Does Outward FDI Generate Higher Productivity for Emerging Economy MNEs? – Micro-level Evidence from Chinese Manufacturing Firms

LINJIE LI
1．School of International Business, Southwestern University of Finance and Economics
555 Liutai Rd, Wenjiang, Chengdu, Sichuan, China, 611130
2． Department of Management, Birkbeck College, University of London
Malet Street, Bloomsbury, London, United Kingdom, WC1E 7HX
Email address: lli06@mail.bbk.ac.uk

XIAMING LIU **(Corresponding author)**
1．School of International Business, Southwestern University of Finance and Economics
555 Liutai Rd, Wenjiang, Chengdu, Sichuan, China, 611130
2． Department of Management, Birkbeck College, University of London
Malet Street, Bloomsbury, London, United Kingdom, WC1E 7HX
Email address: xiaming.liu@bbk.ac.uk
Tel: +44 (0) 207079 0895
Fax: +44 (0) 207 631 6769

Dong Yuan
China Center for Economic Research (CCER), Peking University
5 Yiheyuan Rd, Haidian, Beijing, China, 100871
Email address: alfredyuan123@foxmail.com

Miaojie Yu
China Center for Economic Research (CCER), Peking University
5 Yiheyuan Rd, Haidian, Beijing, China, 100871
Email address: mjyu@nsd.pku.edu.cn

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Abstract

This paper investigates whether emerging economy multinational enterprises (EMEs) that undertake outward foreign direct investment (OFDI) become more productive, controlling for the self-selection into the global investment market. Particularly, we focus on the moderating effects of firm heterogeneity on the OFDI-productivity nexus. A theoretical framework incorporating the resource-based views and institutional theory is established and the propensity-score matching and difference-in-difference (DID) approaches are combined to test the framework, utilizing unique data on Chinese manufacturing firms over the sample period 2002–2008. We find that EMEs turn to be generally more productive after they conduct OFDI, but this productivity effect varies depending on the parent firm and investment strategy heterogeneity. Our results suggest that EMEs without state ownership but with stronger absorptive capability gain higher and more sustainable productivity effects and such gains are higher for EMEs investing in OECD than in non-OECD countries. Policy and managerial implications are discussed.

Key words: Outward Foreign Direct Investment, Total Factor Productivity, Absorptive Capability, State Ownership, Entry Destination

1. Introduction

As an indicator of efficiency, productivity[1] has been argued to be a determinant of firms' survival and sustained competitiveness (Syverson, 2011; Lieberman & Dhawan, 2005) and is crucial for emerging economies to catch up with the rest of the world (Kharas & Kohli, 2011). So far, the research into the productivity differences across firms has come a long way (Bartelsman & Doms, 2000), and the discovery of persistent, large and ubiquitous productivity variations across businesses has shaped the agenda of a couple of research fields seeking to identify the factors affecting productivity, especially the levers that firms can utilize to increase their productivity (Bertrand & Capron, 2015; Syverson, 2011).

Among those levers, MNEs' outward FDI (OFDI) has been touched upon as a mechanism by which firms can not only exploit ownership advantages, but also access new resources, realize resource reallocation stimulate competition, and enhance productivity (Cantwell, 2989; Dunning, 1988; Frost, 2001; Bertrand & Capron, 2015). Emerging economy MNEs (EMEs) are believed to be able to gain more productivity premium from OFDI, as they are based in less innovative developing institutions, possesses less knowledge competencies, and thus have more learning opportunities (Buckley et al, 2007). Given the dramatic growth of OFDI flows from emerging economies, it is critical for both scholars and EME managers to know whether there exists OFDI-led productivity growth for EMEs, and conditions under which an EME can gain more OFDI-led productivity benefits (Li, Strange, Ning & Sutherland, 2016; Chen, Li & Shapiro, 2012).

