




THE NEXUS OF CHINESE OFDI INNOVATION AND ENTREPRENEURSHIP IN EUROPE: A TRUE FIXED EFFECT STOCHASTIC ANALYSIS



 **Tatsiana Dziavochka^{1*}**

 **Elyas Abdulahi Mohamued²**

^{1,2}Huazhong University of Science of Technology, School of Economics, China.

¹Email: tanya_devochka@mail.ru



(+ Corresponding author)

ABSTRACT

Article History

Received: 10 December 2019

Revised: 29 January 2020

Accepted: 13 March 2020

Published: 1 April 2020

Keywords

OFDI

Efficiency

Entrepreneurship

Innovation

Stochastic efficiency model.

JEL Classification:

D83; O11; O30; O32; O52.

In this study, we model economic factors affecting foreign direct investments (FDI) together with research and development spending (R&D), and factors contributing to the opening of new businesses (entrepreneurship). The study used a true fixed effect stochastic efficiency model to assess the efficiency of Chinese outward foreign direct investments (OFDI) in 36 European countries from 2003 to 2016. In the time of the One Belt One Road policy which is expected to be the next phase of the Chinese “Go Global” programme, understanding what drives the surging level of direct investment by China in Europe is timely and pertinent. The results indicate that research and development (R&D) alone is insufficient to attract Chinese FDI. By contrast, the efficiency of new entrepreneurship in Europe is comparatively self-evident in its importance to the attraction of Chinese investment.

Contribution/ Originality: This study makes an original contribution to the existing literature by identifying the motives behind Chinese investment in the European market using a fixed effect stochastic frontier model. It also identifies those factors necessary to attract Chinese investment to Europe.

1. INTRODUCTION

Analyzing the pattern of global FDI is not new. But unlike advanced economies, the growth of investment in developing countries is increasing rapidly, signaling to firms everywhere a need to rethink their global investment strategies (Ramamurti, 2012). Empirical literature recognizes that investments are either domestic or foreign, direct or indirect, and are drivers of economic growth (Dunning & Dunning, 2006). Explicitly, FDI inflows contribute to economic growth by augmenting the productivity of entrepreneurs by providing new investment, better technologies, and managerial skills to both host and home countries (Pegkas, 2015).

Presently, there is a shift in the global sources of FDI away from the multinational enterprises of developed countries in favor of emerging countries. The dynamics and objectives also have shifted (Awate, Larsen, & Mudambi, 2012) and the Chinese have become a net outward investor for the first time (OECD, 2016) and continues to be an import source of FDI to developed and emerging economies. For instance, according to the OECD (2016) the FDI out of the European Union (EU) decreased by 10 percent from \$531 billion US to \$476 billion US in 2016, while the FDI outflows from G20 economies increased by eight percent (\$831 billion US to \$898 billion US). FDI

within all G20 countries increased by 10 percent, while the G20 OECD economies increased by a more modest two percent. In the non-OECD G20 economies the FDI inflow increase was driven mainly by the expansion of China's multinational enterprises (MNEs). According to the UNCTAD (2015) statistics, emerging economies now account for more than one-third of global FDI outflows, up 13 percent since 2007. Over the last few decades, the international emergence of Chinese, South Korean and Indian enterprises in the manufacturing sector has been phenomenal, and their contribution to global FDI has increased by up to \$340 billion US (Ahmad, Draz, & Yang, 2018).

The rapid rise of MNEs and the FDI of emerging countries in recent times calls for a reassessment of the basic understanding regarding the activities of investments (Meyer & Thaijongrak, 2013). The trend in Table 1, illustrates the FDI flow to the world and Europe, followed more or less by a similar, increasing trend, even at the time of the Global Financial Crisis (GFC) of 2007 to 2010. In consequence, China had become the world's leading outward investor by 2016.

According to Buckley, Yu, Liu, Munjal, and Tao (2016) and Bräutigam and Tang (2014) Chinese MNEs were reluctant to invest and seek strategic assets in Western economies, in contrast to their strategy of investing in neighboring countries with the same ethnolinguistic and cultural proximities. However, their current motives and the trends in FDI appear bring into question the validity of the Chinese "proximity effect", and may be regarded as having prompted Chinese MNEs to invest in developed countries. Thus, the increased FDI outflow to Europe and industrialized countries is relatively a new phenomenon. It is apparently an outcome of the 'Go Global' policy – which itself presents an intriguing case for the study of the Chinese MNEs activities in Western and developed economies.

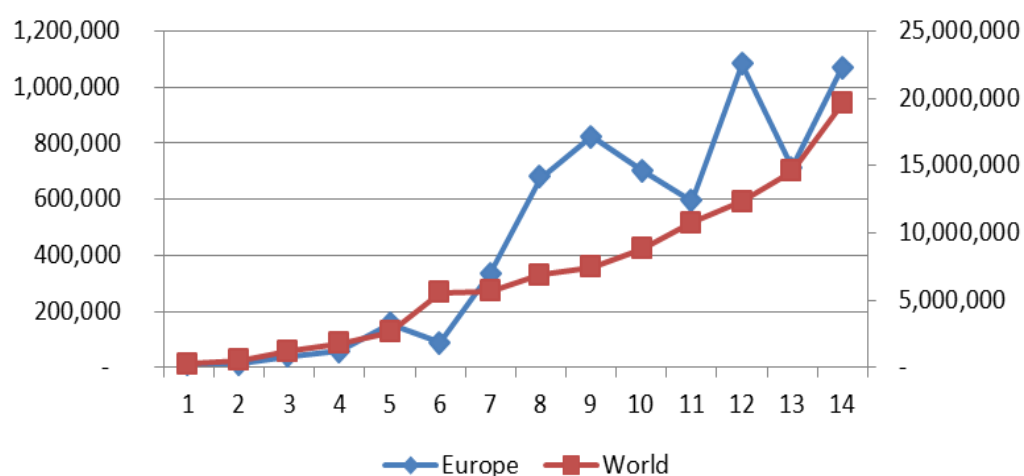


Figure-1. Chinese OFDI to Europe and to the World.

