

# Comparative Analysis of the Efficiency of Direct Investment in China and the US along the Belt and Road

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## Abstract

Comparing and analyzing the factors affecting the investment scale and investment efficiency of 35 countries along the “Belt and Road” between 2006 and 2016, we hope to provide a reference for China to improve investment efficiency. To avoid the effect of unobserved heterogeneity on the velocity measurement of efficiency values, the model in stochastic frontier analysis is used in this article. The results show that the market size and economic stability of the countries along the route are conducive to promoting investment in the two countries, and labor costs are negatively related to the investment scale of the two countries. However, factors such as infrastructure level, geographical distance, and institutional distance have different effects on the investment scale of the two countries. Among the factors that affect investment efficiency, voice and accountability, government efficiency, regulatory quality, and government stability are all conducive to improving the investment efficiency of the two countries. The legal system and the degree of corruption control are inversely proportional to China's investment efficiency, but proportional to the US investment efficiency. In general, the investment efficiency of the United States is higher than that of China, but the overall difference in the value of investment efficiency between the two countries is not large.

## Keywords

True fixed effects model, outward foreign direct investment, investment efficiency.

## 1. INTRODUCTION AND LITERATURE REVIEW

The entry of capital, the generation of local income in the receiving country, and the local impact of the investing country in the receiving country have made FDI one of the topics of concern to this day. FDI is not only a source of economic growth for recipient countries, but also a sign of the maturity of the recipient country's economy. OFDI is beneficial to make up for insufficient domestic resources, strengthen technology spillover effects, and promote market diversification. According to the UNCTAD World Investment Report 2018, China's foreign direct investment in 2017 accounted for 5.9% and 11.1% of global stocks and flows, respectively, ranking third and second in the world. The stock increased by 0.7 percentage points compared with the proportion in 17 years. At the end of 17 years, China's investment stock in the countries along the route accounted for 8.5% of the investment stock of the year. Although China's total foreign direct investment has ranked among the top in the world, there is still a large gap between China and the United States in terms of the distribution balance of investment countries and the proportion of world investment. In 2017, China's stock of foreign direct investment was only equivalent to 23.16% of the US foreign direct investment. China is still at the initial stage of OFDI, and lacks experience and consciousness of avoiding external risks (Jiang Guanhong, 2015).

Compared with traditional economic factors, recent studies have suggested that the institutional factors that affect FDI may be more important than traditional economic factors (Scherr, 2004; Morisset, 2000; Zheng Lei, 2015). The impact of institutional quality on OFDI is heterogeneous in developed and developing countries and in countries with abundant and relatively poor resources. Investors invest in the host country not only from the absolute risk caused by the system quality of the invested country, but also from the absolute risk caused by the gap between the investment country and the host country. Scholars have not reached consensus on the impact of institutional quality and institutional distance on FDI. Table 1 summarizes the impact of institutional quality on FDI and Table 2 summarizes the impact of institutional distance on FDI.

**Table 1.** Summary of the impact of institutional quality on FDI

Institutional quality is positively related to FDI	
Bénassy-Quéré and Coupet(2007)	The FDI stock was selected as the explanatory variable. The sample period was from 1985 to 2000. The research results show that developing countries can attract FDI by improving the quality of their institutions.
Aseidu (2006)	Researched the influencing factors of direct investment in 22 countries in Africa from 1984 to 2000. Using the ratio of net FDI flows to GDP as the explanatory variable, it was concluded that an effective legal system can promote FDI, while corruption and politics instability hinders the flow of FDI.
Yang Jiaohui,etc (2016)	Based on the analysis of China's foreign direct investment flow data from 2003 to 2014, it is found that there is no institutional risk appetite for OFDI in China. The institutional risk appetite is caused by the low economic development level but rich natural resources of the invested countries. However, the better system quality has limited effect on promoting the inflow of OFDI in China.
Wang Xiaoying,etc (2018)	An extended gravity model was used to analyze the determinants of China's direct investment in ASEAN countries from 2003 to 2015. Principal component analysis is used to measure the quality of the system. Studies have shown that OFDI in China is positively related to the quality of the system. The impact of natural resources and system quality on OFDI has a substitution effect. The positive effect of the system will weaken; when natural resources are abundant, the positive effect of institutional quality on OFDI will also weaken.
Institutional quality is negatively related to FDI	
Buckley et al (2007)	An empirical analysis of the factors affecting investment using China's approved investment flow data from 49 countries from 1984 to 2001 shows that China's investment tends to countries with poor institutional quality.
Kolstad and Wiig (2010)	The determinants of China's foreign direct investment from 2003 to 2006. The research results show that the market size of OECD countries is a key factor in determining China's investment in it. For non-OECD countries, China tends to be rich in natural resources but institutional investment in poorer countries.
Wang Yongqin,etc (2014)	An analysis of 842 data from China's investment in 63 countries during the period from 2002.1.1 to 2011.12.31 shows that OFDI in China tends to countries with weak legal systems.
Li Xiaomin and Li Chunmei (2017)	The empirical analysis of the impact of the host country's system quality on China's direct investment in the "Belt and Road" countries from 2004 to 2013 shows that China tends to invest in countries with high levels of corruption, low legal standards and high political risks.
Institutional quality is not related to FDI	
Cheung and Qian (2008)	A sample of data from 31 countries from 1991 to 2005 was selected, and the approved rather than actual investment flow data was used as the explanatory variable. A fixed-effects model was used for empirical analysis. The results show that institutional quality has no effect on FDI.
Liu Min, etc (2016)	After analyzing the investment of 119 countries in China from 2003 to 2014, the Heckman two-stage model was used to conclude that the quality of a country's system has no effect on the investment choice and investment scale of OFDI in China.
Wang Yongqin, etc (2014)	An analysis of 842 data on China's investments in 63 countries during the period from 2002.1.1 to 2011.12.31 shows that: the right to speak, accountability, and political stability are not the determinants of China's OFDI.

