a significant promotion on the current TFP. The estimated coefficient shows that for every 1% change of LnINVEST (- 1), the relative change of LnTFP in the same direction is 0.025%. Therefore, the Var equation shows that China's direct investment in Benin has to some extent promoted the development of Benin's economy, promoted employment, promoted the upgrading of Benin's industrial structure and improved the technological productivity of Benin.

4.3.4 Stability testing

After the Var model is established, its stability should be tested. Only the stable model can be used for impulse response function analysis and variance decomposition analysis. In this paper, the Ar root method is used to test the stability of the model. If the reciprocal of all root modules are in the unit circle, then the Var (1) model is stable according to the Ar Root Diagram and table in Fig.1.

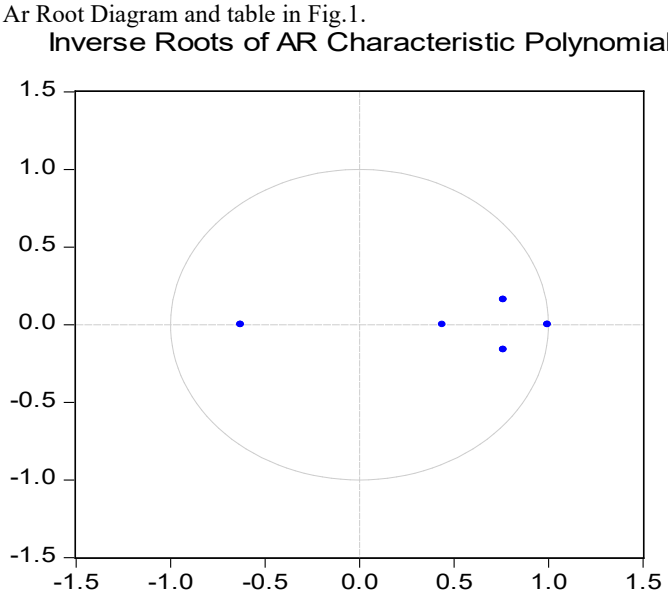

Figure 1: AR Root Diagram

Table 8: AR Roots of Characteristic Polynomial

Endogenous variables: LNINVEST LNGDP LNLABO.....
Exogenous variables: C
Lag specification: 1 1
Dates:04/20/19 Time: 12:44

Root	Modulus
0.996825	0.996825
0.762884 - 0.161126i	0.779714
0.762884 + 0.161126i	0.779714
-0.628593	0.628593
0.440313	0.440313

No root lies outside the unit circle.
VAR satisfies the stability condition.

4.3.5 Granger causality test

The Granger causality is a method proposed by the economist Percy Grainger to predict future values from past values of time series, which can be used to test whether economic variables have statistical causality. It should be noted that Granger causality is not really a causal relationship, but rather a statistically dynamic correlation between variables, but it can indicate whether one variable has "predictive power" over another. In order to find out whether there is significant difference between the endogenous variables, we use the Granger causality test in the framework of Var model for the four variables, and the test results are shown in Table 9.

Table 9: Granger Causality Test

Granger test the original hypothesis	Chi-sq	Degree of freedom	P-value
LnINVEST is not the cause of LnGDP	6.053818	1	0.0139
LnGDP is not the cause of LnINVEST	5. 307226	1	0.0245
LnINVEST is not the cause of LnLABOR	5.024274	1	0.0262
LnLABOR is not the cause of LnINVEST	2.327772	1	0.1271
LnINVEST is not the cause of LnTHIRD	4.546147	1	0.0437
LnTHIRD is not the cause of LnINVEST	0.435106	1	0.5095
LnINVEST is not the cause of LnTFP	3.384563	1	0.0752
LnTFP is not the cause of LnINVEST	3.574995	1	0.0587

According to the Granger causality test, the Granger causality test hypothesis that investment is not the cause of Benin's economic growth assumes a P value of 0.0139, which is less than 0.05. Therefore, the original hypothesis should be rejected to show that Chinese investment in Benin is the cause of Benin's economic growth; economic growth is the Granger causality test reason for the investment stock, suggesting that Chinese direct investment in Benin has contributed to Benin's economic development, and that Benin's economic growth can also attract Chinese investment in Benin. At the significant level of 0.05, China's direct investment in Benin is the Granger cause of employment in Benin and the Percy Grainger cause of upgrading Benin's industrial structure, but the relationship is one way. At the significance level of 0.1, Chinese direct investment in Benin is the Granger causality test reason for the Total factor productivity, and Benin's technological production efficiency will also attract foreign investment in Benin.