Moreover, the effects of FDI have also been found to enhance entrepreneurship, domestic investment, and innovation within different home countries and firms, although these aspects have attracted less attention. Preliminary findings obtained from the longitudinal data analysis of Praag and Versloot (2007) suggest complementarity between FDI and entrepreneurship measured by new business creation. Entrepreneurial opportunities and activities differ significantly across societies. Such differences are an essential factor for varying levels of wealth and prosperity across societies and nations (Praag & Versloot, 2007). One explanation of these differences has it due to cultural, regulatory and institutional difference between nations and to firms' "spillover effects". Many enterprises try to absorb the tangible (natural resources used as production inputs) and intangible (skills, technology, innovation, and entrepreneurship) assets from host to home countries through foreign acquisitions (Bosma, Jones, Autio, & Levie, 2008).

Regarding this, our study emanates from the same question of [Deng \(2007\)](#) though based on a different perspective. Deng put the question: what is the motivation of Chinese outward FDI, and what is the rationale for its increase in Europe? Deng also made a detailed analysis of both primary and secondary data sources to challenge Chinese FDI in advanced economies. Chinese multinational corporations (MNCs) are motivated primarily by the quest for strategic resources and capabilities, and the underlying rationale for such asset-seeking FDI is strategic rather than to obtain physical resources. Other, studies also identify the intangible as crucial sources needed to sustain a competitive advantage in Europe and other industrialized economies ([Barney, 1991](#); [Prahalad & Hamel, 1994](#)).

This study therefore focuses on measuring the effects of R&D spending and entrepreneurship on new business ventures that attract Chinese FDI in the European countries. These specific factors may have different efficiency effects in different countries and in different years. Therefore, we examined them separately as well as in aggregate, using the fixed effect Stochastic Frontier Analysis model (SFA) of [Greene \(2005\)](#).

This study makes two major contributions to the literature. Firstly, we reveal the determinant factors that attract Chinese FDI to developed countries. Second, we assess how the technical efficiency of each country's innovation and entrepreneurship attracts Chinese FDI over different time frames. To reflect this, this article is structured as follows. Section two presents the literature review. Section three presents the data definitions and sources, and the estimation model. The empirical results and related discussion are in section four, and the conclusion in section five.

2. LITERATURE REVIEW

2.1. Theoretical Foundation

[Douglas \(2006\)](#) recognized FDI as one of the most prominent occurrences in the history of economic activity after the Bretton Woods Agreement, which laid the foundation of the current monetary system, globalization, and regional integration. Before discussing FDI, its rationales and prominent models, it must be defined. Following [Petranov \(2003\)](#) we identified FDI as "an international investment, in which the direct investor and the resident of a foreign economy, acquires a lasting interest." Similar definitions are put forth in [Barrios, Dimelis, Louri, and Strobl \(2004\)](#). According to [Gastanaga, Nugent, and Pashamova \(1998\)](#), the primary point of FDI is to extract wealth generated by the recipient, and it is true for all financial markets where more money is taken out than invested.

In explaining the rationale and the process of FDI, [Dunning and Norman \(1983\)](#) model is taken as the pioneer economic model. The main determinants of FDI in his study were market size, unit labor cost, service sector productivity and the inflation rate. [Root and Ahmed \(1979\)](#) stated that the social status of the country was also effective in determining FDI. The development of human capital, the quality of life, the adequacy of the health system and the rate of urbanization are some of the variables that constitute the social status of the country. Similarly, [Schneider and Frey \(1985\)](#) pointed out that human capital could motivate FDI, and also it indicated how FDI is attracted by the size and quality of a country's labor market.

Recently, two theoretical models were proposed which address specifically the determinants, motivations (antecedents) and processes (decision characteristics) of FDI from MNEs. The first was [Mathews \(2006\)](#) Linkage, Leverage, and Learning (LLL) model, which extends the Ownership, Location and Internalization (OLI - or the "eclectic paradigm") framework to newly industrialized countries as well as latecomer MNEs that seek strategic assets. This model was developed to explain how MNEs from peripheral countries in the Asia-Pacific region - for instance Taiwan and South Korea - established themselves successfully in developed countries. [Mathews \(2002\)](#) suggested that internationalization in the pursuit of new capabilities (asset-augmentation) requires a perspective different from the expansion designed to exploit existing capabilities (asset-exploitation).