**Table 2.** Summary of the impact of institutional distance on FDI

Institutional distance is positively related to FDI	Institutional distance is negatively related to FDI
Jiang Guanhong and Jiang Dianchun (2012) used the Heckman two-stage model to conduct an empirical analysis of China's investment in 107 developing countries from 2003 to 2010. The results show that institutional distance has a positive impact on China's OFDI.	Zhang Ruiliang (2018) conducted a study of China's investment in 43 countries along the route from 2003 to 2015. It shows that OFDI in China prefers countries with smaller regulatory distances, and location selection tends to countries with smaller regulatory distances.
Kai Liu and Wenwen Zhang (2018) analyzed China's investment in 52 along the "Belt and Road" from 2005 to 2015, and showed that market-seeking OFDI, resource-seeking OFDI and positive institutional distance are positively correlated, and strategic asset-seeking OFDI Positively related to negative institutional distance.	Johanson and Vahlne (1977) believe that in order to reduce the cost of organizational coordination and adaptability when investing, companies usually choose countries with smaller institutional distances to invest.
	Yang Yaping and Gao Yan (2017) used a negative binomial regression model to study China's investment in 65 countries along the route from 2003 to 2014. It was found that OFDI in China tends to countries with smaller negative institutional distances.

There are relatively few studies on OFDI in the United States and the earlier years. Scholars analyze from policy and non-policy variables, industrial relationship variables, and the basis of government governance. Some scholars distinguish between different investment motivations for analysis. David and Stephen (1995), using baseline data from 1977 and 1982, research on 22 developed countries and 26 developing countries in US direct investment shows that between the two periods and between developed and developing countries The difference. GDP per capita, investment incentives, infrastructure, and policy stability all play a significant role in US direct investment. Cooke's (1997) analysis of U.S. direct investment in 19 OECD countries shows that strict government restrictions on layoffs, contract extension policies, collective bargaining structures, and high levels of guild penetration have hindered the OFDI in the United States. Higher education levels and policies that promote working committees help attract US investment. Steven and Daniel (2003) believe that the basis of government governance is the key to affecting OFDI in the United States. Countries that have not received any investment from the United States are usually characterized by inefficient government, established legal systems that are not based on British common law, and lack of promotion of free and transparent markets. Yeaple (2003) divided US investment into vertical OFDI and horizontal OFDI. When a country's transportation costs and labor costs are low, it will promote the vertical OFDI in the United States, and when a country's transportation costs and labor costs are high, it will promote the increase of the US horizontal OFDI.

At present, scholars use data envelopment analysis (DEA) and stochastic frontier analysis (SFA) to estimate investment efficiency, and domestic scholars have basically reached a consensus on the analysis of China's direct investment efficiency. Li Jiguang et al. (2016) used the BC (95) model to analyze China's investment efficiency in countries along the route from 2005 to 2014. It is found that China's investment in the countries along the route still lacks countries with high investment efficiency, and there is still huge potential for investment in the countries along the route. Cheng Zhonghai and Nan Nan (2017) also selected SFA for efficiency measurement. The research results show that China's investment in countries along the route has obvious regional and individual differences, and investment efficiency is generally low. In addition, geographical distance, investment freedom, legal norms, and the degree of democracy

have hindered China's investment, indicating that there is a system deviation in OFDI in China. Kaiwen Ji and Ji Zhou (2018) used the SFA model to show that China's overall investment efficiency is still low. The higher the political stability, government efficiency, and corruption control in the system quality of the countries along the route, the more favorable it is for the improvement of investment efficiency. The economic freedom and labor sufficiency in economic factors also have a positive impact on the improvement of investment efficiency. Tian Ze and Xu Dongmei (2016) used DEA model and Malmquist index method to find that China's investment efficiency values in different countries are quite different and the overall investment efficiency is not high. Tian Ze et al. (2016) used the super-efficiency DEA method to measure China's investment efficiency in 20 African countries from 2008 to 2014 and analyzed the changing trend of investment efficiency. Investment efficiency not only shows large national differences but is also at a low level.

Foreign scholars have applied the real fixed effect model to the technical efficiency measurement of petroleum companies, the operational efficiency measurement of colleges and universities, the cost efficiency estimation of the power sector, and the technical efficiency measurement of the power distribution industry. Consensus was reached on the importance of observed heterogeneity, the importance of separation of unobserved heterogeneity from inefficiency terms, and the lack of consideration of unobserved heterogeneity for serious deviations in efficiency estimates.

Tanja (2012) used data from 436 ordinary high schools in Finland from 2000 to 2004 to calculate the operating efficiency of ordinary high schools. The results show that different stochastic frontier models have some differences in the measurement of efficiency values. The TRE and TFE models allow for the existence of heterogeneity between schools. The random effects and fixed effects in the models represent the permanent efficiencies of operating efficiency between different schools. Sexual difference. Compared with the FE and RE models, the inefficiency values estimated by the TFE and TRE models are significantly smaller than the structural inefficiencies measured by the FE and RE models. Chuanwang et al. (2017) believe that differences in the economic, cultural, and institutional characteristics of international oil companies may lead to a large number of unobserved heterogeneity. Therefore, a real fixed-effect model was selected to separate the unobserved heterogeneity from the inefficiency term and avoid deviations in the measurement of the efficiency value. Taking the data of the top ten oil companies in the period from 2003 to 2013 as a sample, the comparison results show that the overall efficiency value measured by the TFE model is higher than that calculated by the BC (92) and BC (95) models. Maria and Rauli (2011) aimed to analyze the heterogeneity between different enterprises by combining different possibilities, and measured the technical efficiency of 76 distribution public welfare undertakings in Finland from 1997 to 2002. Comparing the results of the four models of RE, TRE, TFE, and REH, it is shown that the observed and unobserved heterogeneity can seriously bias the estimation of the efficiency value.