4.4 Empirical Research and results analysis

4.4.1 Impulse response

The impulse response function of the Var model is used to analyze the dynamic transmission mechanism and path of the impact of China's direct investment on Benin's economy. In the impulse response chart, the horizontal axis shows the number of lag periods (in years) of the shocks, and the vertical axis shows the response value of each economic index to the shocks. Below is the response of LnGDP, Lnlabor, Lnthird, and LnTFP to the LnINVEST shocks.

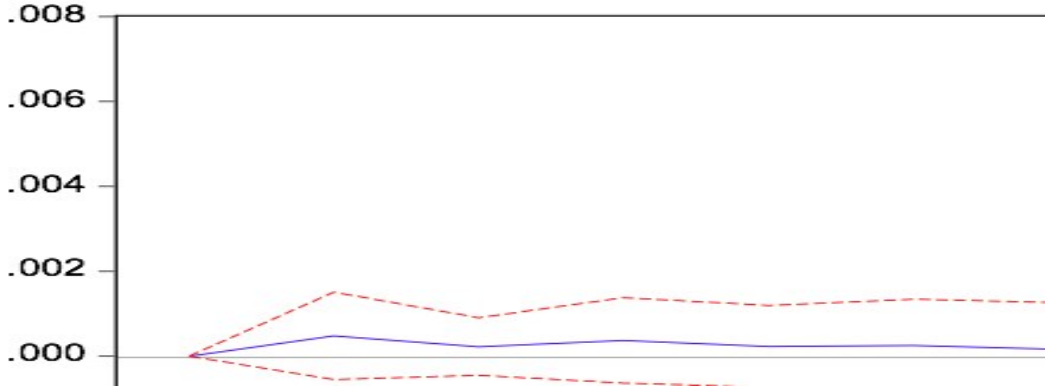

Figure 2: Impulse Response Chart of LnGDP to LnINVEST Shock

As can be seen from figure 2, when the economy is given a unit of positive investment stock, Benin's economic growth responds in a positive direction and gradually increases, reaching its maximum response in the 2nd period, with a response value of 0.005, Then the trend of fluctuation decline tends to converge the response value is 0.001. The impulse response function shows that the positive induction of China's direct investment in

Benin has a positive effect on Benin's economic growth in the long run, but the impact is strongest in the short run.

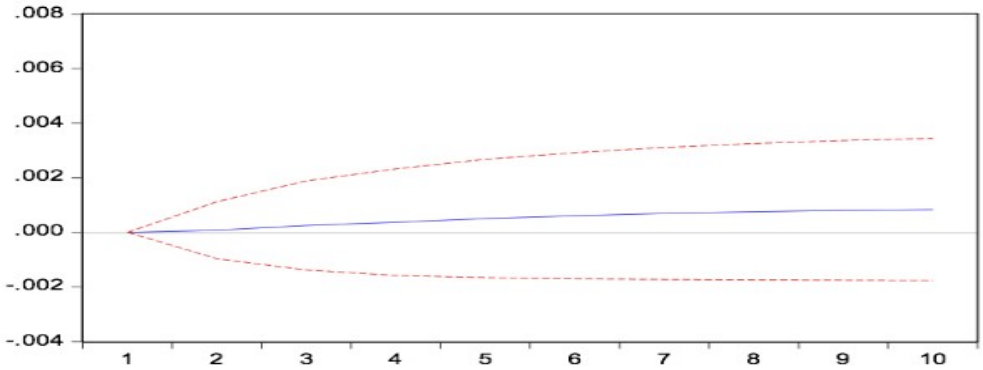

Figure 3: Impulse Response Chart of LnLABOR to LnINVEST Shock

As it can be seen from figure 3, when given a positive impact of the standard deviation of the investment stock, employment in Benin responded positively and gradually increased, reaching a maximum response of 0.006 in the 10th period and tending to converge. The impulse response function shows that the positive impact of the investment stock, i.e., the increase of China's direct investment stock in Benin, has a positive effect on the employment in Benin.