The resource-based view (RBV) has also been used in research on FDI from emerging countries. In the 1980s and 1990s, RBV emerged as a means of understanding the basis for achieving competitive advantages ([Barney,](#)

1991). Proponents of this view argued that organizations should look within the company to uncover the key sources of such competitive advantages. Resources are classified as tangible and intangible, with intangible resources such as intellectual property rights and brand reputation being crucial sources (Barney, 1991; Prahalad & Hamel, 1994). Some researchers have specifically used RBV in the context of outward FDI from the EMNEs (Cooke & Lin, 2012; Cui & Jiang, 2010). The intangible resources are found to be an important factor for Chinese OFDI in Europe. Regarding this, Amighini, Rabellotti, and Sanfilippo (2013) provide an empirical analysis of host country determinants of Chinese outward FDI for the period 2003 to 2008, using data disaggregated by country and industry. The study identifies the relevance of market-seeking, resource-seeking and strategic asset seeking motivations suggested by the theory on FDI to be the determinant. Thus, there are ample research models that support our hypothesis that FDI seeks innovation and entrepreneurship.

2.2. Determinants of Chinese OFDI in Europe

Companies engage in cross-border activities in many different forms and for many different reasons. Some source inputs, components, and services from foreign suppliers because they are cheaper, more readily available, or of higher quality than those from domestic suppliers to appeal. Some sell goods and services in foreign markets, thereby considerably increasing their customer base. Some acquire knowledge assets such as patents, reputation and assets such as brands, or perhaps even other companies in order to quickly obtain competitive advantages that would have taken them a long, and many resources that involve considerable risk to develop by themselves. Some choose to locate activities abroad in order to take advantage of lower costs, or to improve (or even secure) the availability of important resources for the type of business that they are engaged with (Benito (2015).

FDI is the long-term investment by entities from one country located in another country. The literature describes FDI as the primary driver for transferring private capital which results in capital flows and external productivity effects and economic factor movement to a host country (Ahmad et al., 2018). In theory, these external productivity effects can contribute positively to economic growth. For example, knowledge transfers from R&D, and training for employees in home and host countries (Bhattacharya, Patnaik, & Shah, 2012; Fu, 2008). Thus, FDI is an essential vehicle for the transfer of technology, contributing relatively to more growth than domestic investment. However, the higher productivity of FDI holds only when the host country has a minimum threshold stock of human capital (Cooke & Lin, 2012; Fu, 2008). Thus, FDI contributes to economic growth only when a sufficient absorptive capability of advanced technologies is available in the host economy (Borensztein, De Gregorio, & Lee, 1998; Fu, 2008). In general, economists agree that FDI leads to an increased rate of economic growth. A primary growth-enhancing characteristic of FDI is the spillover into the advancement of technology and entrepreneurship that often accompanies foreign capital investment. Domestic investors can also adopt this advanced technology (Albert, Renato, & Brian, 2010).

Statistics show that Chinese non-financial and financial OFID investment is increasing over time. For instance, the non-financial OFID investment of China has increased from \$5.5 billion US in 2004 to \$181.2 billion US in 2016, a rise of approximately 330 percent. In 2006, Chinese firms accounted for 2.8 percent of total R&D projects by foreign investors in Europe, rising from virtually zero in 2001 (Nolan, 2012). The latest 'Science, Technology and Industry Outlook' published by the OECD (2016) further suggests that the research intensity of Chinese firms has massively increased. China has edged in the European Union regarding investment in R&D with its R&D to GDP ratio touching two percent. Such an impressive growth of OFDI investment from China might be due to government policy support and the rapid growth of Chinese companies (Ahmad et al., 2018; Bräutigam & Tang, 2014). For example, the Chinese government has been enthusiastically encouraging its 'One Belt, One Road' strategy since 2013, to export China's enormous manufacturing output and encourage Chinese companies to expand their business overseas (Li, Luo, & De Vita, 2018).

The continuing increase of OFDI from China in industrialized countries has caused it to become a pressing and multifaceted issue. It is interesting to note that developed countries in the West (e.g. the US, Canada, Germany, UK, and France) are among the newest and most attractive locations for Chinese MNEs. According to [Thompson and Thompson \(2009\)](#) Chinese firms are also investing European countries to acquire brands and technology. The authors observed that some Chinese automobile firms have taken over small Italian firms in Turin to gain their technology and design capabilities. This is also likely to benefit the firms that acquire resources from the spillovers resulting from the science and technologies of host countries and enterprises.

2.3. Innovation and Entrepreneurship

In recent years “entrepreneurship” has become a buzzword in public debate. Policy-makers and commentators regard entrepreneurial activity as one of the roads to future prosperity. However, the concept is often used without a precise definition, and it may not always be clear what the different measures are in fact measuring ([Acs & Szerb, 2007](#); [Albulescuab & Tămășilăa, 2014](#)). Analysts and economic theoreticians have long recognized that entrepreneurship and entrepreneurs are important drivers of economic growth, employment, innovation, and productivity. Indeed, the concept dates back centuries to the work of Cantillon, the first academic to explicitly attempt to define ([Ahmad & Hoffman, 2007](#); [Albulescuab & Tămășilăa, 2014](#)) and describe the role of entrepreneurs. In this research the definitions and proxies of entrepreneurship are far from conclusive, and its key characteristics or indicators have already been summarized in the OECD’s Entrepreneurship Indicators Project of [Ahmad and Hoffman \(2007\)](#) that seeks to build a framework for addressing and measuring entrepreneurship. According to the study, entrepreneurship is all about the creation of new businesses. This is why it is important to recognize new business openings as indicators of proxy entrepreneurship.

Two questions suggest themselves in this context:

- 1) Why are policymakers typically interested in entrepreneurship?
- 2) What are the most common definitions of entrepreneurial businesses?