Existing literature has conducted a comprehensive analysis of the factors affecting China's direct investment in countries along the route, and may have different research conclusions due to the difference in index selection and country selection. In the study of investment efficiency, DEA and SFA analysis methods have been used. Scholars have basically reached the following consensus: China's investment efficiency is generally low, investment potential is not fully released, and there are large national differences in investment efficiency. However, scholars did not consider the unobserved heterogeneity in the efficiency estimation. Countries along the route have certain differences in economic, cultural, and institutional aspects, and ignoring heterogeneity among countries may cause an underestimation of efficiency. Secondly, the research on the influencing factors of US direct investment is relatively early and the data periods used are mostly concentrated in the early stage, and empirical analysis of its investment efficiency has rarely been studied. Therefore, based on a comprehensive analysis of various

economic, institutional, and distance factors that may affect direct investment between the two countries, this paper takes into account the unobserved heterogeneity between countries and uses the extended realities in the stochastic frontier analysis method. The fixed-effects model measures efficiency, compares and analyzes the factors that affect the investment scale and investment efficiency of the two countries, and provides relevant suggestions for China to fully release investment potential and improve investment efficiency.

## 2. MODEL ESTABLISHMENT AND DATA SOURCE

In order to measure the technical efficiency in the production function, Meeusen and Broeck (1997) and Aigner et al. (1997) first proposed the Stochastic Frontier Analysis (SFA). The stochastic frontier analysis method can mitigate the lack of efficiency of the gravity model, not only can perform empirical analysis of the factors that affect the inefficiency, but also separate the error term in the gravity model from the individual inefficiencies from white noise. The BC (92) and BC (95) models relax the assumption that the inefficiency term does not change with time, which is more in line with the actual situation and is widely used by scholars, but has not considered the unobserved heterogeneity. Heterogeneity and inefficiency are two completely different concepts. Improvement through a series of ways can reduce or even eliminate the factors that cause inefficiency. Heterogeneity does not change over time and is not controlled by individuals. Missing time-invariant variables, lacking data for explanatory variables, and ignoring difficult-to-quantify explanatory variables can all lead to heterogeneity (Lin et al., 2010). The BC model does not distinguish unobserved heterogeneity from the inefficiency term and may underestimate the calculated efficiency value.

Greene's true fixed effects model (TFE) and true random effects model (TRE) in 2005 incorporated unobserved heterogeneity into the model and separated it from inefficiencies, enabling more accurate estimates. effectiveness. Compared with the TRE model, the TFE model relaxes the assumption that the inefficiency term in the TRE model is irrelevant to the explanatory variables. The table lists the basic form of the above stochastic frontier model and its advantages and disadvantages.

### 2.1. Model Settings

The level of economic development, government policies, socio-culture, and customs differ among countries. These unobserved heterogeneities may affect output and efficiency boundaries (Lai and zhu, 2011). Based on the above analysis, this paper selects the true fixed effect model (TFE) in the random pre-analysis method proposed by Greene (2005a), and assumes that the production function is in the form of a Cobb Douglas function:

$$\ln y_{ijt} = \alpha_j + \beta_1 \ln pgdpy_{ijt} + \beta_2 \ln pgdp_{jt} + \beta_3 res_{jt} + \beta_4 open_{jt} + \beta_5 inflation_{jt} + \beta_6 \ln pgni_{jt} + \beta_7 infra_{jt} + \beta_8 \ln dis_{ij} + \beta_9 dzd_{ijt} + v_{jt} - \mu_{jt} \quad (1)$$

In equation (1),  $i$  represents the investment country (China or the United States),  $j$  represents the countries along the line, and  $t$  represents the year.  $\alpha_j$  represents unobserved heterogeneity.  $\beta$  is the parameter to be estimated. When the investment country is China, the variables  $\ln y_{ijt}$ ,  $\ln pgdpy_{ijt}$ ,  $\ln dis_{ij}$ ,  $dzd_{ijt}$  are represented by the variables  $\ln y_{jt}$ ,  $\ln pgdpc_t$ ,  $\ln disc_j$ ,  $dzdc_{jt}$ , respectively. When the investment country is the United States, the variables  $\ln y_{ijt}$ ,  $\ln pgdpy_{ijt}$ ,  $\ln dis_{ijt}$ ,  $dzd_{ijt}$  are represented by the variables  $\ln y_{jt}$ ,  $\ln pgdpu_t$ ,  $\ln disu_j$ ,  $dzdu_{jt}$ , respectively.  $v_{jt}$  represents a random error term, which is independent of  $\mu_{jt}$  and obeys a normal distribution, that is:  $v_{jt} \sim N(0, \sigma_v^2)$ .  $\mu_{jt}$  is non-negative,

which means the inefficient term, obeys the normal distribution, and is affected by the following variables, namely:

$$\mu_{ijt} = \delta_0 + \delta_1 va_{jt} + \delta_2 ge_{jt} + \delta_3 rl_{jt} + \delta_4 rq_{jt} + \delta_5 cc_{jt} + \delta_6 ps_{jt} + \rho_{ijt} \tag{2}$$

$\delta$  is the parameter to be estimated, and  $\rho_{ijt}$  is the random error, which obeys the normal distribution. The meaning of expression variables in the model is shown in the table3.