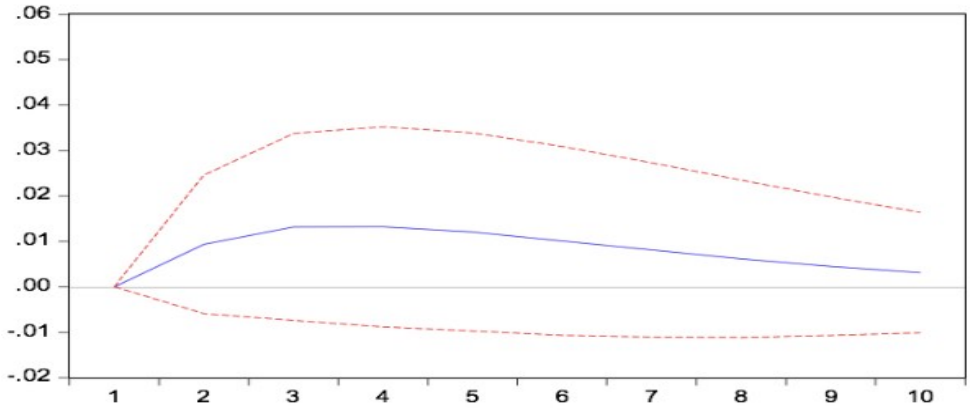

Figure 4: Impulse Response Chart of LnTHIRD to LnINVEST Shock

As can be seen from figure 4, when the investment stock is positively impacted by a standard deviation, the tertiary sector of the economy responds positively and gradually increases, reaching the maximum response in the third period, with a response value of 0.013, followed by a trend of decreasing volatility, eventually, it converges. The impulse response function shows that the positive impact of China's direct investment in Benin has a significant impact on the proportion of the tertiary sector of the economy, and the largest impact in the short term; it shows that China's direct investment in Benin is beneficial to the upgrading of Benin's industrial structure.

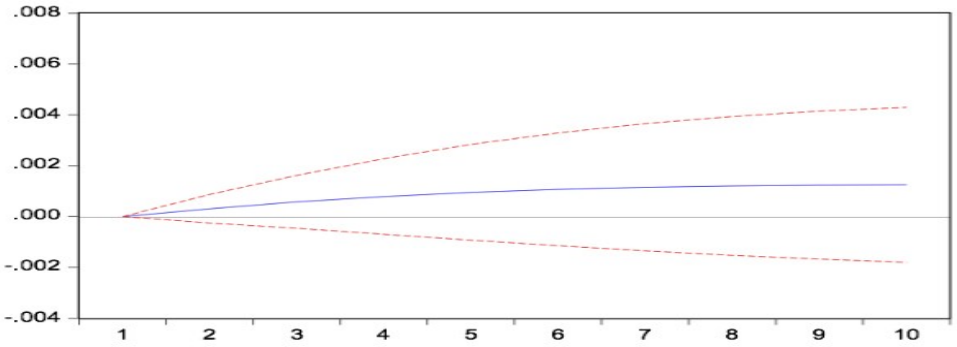

Figure 5: Impulse Response Chart of LnTFP to LnINVEST Shock

As can be seen from figure 5, when the positive impact of the standard deviation of the investment stock is given, the Total factor productivity response is positive and increases slowly, reaching its maximum response in the 9th period, with a response value of 0.012, and then tends to converge. The impulse response function shows that the positive impact of China's direct investment in Benin is beneficial to the improvement of Benin's technological production efficiency. But this process is a slow one, suggesting that the improvement in Benin's technological efficiency will only become more apparent with continued investment.

4.4.2 Variance decomposition

By solving the contribution degree of disturbance terms to the mean square error of the Var model, the variance of time series data forecast is the result of its disturbance and system disturbance. The following is a variance decomposition of LnGDP, Lnlabor, LnTHIRD, and LnTFP. The contribution of the investment stock to the variance of each variable is summarized in Table 10.

Table 10: Variance contribution of China's FDI to Benin's economy

Period	LnGDP	LnLABOR	LnTHIRD	LnTFP
1	0.000000	0.000000	0.000000	0.000000
2	0.204681	0.029758	2.315761	0.795485
3	0.185712	0.203220	5.000584	0.786689
4	0.177496	0.425208	6.760296	0.802731
5	0.219599	0.727288	7.823928	0.816537
6	0.258681	1.040033	8.363530	0.815442
7	0.321037	1.363064	8.617218	0.818814
8	0.362130	1.665057	8.711068	0.818559
9	0.393739	1.944364	8.731800	0.818987
10	0.407642	2.191550	8.722757	0.818995

As can be seen from table 10, the investment stock at the beginning of the second period contributes to the forecast variance of LNGDP, Lnlabor, LnTHIRD, LnTFP, and increases gradually. In period 10, China's direct investment in Benin contributed 0.408 to economic growth, 2.192 to employment and 8.723 to the tertiary sector of the economy, while the contribution to the variance of Total factor productivity is 0.819. The variance decomposition shows that the investment stock contributes the most to the upgrading of the industrial structure in Benin, followed by the employment creation, and the least to the economic growth.