Objectivity is the most commonly used indicator that tries to capture the rationale for entrepreneurial activity. Not all businesses are entrepreneurial despite the fact they take risks, and create products, employment, revenue and tax revenue for the government ([Albulescu & Tămășilă, 2016](#)). Therefore, the question entrepreneurship’s relevance (measured in new business creations) is for the home and host countries to determine. Is Chinese OFDI investment in Europe effective because of entrepreneurship and innovation? This question is vital if entrepreneurship is to be regarded as more than just businesses and the people who own or run them.

Entrepreneurship manifests itself in a variety of ways (see for detail; [Parker \(2005\)](#)). Buying low and selling high, the discovery and diffusion of lower cost technologies in production, the introduction of new products, learning how to better deliver goods and services to customers at lower cost, and the creation of new opportunities to alert potential buyers to the availability and desirability of new products are all entrepreneurial acts. For our purposes, the defining characteristic of entrepreneurship is that the entrepreneur seeks to better his situation by engaging in a beneficial exchange with others. Entrepreneurial opportunities and activities differ significantly across societies. These differences are one crucial factor for varying levels of wealth and prosperity across the world ([Parker, 2005](#); [Praag & Versloot, 2007](#)). One explanation for these differences is purely due to the cultural and institutional differences between nations ([Bosma et al., 2008](#); [Dheer, 2017](#); [Parker, 2005](#)).

A study made by [Blomström and Kokko \(1998\)](#) assessed key factors that affected the establishment of new businesses in eighteen developed and emerging member countries over the period 2003 to 2015. Using panel-data estimation techniques, it identified the effect of macroeconomic and demographic variables as the most significant determinants, followed by individual characteristics of potential entrepreneurs, and the business environment. Regarding FDI and entrepreneurship, different assessments suggested that the complementarity between them and the relations significantly depend on the existing regulatory environment for business startups ([Bosma et al., 2008](#)).

Investments of multinationals are attracted by areas that combine industrial cluster characteristics with an agglomeration of foreign firms that also have a high level of entrepreneurial culture. The role that this last variable plays is fundamental and suggests the idea that multinational corporations (MNCs) invest in regions with entrepreneurial resources (Majocchi & Presutti, 2009).

Many writers have claimed that R&D has two faces. In addition to the conventional role of stimulating innovation, R&D enhances technology transfer (absorptive capacity). The study explores this idea empirically using a panel of European countries. We find R&D to be statistically and economically significant in both technological catch-up and innovation. Human capital also plays a significant role in productivity growth, but we only find a small effect on trade. In failing to take account of R&D-based absorptive capacity, existing US-based studies may underestimate the return from R&D (Griffith, Redding, & Reenen, 2004).

Regarding the proxy of innovation, there is considerable discussion without any consensus. However, several studies use R&D spending and patents as a proxy for innovation (Fernández, López, & Olmedillas, 2018). Even though R&D spending has limitations to proxy innovation, the basic argument behind the use of R&D and patent statistics as a proxy for innovation is clear and parallel. An increase in the R&D efforts of a region results in a higher rate of invention (Beneito, 2006; Makkonen & Robert, 2013).

As it has been well documented in the literature, FDI is closely related to cross-border knowledge spillover effects and economic development of the local market (Branstetter, 2006). R&D capabilities remain as crucial as the ability of a firm to absorb external funds and technology. However, these depend on its prior R&D efforts (Buckley et al., 2010; Cohen & Levinthal, 1990). For instance, although the acquisition of IBM's personal computer (PC) division by Lenovo is often considered as an asset-seeking investment, Lenovo still needs to have a sufficient level of technological resources to be able to manage the new organization and successfully integrate the new technological capabilities in its own organizational routines (Wang, Hong, Kafouros, & Boateng, 2012). The relationship between innovation, FDI and entrepreneurship can be manifested by their mutual-relationship. FDI can bring innovation effects to the host and home countries by spillover channels, and countries may benefit from reverse engineering, skilled labor turnover, demonstration effects, and supplier, and customer relationships (Cheung & Ping, 2004). This has been the major target of developing countries initiatives in FDI and OFDI. In a recent empirical work, Branstetter (2006) has examined the extent to which international trade fosters international "spillovers" of technological information and found FDI an alternate, potentially significant canal to facilitate spillovers. Moreover, Cheng and Ma (2010) indicated Foreign R&D activities by multinational enterprises in a host country also significantly impact the innovation performance of domestic firms when the absorptive ability is taken into account. The findings indicate that both international technology spillover sources and indigenous efforts jointly determine the innovation performances. Thus, MNEs and countries venture to enhance the innovative capacity and spillover effects of industrialized countries where the institutions and the indigenous culture are benign for innovation and entrepreneurship.

Therefore, our study builds on the hypothesis of Chinese MNEs investment in Europe due to the efficiency of the OFID spillover effect on China.

3. METHODOLOGY

3.1. Sources of Data and Variables

Panel data from 36 European countries was used in this paper. The countries chosen were those that have a positive net inflow of Chinese OFDI. The period of the study – 2003 to 2016 - was limited due to the availability of the Chinese OFDI data which comes from the 2017 Statistical Bulletin's section on China's Outward Foreign Direct Investment from the Ministry of Commerce (MOFCOM, 2017). The rest independent economic data comes from the World Development Indicator's (WDI) panel data. The variables are described in Table 1.

Table-1. Data source and Description.