**Table 3.** Model expression variable meaning description

Stochastic frontier	
$lnyc_{jt}$ ( $lnyu_{jt}$ )	logarithm of China (US) stock of direct investment in country j
$lnpgdpc_t$ ( $lnpgdpu_t$ )	logarithm of China's (US) real per capita GDP
$lnpgdp_{jt}$	logarithm of actual per capita GDP of country j
$res_{jt}$	abundance of natural resources of country j
$open_{jt}$	abundance of natural resources of country j
$inflation_{jt}$	inflation rates of country j
$lnpgni_{jt}$	labor costs of country j
$infra_{jt}$	infrastructure level of country j
$Indisc_j$ ( $Indisu_j$ )	logarithm of geographic distance between China (USA) and country j
$dzdc_{jt}$ ( $dzdu_{jt}$ )	institutional distance between China (United States) and country j
Inefficiency function	
$va_{jt}$	voice and accountability
$ge_{jt}$	government effectiveness
$rl_{jt}$	rule of law
$cc_{jt}$	control of corruption
$ps_{jt}$	political stability
$rq_{jt}$	regulatory quality

For the measurement of the efficiency value, the JLMS method proposed by Jondrow et al. (1982) is used to estimate, that is:

$$E[\mu_{jt}|\varepsilon_{jt}] = \frac{\sigma\lambda}{1 + \lambda^2} \left[ \frac{\phi(\gamma_{jt})}{1 - \Phi(\gamma_{jt})} - \gamma_{jt} \right]$$

Where  $\varepsilon_{jt} = v_{jt} - \mu_{jt}$ ,  $\sigma = \sqrt{\sigma_\mu^2 + \sigma_v^2}$ ,  $\gamma_{jt} = \pm \varepsilon_{jt}\lambda/\sigma$ ,  $\phi(\gamma_{jt})$  and  $\Phi(\gamma_{jt})$  represent the standard normal distribution of  $\gamma_{jt}$  probability density function and cumulative distribution function.  $\lambda$  is the ratio of the standard deviation of the inefficiency term and the random error term, so  $\lambda$  can measure the effectiveness of the stochastic frontier estimation. In addition, the validity of the model estimation results and the significance of the estimation results are positively correlated with  $\lambda$ .

According to the method proposed by Battese and Coelli (1988), the investment efficiency of investor country i for country j along the route is expressed as  $TE_{ijt} = \exp(-\hat{\mu}_{ijt})$ ,  $0 \leq TE \leq$

1. When  $TE = 1$ , it means that the output is completely effective at the front, and there is no inefficiency. When  $TE < 1$ , it means that the output is below its leading edge, and it is in an inefficient state at this time.

## 2.2. Variable Selection and Data Source

**Explained variable:** This article uses the stocks of direct investment in the countries along the route from 2006 to 2016 as explained variables for the following reasons: The global output distribution is determined by foreign investors, so it determines the capital stock. In addition, the stock of direct investment is financed through local capital markets and is a better indicator of capital ownership. Compared to flows, investment stocks have less volatility. Especially in relatively small countries, FDI flows can be more volatile (Bénassy-Quéré et al, 2007). The FDI stock reflects the cumulative effect of direct investment between the two countries in the countries along the route, and reflects the long-term behavior of investment between the two countries, enabling a better comparative analysis of the two countries.

**Stochastic frontier:** ① **Market size:** One of the motivations of OFDI is to seek the market. GDP, real per capita GDP, and GDP growth rate are three academically used indicators selected to measure the market. This article selects the actual GDP per capita (Zhang and Daly, 2012) to describe the market purchasing power of the investing countries and countries along the route, and expressed in 2010 constant US dollars. ② **Abundance of natural resources in countries along the route:** According to Asiedu (2006), Cheng and Ma (2007), rich natural resources are one of the unique advantages of recipient countries in attracting FDI, and they play an important role in analyzing FDI. The method of Zhang (2009), Asiedu and Lien (2011) is used to express the proportion of fuel, ore and metal exports in commodity exports to countries along the route. ③ **The degree of opening up of the countries along the route:** It is measured by the ratio of exports of goods and services of the countries along the route to the GDP of the country. ④ **Economic stability of the countries along the route:** Expressed by the inflation rate measured by the GDP deflator. ⑤ **Labor cost of the countries along the route:** This article adopts the method of Yang Yaping and Gao Yan (2017), and uses the GNI per capita of the countries along the line as the measure of labor costs. ⑥ **The infrastructure level of the countries along the route:** the method of Yue biting and Fan Tao (2014) and Liu Shuangqin (2018) is used to express the number of Internet broadband users per 100 people. Investing in a country with a high level of infrastructure helps to reduce the operating costs of enterprises and thereby increase their productivity. ⑦ **Geographical distance:** This article uses the distance between the investing country and the capitals of the countries along the route to measure. **Institutional distance:** Institutional differences between the investing country and the countries along the route will lead to systemic risk of investment, leading to rising investment costs and inhibiting investment by the investing country in the host country. Referring to the six indicators used to measure the quality of the system in the World Governance Indicators WGI database commonly used by scholars at present, the average values of the six dimensions of the system quality indicators of the investing countries and countries along the route are taken as the difference and the absolute value is taken.

**Inefficiency function.** The quality of a country's system and its changes reflect the country's continuous choice of developing governments and citizens, and it reflects the tradition and system of a country's exercise of power. The system quality of the countries along the route will lead to absolute risks of investment in the country, and differences in the system quality of countries may cause unobserved heterogeneity. This article selects six dimensions of indicators published by the World Governance Indicators WGI and the six indicators are all positive indicators. The larger the value, the higher the quality of the institutions in the countries along the route. A mature and sound system can effectively reduce the risk of uncertainty in investing

in the country, and in countries with poor system quality, the possibility of investor assets being deprived is greatly increased. The expected results and theoretical descriptions of the relevant variables are shown in the table4.