Yet, as a sizable literature has gone to the impact of OFDI on employment, exports, investment, and productivity in developed economies (Bitzer & Kerekes, 2008; Chen & Yang, 2013; Chuang & Lin, 1999; De La Potterie & Lichtenberg, 2001; Herzer, 2008, 2010, 2011; Kogut & Chang, 1991; Pradhan & Singh, 2008), studies on the crucial OFDI-productivity link in EMEs are very limited (Herzer, 2011; Zhao, Liu, & Zhao, 2010). Even though some studies have referred to this linkage, their results are inconsistent (Cozza, Rabellotti & Sanfilippo; 2015; Zhao, Liu & Zhao, 2010; Lee, Chyi, Lin & Wu, 2013; Yang, Chen & Huang, 2013; Masso & Vahter, 2008; Chen, Li & Shapiro; 2012; Chen & Tang, 2014; Li, Strange,

[1] Firm productivity is a component of a country's production efficiency, which plays an essential role in shaping a country's GDP growth. Therefore, we choose firm productivity as our dependent variable, to some extent, to shed some light on a country's growth.

Ning & Sutherland, 2016), probably because of a lack of careful consideration of the moderating effects of firm-level heterogeneity (Herzer, 2011), proper control for the endogenous self-selection bias and suitable productivity measurement techniques (De Loecker, 2007; Hijzen, Inui, & Todo, 2007; Hijzen, Jean, & Mayer, 2011).

This study aims to address the above-mentioned research gaps and will contribute to the existing literature in the following ways. Firstly, given EMEs' lack of capabilities and their strong resource-dependence on home country governments (Buckley et al., 2007; Buckley, Cross, Tan, Xin & Voss, 2008; Deng, 2007; Ramasamy, Yeung, & Laforet, 2012; Wang, Hong, Kafouros, & Wright, 2012), we develop a novel theoretical framework which incorporates both the resource-based view (RBV) and institutional theory (IT) to explain the mechanisms for EMEs' OFDI-productivity nexus. Empirical studies about the impact of OFDI tend to be based on a general literature review or "international business theory". To our best knowledge, this is the very first study that looks at EMEs' productivity gains from OFDI at the firm level in line with an analytical framework explicitly incorporating both resource- and institution-based lenses. Compared with developed economy MNEs, EMEs are more resource seeking, and are strongly influenced by their home country institutions. As a result, an application of both RBV and IT to analyse OFDI by EMEs would be more appropriate.

Secondly, our study contributes by explaining and testing whether and how firm heterogeneity in terms of state ownership, absorptive capacity and internationalization strategy moderates OFDI's productivity effects on EMEs. The nexus between OFDI and productivity is complex (Hennart, 2011; Li, 2007; Verbeke & Brugman, 2009) and the productivity effect of OFDI is by no means automatic (Kokko & Kravtsova, 2008). Suggested by Helpman et al. (2003), firm heterogeneity drives their diversity in strategy and performance. In line with both institutional and resource-based perspectives, our study contributes to existing literature by identifying state ownership, absorptive capacity and internationalization strategy as three important moderators and explaining the mechanisms with which these moderators affect the OFDI-led productivity growth nexus (Wang et al., 2012; Cui & Jiang, 2012; Choudhury & Khanna, 2014; Cohen & Levinthal, 1990; Zahra & George, 2002; Bertrand & Capron, 2015).

Methodologically, we augment Olley and Pakes' (1992) semi-parametric approach to measure total factor productivity (TFP), via introducing the OFDI dummy and export dummy in the production function, allowing for various production estimation functions for EMEs with different OFDI and export status. This enables us to not only efficiently control for the possible simultaneity and selection biases (Olley & Pakes, 1992), but also successfully remove the potential productivity estimation bias from omitting influential variables in the production function estimation (De Loecker, 2011; De Loecker, Goldberg, Khandelwal, & Pavcnik, 2012). In addition, a method combing the propensity-score matching and difference-in-difference (DID) approaches will be employed, to examine the 'real' OFDI-led productivity change for EMEs via careful control for the possible endogeneity of productivity change (Arnold & Javorcik, 2005).

China's drastic changes in OFDI orientation and rapid growth in OFDI flows since 2002 provide us with a natural setting for analyzing the relationship between OFDI participation and firm productivity variations. Based on an integrated dataset from 1516 Chinese firms with 2033 foreign subsidiaries from China's National Bureau of Statistics, Ministry of Commerce, local government reports and firm-level official websites for the period 2002-2008, we examine the instantaneous and future productivity gains upon OFDI entry controlling for the self-selection process. We find positive productivity premiums for EMEs with OFDI, but this productivity effect varies significantly according to EMEs' heterogeneity in state ownership, absorptive capacity, and investment destination. The estimation results indicate that EMEs without state ownership gain positive productivity premium via OFDI, while this effect is insignificant for those with state ownership. We also find that EMEs with stronger absorptive capability and OFDI in OECD countries gain higher and more sustainable productivity premium than in non-OECD countries.