Variables	Definitions	Source
OFDI-Stock	Chinese Outward direct investment to Europe	China Statistical bulletin
Population	The total population of the countries	WDI
NB	New businesses registered (number)	WDI
R&D	Research and development expenditure (% of GDP)	WDI
Capital	Gross fixed capital formation (% of GDP)	WDI
Rents	Total natural resources rents (% of GDP)	WDI
GDP/capita	GDP per capita (current US\$)	WDI
GDP	GDP (current US\$)	WDI
Inflation	Inflation, GDP deflator (annual %)	WDI
Trade	Trade (% of GDP)	WDI
Imports	Imports of goods and services (% of GDP)	WDI
Year	Period of the study (2003-2016)	

3.2. The Stochastic Frontier Model

Stochastic production frontiers were initially developed for estimating technical efficiency rather than capacity and capacity utilization. However, the technique also can be applied to capacity estimation through modification of the inputs incorporated in the production (or distance) function. A potential advantage of the stochastic production frontier approach over data envelopment analysis (DEA) is that random variations in the catch can be accommodated, so that the measure is more consistent with the potential harvest under “normal” working conditions. A disadvantage of the technique is that although it can model multiple output technologies, doing so is somewhat more complicated, and requires stochastic multiple output distance functions, and further raises problems for outputs that take zero values (Kang & Fratianni, 2006; Stack, Ravishankar, & Pentecost, 2015).

3.2.1. The Underlying Theory

A production function defines the gap of technical efficiency between the level of inputs and the resulting level of outputs. If estimated econometrically from data on observed outputs and input usage, it indicates the average level of outputs that can be produced from a given level of inputs (Schmidt & Tango, 1986). Several studies have estimated the relative contributions of the economic factors of production and the relationship between determinants of economic growth through estimating production functions at different levels.

An implicit assumption of production functions is that all firms are producing in a technically efficient manner, and the representative (average) firm therefore defines the frontier. Variations from the frontier are thus assumed random, and are likely to be associated with mis- or un-measured production factors. In contrast, estimation of the production frontier assumes that the boundary of the production function is defined by “best practice” form or country. It therefore indicates the maximum potential output for a given set of inputs along a ray from the origin point. Observations within the frontier are deemed “inefficient”, so from an estimated production frontier it is possible to measure the relative efficiency of certain groups or a set of practices from the relationship between observed production and some ideal or potential production (Greene, 2005).

One of the key steps of the strategic financial management (SFM) is to choose the appropriate production function of the analysis. Regarding this, we deployed the popular Cobb-Douglas production function. The econometric model of our study is true fixed-effect panel stochastic frontier model.

$$y_{it} = \alpha_i + x'_{it}\beta + v_{it} - u_{it} \quad (1)$$

$$u_{it} = f(z)$$

Compared to the standard panel data model, the model, (1) has an additional term $-u_{it}$, representing time-varying inefficiency. When α_i which is not part of the inefficiency is treated as a fixed parameter, the model (1) turns out to be the stochastic frontier model of “true-fixed effect model” (Greene, 2005). Thus, the model can be written as:

$$\ln OFDI_{it} = \alpha_0 + \alpha_1 \ln(GDP_{it}) + \alpha_2 \ln(GDPChi) + \alpha_3 \ln(X_{it}) + \alpha_4 \ln(IRDI_{it}) + \alpha_5 \ln(INB_{it}) + (v_{it} - u_{it})$$

Where the $\ln(OFDI_{it})$ is the logarithm of Chinese OFDI stock in a host country $i, i=1, \dots, I$ at a period of year t . x_{it} is a vector of N factors of OFDI considered for each European countries at year t . $f(\cdot)$ is the function of OFDI frontier, and β is the vector of the coefficients to be estimated. The technical efficiency of each country i is given by TE_{it}

The focus of the study is to find out how R&D and new businesses (NB) efficiency/inefficiency affect the Chinese OFDI in Europe.

According to Greene (2005) if the estimation of the u_{it} is zero, the entire estimation stays similar with the standard panel data model of the Cobb-Douglas specification with ordinary e_{it} . Thus, to see the robustness of the estimation, it is vital to check the post estimation or diagnostic check on the SFA result using the following procedure;

$$\sigma^2 = \sigma_u^2 + \sigma_v^2$$

$$y = \sigma_u^2 / (\sigma_u^2 + \sigma_v^2)$$

4. EMPIRICAL RESULTS AND DISCUSSIONS

Tables 2 and 3 report the descriptive statistics and correlation table respectively. Table 2 provides data regarding the mean values, standard deviation, and the maximum and minimum values of the explanatory variables. Table 3 presents results from the correlation matrix between outward FDI and all variables used in our model. The highest positive correlation (0.91) occurs between the total population and per capita income constant in 2010, while the lowest positive correlation (0.0091) is between outward OFDI and resource rent. Regarding negative relationships, the highest is that between total population and total trade (-0.5766) and the lowest is between new business opened and inflation (-0.1145). The average variance inflation factors (VIFs) is well below the acceptable threshold of 10 (Neter, Wasserman, & Kutner, 1985) indicating that our data do not suffer from severe problems of multicollinearity. Furthermore, since most Chinese OFDI projects are a relatively recent phenomenon, there is little reason to be seriously concerned about reverse causality running from OFDI to parent firm and home economic characteristics. Nevertheless, in order to mitigate the potential causality problem, we follow the previous studies (Raff, Ryan, & Stähler, 2009) and lag all independent variables by one year ahead of the establishment year of each foreign subsidiary.