**Table 4.** Expected results and theoretical explanation of variables

Stochastic frontier			
Variable	Expected results		Theoretical elaboration
	China	US	
$lnpgdpc_t$ ( $lnpgdpu_t$ )	+	+	According to Dunning's investment development path theory, the stage of a country's economic development determines the stage of development of a country's outward investment and foreign investment. Therefore, it is expected that the actual per capita GDP of the investing country will promote direct investment.
$lnpgdp_{jt}$	+	+	Real per capita GDP is one of the indicators of a country's comprehensive development level, which not only affects the inflow of FDI, but also relates to the quality of a country's system (Pan Chunyang and Liao Jia, 2018). The higher the actual GDP per capita of a country, the greater the market potential for investment in that country. The utility of economies of scale and economies of scale and the effective use of resources will increase, the more it will help attract direct market-seeking as the main motivation investment. At the same time, the actual per capita GDP is also the main measure of market potential, which has an important influence on the location choice of the seeking FDI in the B market. Therefore, the actual per capita GDP of the countries along the route is expected to promote the direct investment of the two countries.
$res_{jt}$	+	+	Seeking resources is one of the main motivations of FDI. The internalization theory states that equity control is very important in the development of scarce resources. Enterprises can obtain resources such as minerals, forestry and oil and gas in countries along the route through investment such as holding acquisitions. Therefore, it is expected that the richer a country's natural resources are, the more it will help attract other countries' investments in that country.
$open_{jt}$	+	+	The higher a country's opening up to the outside world, the lower its threshold for foreign capital to enter the country, and the more favorable it is for FDI inflows. Therefore, it is expected that the higher the openness of the countries along the route, the more they will attract investment from China and the United States.

$inflation_{jt}$	–	–	The higher the inflation rate of a country, it usually means that the country's economy is more unstable. Economic instability will increase the uncertainty and variability of the expected return made by investors, may hinder investors from making investment decisions, reduce investment scale, and inhibit FDI inflows. Therefore, investment in both countries is expected to favour countries with lower inflation rates.
$lnpgni_{jt}$	*	*	The higher the labor cost of a country, the higher the cost of investing in the country, which will weaken the competitiveness of the enterprise to a certain extent. On the contrary, if the company transfers production to a country with relatively low production costs, it can not only reduce the cost of the enterprise but also play a role in alleviating the rise in the price of production factors. On the other hand, if higher labor costs are caused by an increase in the proportion of high-quality employees, it will attract investors to invest. In addition, countries with high GNI per capita have relatively strong market purchasing power, which has a positive effect on attracting investment. Therefore, the impact of GNI per capita on FDI depends on the relative magnitude of the impact of the above aspects on FDI, so the impact of labor costs on FDI is uncertain.
$infra_{jt}$	+	+	The improvement of the host country's infrastructure has enhanced the convenience of local transportation and communication, increased the country's economic growth, and affected market-use and factor-use FDI. Infrastructure investment will increase the total demand of society and be beneficial to the economic development of the investing country. Investing in countries with high levels of infrastructure can help reduce transportation and transaction costs. Therefore, the infrastructure level of the countries along the route is expected to have a positive impact on the direct investment of the two countries.
$Indisc_j(Indisu_j)$	–	–	Geographical distance is one of the important factors that affect the economic exchanges between the two countries. To some extent, it measures the degree of economic friction between the countries along the route and the investing countries. The closer the two countries are, the closer the two countries are, and vice versa (Li Jiguang et al., 2016). The trade between the two countries with long geographical distances will increase transportation costs. Not only that, as the distance increases, the difficulty of obtaining timely and sufficient information also increases, which increases the risk of investment to some extent.

			Therefore, the two countries are expected to tend to invest in countries that are geographically close.
$dzdc_{jt}(dzdu_{jt})$	–	–	Institutional distance is an objective risk that investors face when investing. The greater the distance between the two countries' systems, the more difficult it will be for investors to understand the market information of the host country, which will increase the legal and political risks they face. In addition, investors will spend more on adapting and coordinating, negotiating transactions, and ensuring the normal performance of contracts. In order to carry out production and operation more effectively in the countries where they invest, investors need to abide by local systems and rules, increasing the difficulty for investors to achieve internal and external legitimacy. Increasing risks and costs will reduce companies' expectations of expected returns. In contrast, companies investing in countries with systems close to their home countries will reduce these risks and costs. Therefore, it is expected that the greater the institutional distance between the investing country and the countries along the route, the more difficult it will be to attract direct investment.

Inefficiency function

Variable	Expected result		Theoretical elaboration
	China	US	
$va_{jt}$	*	*	In countries where the indicators of citizen's voice and accountability are high, it reflects the country's emphasis on citizens' rights. Citizens can exercise their rights more freely and have a higher degree of democratization. The impact of the degree of democratic politics on FDI is two-sided. On the one hand, the higher the degree of democratization of a country, the higher the degree of openness of the country, and the freedom of speech also makes the transmission of information smoother, which is helpful to avoid the risks and costs of corporate investment caused by information asymmetry. Moreover, more active financial markets usually have a higher percentage of listed companies, which broadens the channels through which FDI can enter the country. On the other hand, in countries with higher indicators, citizens' awareness of safeguarding their own interests will be stronger. Over-assertion of labor rights, welfarism, and over-inflated union forces may have an inhibitory effect on FDI inflows (Wang et al., 2014). Therefore, the impact of the indicators of citizen's voice and accountability on FDI in both countries is uncertain.