The rest of the paper is organized as follows. In line with RBV and IT, the next section introduces our literature review and hypothesis development. In Section 3, we describe the dataset, measures of variables and econometric model. Our estimation results will be presented in Section 4. Section 5 presents our robustness check via different TFP and investment destination measures, one-step system-GMM estimation and re-estimation of absorptive capacity's moderating effect in both technology intensive and

other industries. Finally, Section 6 offers discussions and conclusions.

2. Literature review and hypothesis development

Recent research in management has stressed the role of productivity as an indicator of firm performance as it is a representative of a firm's general resource efficiency (Datta, Guthrie, & Wright, 2005), sustained competitive advantage (Lieberman & Dhawan, 2005) and competitiveness (Causa & Cohen, 2004; Koch & MaGrath, 1996). OFDI has been touted as an important determinant of the firm's productivity growth because it helps increase firm size and access new knowledge, making the firm more competitive in its home market (Schmookler, 1954, Bertrand and Capron, 2015). As later comers, EMEs, in contrast to developed country MNEs, are more likely to pursue productivity enhancement via OFDI as they are based in less innovative developing regions, possess a relatively narrow range and intensity of knowledge competencies, and hence more urgently engage in asset-seeking FDI in order to address their competitive disadvantages and improve their global competitiveness (Buckley et al., 2007). However, so far existing literature has generated inconsistent estimation results about the productivity effect of OFDI on EMEs (Bitzer & Kerekes, 2008; De La Potterie & Lichtenberg, 2001; Driffield & Chiang, 2009; Herzer, 2011; Hijzen et al., 2007; Masso & Vahter, 2008), which challenges the direct OFDI-productivity growth linkage based on traditional international business theory (Cantwell 1989; Dunning,1988; Frost, 2001; Shan & Song, 1997; Teece, 1992), and stimulates us to ask why the testing results of the OFDI-led productivity growth hypothesis based on similar datasets and estimation techniques are so mixed.

Among the early country studies, Herzer (2012), Goodarzi and Moghadam (2014), and Bitzer and Görg (2009) generate opposite empirical results about the impact of OFDI on domestic productivity. Driffield, Love and Taylor (2009) find that both technology-sourcing and efficiency-seeking FDI increases domestic productivity. Herzer (2011) also confirms that OFDI has, on average, a robust positive long-run effect on in developing countries. Herzer (2012) further reports a positive relationship between OFDI and domestic output and productivity. But De la Potterie and Lichtenberg (2001) assert that OFDI's productivity effect happens only if a country invests in R&D intensive countries.

For industry-level research, Braconier, Ekholm, and Knarvik (2001) find neither evidence of FDI-related R&D spillovers, nor any correlation between OFDI per se and domestic productivity. Bitzer and Kerekes (2008) indicate that FDI receiving countries benefit strongly from inward FDI-related knowledge spillovers, but positive OFDI-led technology souring effects have not been found. Deploying a similar dataset Bitzer and Görg (2009) even find that a country's stock of OFDI is, on average, negatively related to productivity. However, Driffield and Chiang (2009) report a positive association between OFDI to mainland China and labor productivity in Taiwan.

In contrast with country- and industry- level analysis, firm-level study is argued to be better for investigating OFDI's productivity effect, as it avoids the aggregation bias (Holz, 2004), and provides channels for identifying firm heterogeneity (Helpman, Melitz, & Yeaple, 2003), assisting in explaining firm-level variations in OFDI-led productivity effect. Kimura and Kiyota (2006) show that firms engaging in OFDI experience a 1.8 percent higher productivity growth than domestic firms not engaging in OFDI in Japan. However, Hijzen, et al. (2007) cast doubt on the positive results generated from the above firm-level studies as they fail to control for the endogeneity bias that arises when more productive firms self-select into investing abroad. To deal with this endogeneity problem, Hijzen, et al. (2007) apply propensity score matching and difference-in-difference analysis to data of Japanese firms for the period 1995-2002, and they find insignificant impact of OFDI on firm productivity in Japan. Barba Navaretti and Castellani (2004) apply the same methods as Hijzen, et al.'s (2007) to Italian firm-level data, and find that multinational firms have higher total factor productivity growth after investing abroad than national counterfactual firms. Employing cross-section data from a sample of French acquiring firms and non-acquiring firms, Bertrand & Capron (year of publication?) find positive relationships between OFDI via M&A and the acquirers' productivity at home. Branstetter (2006) also confirms that OFDI is a channel of technology spillover for Japanese MNEs undertaking OFDI in the United States.