Table-2. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
OFDI	518	7.677729	3.217935	1.386294	15.02
POP	518	15.73968	1.340907	13.33844	17.93166
NEW	518	9.69227	1.388711	7.256297	13.40546
CAP	518	3.097205	0.199897	2.443961	3.700632
TR	518	4.601589	0.442156	3.820108	6.016576
GDP	518	25.51386	1.874653	21.25842	28.98959
R&D	518	-0.00946	0.915069	-4.12832	1.321604
RR	504	-0.85876	1.905215	-8.31585	2.969365
GDP/c	518	9.775911	1.035748	6.306804	11.68877
INF	483	0.847352	1.15958	-6.70071	4.320166
Year	518	2009.5	4.035026	2003	2016

Table-3. Correlation matrix of variables.

Variables	OFDI	POP	NEW	CAP	TR	GDP	R&D	RR	GDP/c	INF	Year
OFDI	1										
POP	0.5766	1									
NEW	0.546	0.8009	1								
CAP	-0.2818	-0.1712	-0.2205	1							
TR	-0.0894	-0.5766	-0.4578	0.104	1						
GDP	0.6888	0.8456	0.7848	-0.2719	-0.4248	1					
R&D	0.3772	0.1874	0.3614	-0.2181	0.0332	0.5517	1				
RR	0.0837	0.1462	0.1482	0.1084	-0.1423	-0.0695	-0.3822	1			
GDP/c	0.4341	0.1517	0.2987	-0.2643	0.0216	0.6493	0.7549	-0.421	1		
INF	-0.2369	-0.1232	-0.1145	0.3028	0.0188	-0.2821	-0.2146	0.1923	-0.3634	1	
Year	0.4477	0.0067	0.045	-0.2592	0.1571	0.0836	0.1237	0.0091	0.1349	-0.32	1

Table 4 reports the estimated results of the determinants of OFDI from China using the SFA. Column 1 shows the results of the baseline model that considers the effects of the GDP level of host countries, the inflation rate of host countries, total population, fixed capital formation, and per capita income. Moreover, the estimation consists the Z value of R&D spending which is used to proxy innovation of the host countries, and new businesses opened during the research period. The factor enables us to estimate the efficiency level of the factors in the countries. The estimation used a one-year lag of the variables to hold the potential issue of reverse causality and consider the time effect of each determinant.

According to the result GDP level of the host country, population (POP) and trade (TR) have a positive and significant effect on OFDI of China at least at five percent level of statistical significance, whereas resources rents (RR), capital (CAP), and inflation (INF) rates exert a negative and significant effect on OFDI at a level of one percent. However, the rest is not an essential determinant of Chinese OFDI in Europe. Furthermore, the estimation of the efficiency effect of the innovation R&D spending and the entrepreneurship (NEW) on the OFDI. Thus, in columns three and four, the Z variables are included separately one after the other to observe the solo effects of each factor. Consequently, the result suggests that nearly similar efficiency effect of innovation and entrepreneurship on the OFDI stock flow in Europe. The rest of the control and explaining variable stays more or less the same as the result shown in column one (baseline model).

The finding in Table 4 indicates a negative and statically significant effect of entrepreneurship on OFDI-stock in Europe. In other words, the Chinese OFDI stock in Europe is efficient in entrepreneurship. The result implies that Chinese investments in Europe are attracted by areas that combine industrial cluster characteristics with an agglomeration that have a high level of entrepreneurial culture. The role that this factor plays is fundamental and suggests the idea that MNCs invest in regions with entrepreneurial resources.

Table-4. Stochastic Frontier estimation results.

Variables	(1)	(2)	(3)
	all	lnew	R&D
Frontier			
POP	29.356*** (5.85)	31.046*** (6.82)	-201.211*** (-1710.34)
CAP	-3.455*** (-7.23)	-3.088*** (-6.69)	-1.688*** (-5.12)
TR	4.064*** (7.07)	3.701*** (6.47)	2.897*** (14.53)
GDP	7.350* (1.70)	6.133 (1.62)	202.657*** (2168.71)
RR	-0.474*** (-3.28)	-0.428*** (-3.08)	-0.118** (-2.35)
GDP/c	-3.710 (-0.86)	-2.586 (-0.68)	-200.800 (.)
INF	-0.173*** (-2.64)	-0.204*** (-3.18)	-0.303*** (-4.05)
_cons			-39.437*** (-17.94)
Mu			
NEW	-8.533*** (-3.17)	-2.853*** (-6.25)	
R&D	2.082*** (2.75)		18.904*** (4.88)
_cons	66.570*** (3.32)	24.981*** (6.64)	-58.817 (.)
Usigma			
_cons	0.439 (0.55)	-2.079** (-2.30)	4.739*** (77.88)
Vsigma			
_cons	0.273*** (3.83)	0.275*** (4.04)	-3.361*** (-4.01)
Post estimation			
$\sigma^2 u$	0.192721	4.322241	22.45812
$\sigma^2 v$	0.074529	0.075625	11.29632
σ^2	0.26725	4.397866	33.75444
γ	0.721126	0.982804	0.665338
N	470	470	470
N_g	36.000	36.000	36.000
t statistics in parentheses			
=** p<0.1	** p<0.05	*** p<0.01"	