$ge_{jt}$	—	—	The more efficient the government, the more efficient the approval process required for investment. It is conducive for investors to seize investment opportunities and improve investment efficiency. At the same time, in countries with high government efficiency, the higher the quality of the public goods they provide, it will help investors to increase the expected value of the returns they can make from investments, increase the productivity of enterprises, and attract investors to make investment decisions. Therefore, it is expected that the higher the efficiency of the government, the better the investment efficiency.
$rl_{jt}$	+	—	The legal system, especially the effectiveness of contracts and the degree to which the judiciary complies with the law, play an important role in protecting investors' rights. If the investor's property rights are not legally protected, it will not only increase the risk of investment uncertainty, but also reduce the initiative of the enterprise to create new ones. Not only that, if there are major deficiencies in the laws and regulations of a country, the company's assets may be plundered by implementing contractual discrimination and high taxes on investment companies, affecting the normal operation of the company. On the other hand, strict legal system will have higher requirements for enterprises. For example, obligations on environmental protection, fair competition and social responsibility will increase additional costs for enterprises. However, Chinese companies in countries with weak legal systems can, based on their long-term development advantages (such as special ownership advantages), enable them to develop better. Therefore, it is expected that the legal system is positively related to the efficiency of US investment and China Investment efficiency is negatively correlated.
$cc_{jt}$	+	—	On the one hand, countries with severe corruption will increase the cost of enterprises in non-productive areas, increase the uncertainty of the investment environment and the unpredictability of investment activities, and greatly reduce the possibility for investors to obtain fair competition opportunities, which will hinder companies from Countries to invest. On the other hand, when the government of a country has too many restrictions on foreign investment behaviors and the government's operation efficiency is low, Chinese enterprises often can unblock the market through non-market behaviors due to the imperfect market mechanism. Institutional friction, reducing the

			cost of obtaining projects, etc. Chinese companies have a comparative advantage over investment companies in other countries. Therefore, it is expected that the investment efficiency of the United States is positively related to the degree of corruption control, and the investment efficiency of China is negatively related to the degree of corruption control.
$ps_{jt}$	-	-	The countries with worse political stability, the more difficult it is for investors to protect their investment rights, and the risk of investment and the uncertainty of returns are extremely high. The political instability of a country may cause market-oriented enterprises to change their business models, such as replacing the way of directly owning production facilities with a pure market service model. Therefore, it is expected that countries with higher political stability will help both countries to improve investment efficiency.
$rq_{jt}$	+	+	The countries with good regulatory quality are, in the first place, more conducive to the orderly and efficient operation of the market. Second, the stronger the restrictions on corporate behavior, such as requiring companies to fully disclose accounting information in accordance with regulations and industry norms, it is conducive to maintaining a high degree of transparency in corporate finances, and it is conducive to encouraging investment. The reduction of the possibility of an enterprise's internal income being illegally embezzled will help protect the shareholders' rights and interests of the company and increase shareholders' confidence in the company's investment. In addition, the effective government supervision has alleviated the asymmetry of information to a certain extent and reduced the investment risk caused by the asymmetry of information. Therefore, it is expected that China and the United States will invest more efficiently in countries with higher regulatory quality.

Because of the logarithmic processing of direct investment stocks, this article excludes countries with negative direct investment stocks. Secondly, because what this article intends to study is the comparison between China and the United States in direct investment in the same countries along the route, excluding countries with only China (US) investment, and finally 35 countries along the route were selected for analysis. In order to eliminate the influence of heteroscedasticity, the direct investment stocks, the actual per capita GDP of the investing countries and the countries along the route, and the GNI per capita of the countries along the route are logarithmic. The missing data of some years of the data indicators used in this paper are estimated by interpolation. The gross attribute results and data sources of the variables are shown in Table 5.

**Table 5.** Variable descriptive statistics and data sources

Variable	Mean	Standard deviation	Minimum value	Max	data source
lnyc	18.34	2.67	11.51	24.23	Statistical Bulletin of China's outward Foreign Investment
lnyu	20.68	2.82	13.82	26.27	U.S. Department of Commerce Website
lnpgdpc	8.48	0.25	8.03	8.84	World Bank Database
lnpgdpu	10.82	0.03	10.77	10.87	World Bank Database
lnpgdp	8.97	1.20	6.45	11.19	World Bank Database
res	25.25	28.52	0.66	97.90	World Bank Database
open	106.28	60.61	25.31	441.60	World Bank Database
inflation	5.00	7.15	-25.96	38.88	World Bank Database
lnpgni	8.96	1.18	6.50	11.10	World Bank Database
infra	10.37	8.87	0	32.77	World Bank Database
lndisc	8.64	0.32	7.75	8.95	CEPII
lndisu	9.18	0.28	8.79	9.69	CEPII
dzdc	0.70	0.55	0	2.13	Global Governance Indicators Database (WGI)
dzdu	1.20	0.62	0.01	2.44	Global Governance Indicators Database (WGI)
va	-0.14	0.78	-1.91	1.21	Global Governance Indicators Database (WGI)
ps	-0.20	0.99	-2.81	1.5	Global Governance Indicators Database (WGI)
ge	0.29	0.71	-0.88	2.44	Global Governance Indicators Database (WGI)
rq	0.34	0.68	-1.00	2.26	Global Governance Indicators Database (WGI)
rl	0.14	0.67	-0.97	1.83	Global Governance Indicators Database (WGI)
cc	0.02	0.76	-1.43	2.25	Global Governance Indicators Database (WGI)