4.4.3 Result analysis

This paper empirically analyzes the impact of Chinese direct investment on Benin's economy by constructing Var model, and draws the following conclusions:

The Johansen co-integration test shows that there is a long-term stable equilibrium relationship between investment stock and macroeconomic variables. According to the Granger causality, Chinese direct investment in Benin is the main source of economic growth in Benin, which will also attract Chinese investment in Benin. Direct Investment in Benin is the one-way Percy Grainger reason for the upgrading of employment and industrial structure in Benin. Only when the assumptions are relaxed does the investment stock and Total factor productivity show a two way Granger causality. Based on the impulse response function analysis of Benin's economic variables, it is found that the positive impact of China's direct investment in Benin has positive effects on Benin's economic growth, employment, industrial structure optimization and technological productivity. In the short run, the investment stock has a strong contribution to the economic growth and the proportion of

tertiary sector of the economy, while the impact on the employment and the Total factor productivity is more obvious in the medium and long run. The variance decomposition shows that the contribution of the investment stock to the tertiary sector of the economy and employment is higher than the contribution of the investment stock to economic growth and Total factor productivity.

- China's direct investment plays a significant role in Benin's GDP growth

China's direct investment has the strongest positive impact on Benin's GDP growth in the short term, but the positive impact on Benin's GDP growth in the long term has declined and gradually stabilized. The growth of Benin's gross domestic product (GDP) showed that Chinese direct investment made up for the shortage of funds in Benin, fully stimulated the potential of the market and promoted the development of the economy. Since there was little direct investment from China to Benin before 1972, the entry of China's direct Investment has played a significant role in promoting the Beninese economy and has brought about capital, technology and other advantages. However, with the gradual increase of China's direct investment, capital, technology and other important economic factors have not been significantly improved, so the impact of these investments on the Beninese economy has not been fully realized. Still, Chinese direct investment could boost Benin's economy.

- Chinese direct investment has a positive impact on Benin's labor market

In the short term, Chinese direct investment has a positive effect on employment in Benin, and in the long term the positive effect of investment on employment growth is more significant and tends to be stable. The increase in the number of jobs indicates that Chinese direct investment has created a large number of labor opportunities for Benin. Chinese companies with direct investment have invested in factories in Benin and in the construction of infrastructure, such as factory buildings, which require a large number of workers; in addition, they have created a large number of local jobs. In the long run, the expansion of China's direct investment has led to a growing demand for labor, which has had this effect.

- China's direct investment drives the development of the tertiary sector of the economy

In the short term, Chinese direct investment has contributed more to the tertiary sector of Benin's economy, while in the long term; Chinese direct investment has contributed less the tertiary sector of Benin's economy. This shows that by absorbing the technology and production experience of China, Benin has achieved technological progress in its enterprises, thus contributing to the development of the tertiary sector of the economy. Therefore, China's direct investment in Benin is conducive to the upgrading of Benin's industrial structure.

- China's direct investment promotes the upgrading of Benin's technology

In the short term, Chinese direct investment is beneficial to the improvement of technological production efficiency in Benin, but the process is slow, while in the long term, the positive impact of investment on technological upgrading is more significant and tends to be stable. This suggests that only sustained investment will have a more pronounced impact on technical efficiency in Benin. Benin's technological progress shows that it has learned from China's production technology and management experience by attracting Chinese investment, which has promoted Benin's development in science and technology, human resources and management, thereby raising the technological level of Benin. From the perspective of the effect of technological competition, the entry of Chinese enterprises into the Benin market, through direct investment activities, have intensified the level of competition in the market. Consequently, Beninese enterprises have been forced to upgrade their technology and improve the utilization of resources in order to gain more market share. Therefore, technological competition has effectively promoted the upgrading of Benin's technological level.