However, the positive and significant result of innovation indicates the inefficiency of Chinese OFDI in Europe. The impacts of direct investment may have a spillover effect of technology, innovation and intangible resources for the home country. However, similar to the impacts of the investment from emerging economies, direct investment by China in Europe is not efficient regarding innovation and the R&D spending of European countries. The ability to exploit external knowledge is thus a critical component of innovative and absorptive capabilities. Studies argue that the ability to evaluate and utilize outside knowledge is mostly a function of the level of prior related knowledge (Chen, 2017; Cohen & Levinthal, 1990; Wang et al., 2012). At its most essential level, this prior knowledge includes basic skills or even a shared language, and may also include knowledge of the most recent scientific or technological developments in a given field (Cohen & Levinthal, 1990). The empirical result supports the findings of Zhao-Lin (2011) which states China's OFDI does not provide change on domestic total factor productivity, technical

progress, and technical efficiency. Regarding this, Buckley et al. (2010) and Cohen and Levinthal (1990) also found Chinese OFDI to be associated with high levels of political risk, cultural proximities, and the market size of host countries, geographic proximity and natural resources endowments. Thus, the inefficiency of Chinese OFDI in Europe regarding R&D spending seems in line with the past empirical results.

Furthermore, MNEs from emerging economies may not possess similarly strong technological resources as those firms from developed countries (Dunning, Kim, & Park, 2008; Gorynia, Nowak, & Wolniak, 2010). This argument leads some scholars to suggest that the outward FDI of Chinese firms is not driven by exploitation of unique resources, but by 'learning' objectives that may enable them to overcome resource constraints associated with technological gaps and later-mover disadvantages in international markets (Athreye & Kapur, 2009; Deng, 2009).

Although R&D and marketing resources are ownership advantages that drive the internationalization of traditional MNEs, we find them not so crucial for the internationalization of EMEs. Government involvement through state ownership may also lead to further reliance on external resources and reduce the firm's motivation to become more competitive by developing internal capabilities. Even when firms undertake resource- and knowledge-seeking FDI, they still need to have their resources and capabilities to be able to absorb and understand the value of external knowledge (Cohen & Levinthal, 1990; Wang et al., 2012). The ability to exploit external knowledge is thus a critical component of innovative capabilities.

We argue that the ability to evaluate and utilize outside knowledge is mostly a function of the level of prior related knowledge (Cohen & Levinthal, 1990). Thus, the inefficiency of Chinese OFDI in Europe regarding R&D spending seems in line with past empirical results.

Table-5. The average efficiency level of countries.

Variables	Observations	Mean	Std. Dev.	Min	Max
all_jlm	470	0.8341753	0.1985347	0.0065166	0.9686659
lnew_jlm	470	0.7682954	0.3353799	0.0141491	0.9907431
lR&D_jlm	470	0.3259985	0.2839864	0.0000652	0.8886036

The estimation model of Table 5, enables us to extract the average efficiency level of the innovation and entrepreneurship of European countries regarding the Chinese OFDI stock in Europe.

Based on Table 6, the total efficiency estimation of the R&D and entrepreneurship is 83.4 percent. The figure indicates a higher efficiency effect of the Chinese OFDI stock in Europe. However, disaggregating the figure separately, the specific effect of each factor differs considerably. Thus, based on the Table 6 estimation, the average efficiency level of Chinese OFDI in Europe is 32.6 percent. The figure is shallow and indicates the Chinese OFDI in Europe is still low and far from realizing ample effect on innovation. In another words, even though the Chinese OFDI trend indicates an upward surge regarding innovation, the direct investment possesses a significant margin in Europe. However, the efficiency level of new businesses opened is 77 percent. The result is self-evident regarding the importance of new entrepreneurship in attracting Chinese OFDI stock.

The least efficient country is Albania with an entrepreneurship efficiency of 0.03955, and the most efficient country is the United Kingdom with an efficiency score of 989801. Similarly, Lithuania is the most efficient regarding innovation (0.115825) compared to the rest of Europe. Contrarily, Bosnia-Herzegovina is the least efficient with an innovation efficiency value of 0.609109.

The result indicates that no European country is ready to open an opportunity for direct investment with Chinese MNEs based solely on innovation. According to the table, almost all innovative countries in Europe have the lowest efficiency innovation value for Chinese OFDI. However with regard to entrepreneurship, these countries seem open and efficient for Chinese OFDI.

Table-6. Efficiency measures.