### 3. ANALYSIS OF EMPIRICAL RESULTS

Table 6 shows the result. Stochastic frontier: ① The coefficient of China's actual per capita GDP is significantly positive, indicating that with the expansion of the Chinese market, direct investment in countries along the route will be promoted. The actual per capita GDP of the United States is not significant and negative, indicating that when the market size of the United States expands, it will reduce direct investment in countries along the route; ② From the perspective of investment motivation, China and the United States exist in direct investment in countries along the route. Significant market-seeking motivations, and the coefficients of actual per capita GDP of the countries along the line are all significantly positive; ③ The natural richness of the countries along the line has a different impact on the direct investment of the two countries. China tends to be rich in natural resources, while the United States does not have

the motivation to seek resources in the direct investment of the countries along the route; ④ The degree of opening up of the countries along the route is conducive to promoting investment in the two countries, but the impact on both countries' investment is significant. It may be related to the use of the measure of the ratio of total imports and exports to GDP, and investment in countries along the route may rely more on infrastructure and other factors; ⑤ Countries with higher inflation rates tend to have more unstable economies, and both countries tend to be economically stable countries, for the United States, the impact of economic stability on their investment is more significant; ⑥ The coefficient of GNI per capita of the countries along the line is significantly negative, indicating that labor costs are a key factor affecting direct investment in the two countries. Countries with higher labor costs have higher investment costs for enterprises, so countries with lower labor costs are more conducive to attracting investment from both countries; ⑦ The United States tends to invest in countries with higher infrastructure levels, consistent with the results of Loree and Gusinger (1995), Mody and Srinivasan (1998). It may be because the higher the level of infrastructure, the lower the cost of investment and the higher the company's expected return. For China, the impact of the infrastructure level of the countries along the route on China's investment in the countries along the route is not significant. The countries with the worse infrastructure level are more conducive to attracting Chinese investment. It may be because the purpose of China's investment in the countries along the route is not limited to economic benefits, but also policy implications to help the countries along the route develop together. Consistent with the research conclusions of most scholars, countries with closer geographic distances are more attractive to China's investment. The closer the geographical distance, the lower the transportation cost when investing, and it can reduce the cultural and customary differences caused by the increase in geographical distance, thereby reducing the cultural cost. The United States, on the other hand, tends to invest in countries along the route that are geographically far away. The impact of institutional distance on China's direct investment in countries along the route is not significant. It will bring "foreigner advantages" to Chinese investment enterprises, speed up enterprises to become familiar with and adapt to the local affairs and orientation of investment, and can reduce the uncertainty of the external environment to a certain extent and reduce investment risks. And American investment tends to countries with farther institutional distances. The system quality of the countries along the route is low, which is far from the quality of the US system.

Inefficiency function: ① The coefficients of citizen's right to speak and accountability are both negative, which indicates that the higher the value, the more favorable the two countries are to improve investment efficiency, and the impact on the US investment efficiency is significant at the 5% significance level. The development of democratic politics will increase the country's degree of openness, which will help the country to obtain more trade opportunities and attract foreign capital inflows. ② Government efficiency has a positive effect on the improvement of investment efficiency in both countries. The full-quality services support the development of enterprises, and also reduce the constraints faced by enterprises, which is conducive to the formation of stable expectations and encourages enterprises to make long-term investments; ③ The legal system has an impact on the investment efficiency of both countries at 5% significance, China is more efficient in investing in countries with weaker legal systems. State-owned enterprises are the main body of China's foreign investment and the quality of China's system is not high. They are more familiar with the environment of a weak legal system and a weak market. They have "specific advantages" and know how to use "non-market behaviors" to reduce economic costs. The United States is more efficient in investing in countries with sound legal systems. ④ The higher the regulatory quality of the countries along the route, the more favorable the improvement of the investment efficiency of the two countries,

and the regulatory quality has a significant impact on the improvement of the value of US investment efficiency. Countries with better regulatory quality provide policies that are more conducive to the long-term development of enterprises, set certain standards for economic activities, reduce information asymmetry, and reduce the risks faced by enterprises. At the same time, a sound regulatory system can better protect the interests of shareholders, make profit expectations, and meet corporate profit-seeking goals; ⑤ The higher the corruption control, the higher the US investment efficiency, but the lower the investment efficiency of China. It may be because when corruption exists in the countries along the route, investment costs will increase, and the low quality of public goods provided by the government will become a hindrance to improving investment efficiency. And Chinese enterprises are good at using lower-cost behaviors such as corruption, reducing friction with local governments, and reducing investment costs. Therefore, the efficiency of investment in countries with higher levels of corruption will be higher; ⑥ The coefficient of government stability is 5% The level of significance is significantly negative, indicating that government stability has a positive impact on improving investment efficiency in both countries. A safe and stable social environment is an important prerequisite for the production of enterprises. Countries with poor political stability will directly increase the investment risks of enterprises, which is not conducive to enterprises' innovation and continuous production and operation. On the whole, US investment is in line with mainstream international investment theory, that is, OFDI should flow more to countries with better system quality, corporate property rights and assets can be effectively protected, investment returns can be expected, and investment risks are relatively low.