5. Conclusions and recommendations

Through empirical analysis using the Var Model, it was established that in the short term, Chinese direct investment has the following effects on the Beninese Economy: it has the strongest positive impact on GDP growth, has a positive impact on employment, has a greater contribution to the proportion of tertiary sector of the economy, and is conducive to the improvement of technological production efficiency, but the process is slow; In the long run, Chinese direct investment has the following effects on the Beninese Economy: the positive effect on GDP growth is less than in the short run but tends to be stable; the positive effect on employment growth is more significant and tends to be stable in the short run; the positive effect on the proportion of tertiary sector of the economy is less than in the short run; and the positive effect on technological upgrading is more significant and tends to be stable. It can be concluded that China's direct investment has a positive impact on Benin's economy (GDP), employment, industrial structure and technical level, which has become an indispensable driving force for Benin's economic development. On this basis, in order to fully emphasis the positive role of Chinese direct investment in the economic development of Benin, this paper will provide recommendations for the future direction of economic development of Benin.

- **Improving infrastructure**

Given the general investment climate in Benin, which is less attractive to Chinese companies, improving Benin's infrastructure will help attract more Chinese companies to invest in Benin. Infrastructure construction is

the foundation of economic development. Benin's immediate priority is to develop its own infrastructure in an orderly manner and strongly support Chinese enterprises to invest in infrastructure construction in Benin. Investment by Chinese companies in infrastructure will help improve the living standards of Beninese citizens and stabilize the political and social environment. In addition, the government of Benin should focus on and maintain the construction of the port of Cotonou, which not only promotes the development of port trade, but also facilitates Chinese direct investment in Benin. Investment in port facilities, highways, railways and telecommunications will be introduced to realize cooperation between the government and enterprises and improve public services in port areas. Building a railway to connect Benin (Cotonou), Niger (Niamey), Togo (Lomé), Ivory Coast (Abidjan) and other hinterland countries, strengthen the system and management.

- **Improving the quality of the workforce**

Improving the skill level of the labor force can better meet the demand of the factory, help to increase the number of the industrial population, and also reduce the labor cost of Chinese enterprises. In terms of education, the government of Benin should encourage outstanding Beninese students to study in China and acquire the necessary work skills, so as to continuously transfer talents and knowledge to Benin and help to better establish employment channels and information exchange platforms.

- **Expanding the economy**

The impact of Chinese direct investment on Benin's economic growth is strongest in the short term, while the impact of investment on Benin's economic growth has declined in the long term. Therefore, in the short term, it is reasonable for the government of Benin to continue to expand its scale and attract more Chinese enterprises to invest in Benin. The expansion of investment to enhance productive capacity, particularly in the production of high-income resilient commodities, provides an opportunity to expand export markets. This can be achieved by injecting impetus into commodity production through foreign investment, gradually changing the culture of over-reliance on the export trade of raw materials to boost GDP, improving production efficiency, forming an export trade structure with raw materials as the main factor and local manufactured products as the auxiliary factor, and expanding the volume of domestic export trade, to encourage the national consumption to achieve their own economic development, thus expanding the scale of the economy to a new stage.

- **Adjusting the industrial structure**

The government of Benin should first adjust and optimize the secondary sector of the economy to take full advantage of Chinese direct investment. The secondary sector of the economy is a pillar industry of economic development, but the secondary sector of the economy has a low share of the economy, and the Beninese government should focus on secondary sector of the economy as a way to attract Chinese direct investment. In addition, the government of Benin should strengthen the guidance of foreign investment in high-tech research and development and high-end manufacturing, in order to achieve the effect of innovation upgrading, as well as the upgrading of traditional industries such as metallurgy and textile industries, using foreign capital to make pillar industries and traditional industries develop healthily at a higher pace.

Secondly, the tertiary sector of the economy should be optimized and the structure of foreign capital improved. The government should guide foreign investment to modern logistics, scientific research and financial services, and should establish attractive policies to encourage foreign direct investment, such as tax reduction and exemption, in addition, attention should be paid to the training of domestic personnel in the service industry. The government of Benin should open its service sector to the outside world, expand and diversify economic trade and investment cooperation between China and Benin, such as encouraging Chinese investment in Benin's transport infrastructure, such as road construction, and further developing Benin's tourism industry. At present, Benin's financial and tourism industries are relatively backward. China and Benin should strengthen cooperation in the fields of tourism, finance and telecommunications in order to foster new growth points of trade. In addition, Benin should strengthen cooperation with Chinese enterprises in areas such as finance and insurance, and encourage China to open joint-venture hospitals and educational institutions in Benin. In view of the need to improve the level of financial services in Benin, the vigorous development of foreign trade is conducive to the rapid development of the financial sector, the service sector and so on. Benin should therefore now focus on an orderly improvement in the level of development of the tertiary sector of the economy.

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