Country	all_ilm	all_bc	lnew_ilm	lnew_bc	IR&D_ilm	IR&D_bc
Albania	0.61983	0.662456	0.03955	0.041874	0.528903	0.970859
Austria	0.542146	0.596792	0.197984	0.209611	0.278134	0.930369
Belgium	0.913195	0.91672	0.964946	0.965539	0.2281	0.003322
Bulgaria	0.940552	0.942241	0.976748	0.977013	0.304605	0.710418
Bosnia and Herzegovina	0.746751	0.770643	0.040443	0.04282	0.609109	0.933825
Belarus	0.602382	0.623075	0.503602	0.513593	0.189711	0.558978
Czech Republic	0.915851	0.919155	0.963719	0.96436	0.384495	0.127165
Germany	0.943275	0.944813	0.981819	0.981981	0.280782	0.122923
Denmark	0.918298	0.921471	0.969949	0.970394	0.299	0.113636
Spain	0.951742	0.952879	0.984407	0.984529	0.526613	0.240468
Estonia	0.89509	0.900119	0.942603	0.944152	0.326344	0.224459
Finland	0.87101	0.878473	0.936077	0.937963	0.162207	0.133169
France	0.952097	0.953204	0.985111	0.985221	0.285746	0.352372
United Kingdom	0.965054	0.965651	0.989801	0.989853	0.253883	0.447849
Greece	0.861792	0.870167	0.803836	0.815401	0.46709	0.011504
Croatia	0.881067	0.887453	0.900816	0.905074	0.402996	0.297686
Hungary	0.92785	0.930336	0.970814	0.971238	0.387135	0.444547
Ireland	0.90837	0.912246	0.962261	0.96294	0.552355	0.062414
Iceland	0.256024	0.286875	0.150632	0.155476	0.193461	0.058006
Italy	0.950156	0.95135	0.983509	0.983643	0.297159	0.139242
Lithuania	0.860817	0.869324	0.840198	0.849067	0.115825	0.069656
Luxembourg	0.403956	0.430858	0.279462	0.289005	0.315815	0.486695
Latvia	0.903772	0.90803	0.945458	0.946868	0.015415	0.029122
Moldova	0.82472	0.837716	0.47902	0.500882	0.512955	0.935186
Macedonia, FYR	0.870713	0.878258	0.757707	0.772009	0.359723	0.460202
Montenegro	0.598302	0.642298	0.121178	0.128292	0.175901	0.670559
Netherlands	0.935165	0.937186	0.977234	0.977491	0.144309	0.181278
Norway	0.923277	0.926081	0.964787	0.965407	0.328295	0.64064
Poland	0.918355	0.921516	0.957794	0.958704	0.497661	0.293358
Portugal	0.937428	0.939289	0.974961	0.975266	0.633019	0.207089
Romania	0.950984	0.952143	0.982263	0.982419	0.604306	0.973091
Russian Federation	0.964105	0.964735	0.989194	0.989252	0.388322	0.96591
Serbia	0.885686	0.891603	0.907422	0.911095	0.341034	0.826217
Slovak Republic	0.925355	0.927971	0.963667	0.9643	0.490596	0.084691
Slovenia	0.755545	0.778008	0.620842	0.641802	0.303289	0.055438
Sweden	0.922593	0.925462	0.972916	0.973282	0.254836	0.498914

5. CONCLUSION

This paper has analyzed the effects of innovation and entrepreneurship indicators on Chinese OFDI by using random effect stochastic frontier regression. The countries in this paper were chosen based positive net inflow of Chinese OFDI in the period of 2003 to 2016. According to the results, gross domestic product, total population, inflation, fixed capital investment, GDP per capita, resource rents and trade were found to have significant effects on Chinese outward foreign direct investment.

The market size of the host country, total population and trade, resource rent, fixed capital formation, and inflation rate exerts a negative and significant effect on OFDI at a level of one percent that significantly affects the OFDI of China at a level of at least five per cent statistical significance. However, the increase or decrease in GDP per capita of European countries does not have any significant effect on direct investment from China.

Furthermore, the estimation of the efficiency effect of R&D spending and entrepreneurship on the OFDI are included separately one after the other to observe the solo effects of each factor. Consequently, the results suggest a nearly similar efficiency effect with the baseline model (column 1) of innovation and entrepreneurship on the OFDI stock flow in Europe.

The Chinese OFDI stock in Europe is negative and significant, indicating the efficiency of entrepreneurship in attracting Chinese OFDI to Europe. The result implies the Chinese investments in Europe are attracted by areas

that agglomerate and have a high level of entrepreneurial culture. The role that this factor plays is fundamental and suggests that MNCs' invest in regions with entrepreneurial resources. Besides, the Chinese outward foreign direct investment to Europe indicates a positive and significant result, implying that investment in Europe is not efficient regarding innovation and R&D spending. Studies affirm that the ability to exploit external knowledge is a critical component of the innovative and absorptive capabilities of the home country (China) and also depends on the ability to evaluate and utilize outside knowledge which is mostly a function of the level of prior related knowledge (Chen, 2017; Cohen & Levinthal, 1990; Wang et al., 2012).

The estimation enables us to extract the average efficiency level of the innovation and entrepreneurship of European countries. The figure indicates higher efficiency effect with the total efficiency estimation of the R&D and entrepreneurship of 83.4 percent. However, disaggregating the figure separately, the specific effect of each factor differs considerably. The figure shows little to indicate that Chinese OFDI in Europe is still low and far from realizing ample efficiency effect regarding the innovation. In other words, even though the Chinese OFDI trend indicates an upward surge, it is inefficient regarding the R&D spending effect. Contrarily, the efficiency level of new businesses opened is 77 percent, which is comparatively self-evident concerning the importance of new entrepreneurship in attracting Chinese OFDI stock.

Regarding the efficiency of countries, the least efficient is Albania with an entrepreneurship efficiency of 0.03955, and the most efficient country is the United Kingdom with an efficiency score of 989801. Similarly, Lithuania is the most efficient regarding innovation 0.115825 compared to the rest European countries. Contrarily, Bosnia-Herzegovina is the least efficient with an innovation efficiency value of 0.609109. The result indicates that no European country is ready to open an opportunity for direct investment with Chinese MNEs based solely on innovation. According to the table, almost all innovative countries of Europe have the lowest efficiency value of innovation for Chinese OFDI. However with regard to entrepreneurship, these countries seem open and efficient for the purposes of Chinese OFDI.

Funding: This study received no specific financial support.

Competing Interests: The authors declare that they have no competing interests.

Acknowledgement: All authors contributed equally to the conception and design of the study.

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