**Table 6.** Outcome of Practice

China			US		
Stochastic frontier					
Variable	Coefficient	Standard Deviation	Variable	Coefficient	Standard Deviation
lnpgdpc	4.335***(0.000)	0.340	lnpgdpu	-3.467(0.061)	1.852
lnpgdp	13.78** (0.003)	4.687	lnpgdp	7.611***(0.000)	1.531
res	0.006 (0.442)	0.007	res	- 0.035***(0.000)	0.006
open	0.004 (0.176)	0.003	open	0.003 (0.241)	0.003
inflation	-0.007 (0.273)	0.006	inflation	-0.016* (0.025)	0.007
lnpgni	-14.067** (0.002)	4.650	lnpgni	-5.788*** (0.000)	1.269
inf	-0.034 (0.057)	0.018	inf	0.065*** (0.000)	0.010
lndisc	-1.739** (0.004)	0.609	lndisu	3.270*(0.029)	1.502
dzdc	-0.033 (0.937)	0.421	dzdu	8.453** (0.003)	2.891

Inefficiency function					
va	-0.186 (0.598)	0.352	va	-1.408**(0.003)	0.470
ge	-0.604 (0.090)	0.356	ge	-0.880 (0.093)	0.524
rl	1.162** (0.005)	0.412	rl	-2.052**(0.006)	0.751
rq	-0.373 (0.279)	0.345	rq	- 1.501*** (0.000)	0.427
cc	0.138 (0.669)	0.323	cc	-1.205*(0.011)	0.474
ps	-0.397** (0.002)	0.131	ps	-1.391**(0.002)	0.454
$\sigma_{\mu}$	0.702*** (0.000)	0.101	$\sigma_{\mu}$	0.369*** (0.000)	0.071
$\sigma_{\nu}$	0.338*** (0.000)	0.060	$\sigma_{\nu}$	0.321*** (0.000)	0.070
$\lambda$	2.076*** (0.000)	0.142	$\lambda$	1.149*** (0.000)	0.111
loglikelihood	-402.019			-254.033	

The average investment efficiency of China and the United States is 0.59 and 0.72, respectively. Except that China has higher investment efficiency values in Singapore and Macedonia than in the United States, the investment efficiency of other countries is lower than that of the United States, and the average investment efficiency of the United States in Singapore and Macedonia is lower than the average investment efficiency of China in the countries along the route by 0.59. The average value of China's investment efficiency in countries along the route is between 0.27 and 0.7. The countries with the lowest and highest average investment efficiency are Israel and Malaysia, respectively. The average investment efficiency is concentrated between 0.6-0.7, accounting for 51.43%. The average investment efficiency of the United States is between 0.52 and 0.77, concentrated between 0.7-0.8, accounting for 77.14%. The figure shows the change in the average annual investment efficiency value of China and the United States. Overall, China's investment efficiency value has shown a slow upward trend. The U.S. investment efficiency value is higher than China each year. However, there were obvious downward trends in 07-08, 09-12 and 15-16.

#### 4. CONCLUSIONS AND POLICY RECOMMENDATIONS

In terms of investment motivation, both China and the United States have shown market-seeking motivation and efficiency-seeking motivation in their direct investments along the route, but the United States has not shown resource-seeking motivation. Countries with better infrastructure and more stable economies are attractive to US direct investment. In addition, the United States tends to invest in countries with institutional distances and geographic distances, while China prefers to invest in countries with closer geographical distances. Among the factors that affect investment efficiency, on the whole, the six indicators of system quality have a positive impact on improving US investment efficiency. Except for the government efficiency coefficient, the other indicators have passed the significance test. For China, except

for the coefficients of the  $rl$  and  $cc$ , which are positive in the inefficiency equation, the coefficients of the other variables are all negative. This shows that China has higher investment efficiency in countries with weaker legal systems and worse corruption control. Second, of the six dimensions of system quality, only the legal system and government stability have a significant impact on China's investment efficiency, and the remaining variables have no significant impact. Regarding the investment efficiency values of the two countries in the countries along the route, except for Macedonia and Singapore, the overall investment efficiency of the United States is higher than that of China. Sino-US investment efficiency values are concentrated between 0.6-0.7 and 0.7-0.8, respectively. Compared with the United States, China's foreign direct investment started late, lacking relevant experience, and still has investment potential.

First, geographical distance limits China's investment in countries along the route, which may cause China to lose some investment opportunities. On the one hand, it is possible to broaden transportation methods and reduce transportation costs by investing in infrastructure construction. On the other hand, to change the way of investment, you can use joint ventures and mergers to make use of local resources to reduce humanities costs caused by differences in customs and religious culture. Secondly, one of the reasons why China's investment efficiency is lower than that of the United States may be that the United States is more inclined to invest in countries with better system quality. Therefore, when investing in China, we must take good precautions against risks and reasonably choose investment destinations. Most of the developing countries along the route have a single economic model, and often face instability in the country, which increases investment risks. In 2015, the new Greek government came to power and announced the suspension of China's Reeves port project. In March of the same year, the new Sri Lankan government came to power and suspended China's Colombo port project. According to the "China's Belt and Road Trade and Investment Development Research Report" issued by the National Institute of Trade and Economic Cooperation of the Ministry of Commerce, manufacturing, construction, wholesale and retail, leasing and business services, and agriculture, forestry, animal husbandry and fishery account for China's Over 70% of the investment in countries along the route. These industries have the characteristics of large investment funds, long payback periods, susceptibility to political and economic risks in the countries along the line, and the impact of political relations with China. Once the countries along the line suspend projects invested by China for various reasons, it will be a huge loss. Therefore, China must strengthen strategic mutual trust with the countries along the route, eliminate the impact of the "China threat theory", promote information exchange and mutual communication with the countries along the route, and eliminate the limitations of China's infrastructure investment in ASEAN and other countries. A breakthrough was made in the project. Together, we will build a sound business environment and provide reasonable protection for corporate investment.

For Chinese enterprises, they must continuously innovate and learn from advanced foreign management concepts. They are in a favorable position in the competition of investment projects in countries along the route, while at the same time maximizing efficiency to increase productivity and enhance corporate efficiency. At the same time, it is necessary to raise awareness of risk management, implement diversified competition strategies, strictly approve and evaluate the feasibility of outbound investment projects, and prudently use mergers and acquisitions to invest. Strengthen the comprehensive training of employees, implement localization strategies, improve the adaptability in countries along the route, and reduce friction caused by cultural differences.

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