Although a number of empirical studies deal with OFDI-related productivity diffusion in developed countries, less attention has been paid to productivity changes induced by OFDI in emerging economies. There are some empirical attempts based on firm-level data from Taiwan, mainland China and Estonia, but the estimation results of these studies are still mixed (Cozza, Rabellotti & Sanfilippo; 2015; Zhao,

Liu & Zhao, 2010; Yang, Chen & Huang, 2013; Masso & Vahter, 2008; Chen, Li & Shapiro; 2012; Chen & Tang, 2014; Li, Strange, Ning & Sutherland, 2016; Chen & Yang, 2013; Chuang & Lin, 1999; Lee, Chyi, Lin & Wu, 2013). A summary of the past research results on OFDI-led productivity at the firm-level[2] has been illustrated in Table 1.

So why are the testing results of the OFDI-led productivity growth hypothesis based on similar micro data and estimation techniques so mixed? Helpman et al. (2003) suggest that firm level specific heterogeneity makes firms' investment strategy and performance diversity possible (Grossman, Helpman & Szeidl, 2006). Kokko & Kravtsova (2008) also emphasize that technology diffusion and productivity premium are not automatic. Higher productivity gains should be expected for EMEs which have higher R&D and absorptive capability and invest in relatively developed regions (Almeida & Kogut, 1997; Audretsch & Feldman, 2004; Cantwell & Janne, 1999; Cohen & Levinthal, 1989, and 1990; Dosi, 1988; L. Kim, 1997; Lall, 1992). Additionally, variations in parent firms' ownership (Ramasamy, Yeung, & Laforet, 2012) and OFDI investment location (Branstetter, 2006; Li, 1995; Nocke & Yeaple, 2007) may significantly moderate EMEs' learning-by-OFDI effect. However, so far there has been no report of any comprehensive investigation of whether OFDI's productivity effect varies depending on firm heterogeneity, and how the firm-level heterogeneity moderates the OFDI-productivity change nexus (Almeida & Kogut, 1997; Bitzer & Kerekes, 2008; Branstetter, 2006; K. M. Chen & Yang, 2013; Chuang & Lin, 1999; De La Potterie & Lichtenberg, 2001; Herzer, 2008, 2010, and 2011; Kogut & Chang, 1991; Pradhan & Singh, 2009).

Given that emerging economies' OFDI growth rate has exceeded that from developed countries in the past decade (Buckley et al., 2007; Wang et al., 2012), more systematic research on OFDI from EMEs is required. Our work will contribute to the literature by introducing and testing an extended learning-by-OFDI model, which takes into consideration EMEs' heterogeneity. RBV and IT will be utilized as the theoretical underpinning for this model. The theoretical framework is demonstrated in Figure 1 and we believe that it can better explain and predict OFDI's productivity effect.

[2] Due to space limitation, a summary of country and industry level studies is not included in the table, but available upon request.

Table 1: OFDI-led Productivity Growth: Summary Results of Previous Firm-level Studies

Authors	Topic	Theoretical approaches	Data and context	Analytical techniques	Main findings
Firm-level studies with positive results:					
Cozza, Rabellotti, and Sanfilippo (2015)	The impact of outward FDI on the performance of Chinese firms	NA	Firm-level data of Chinese multinationals' OFDI into advanced European countries.	Propensity score matching and DID	China's OFDI has a positive impact on domestic activities. Specially, OFDI via M&A facilitates early access to intangible access, but is detrimental to financial performance, while greenfield investments have stronger impacts on productivity and scale of Chinese multinationals investing in Europe.
Kimura and Kiyota (2006)	Exports, FDI, and productivity: Dynamic evidence from Japanese firms	NA	Longitudinal panel data on Japanese firms from 1991 to 1994	Regression model	Exports and foreign direct investment appear to improve firm productivity once the productivity convergence effect is controlled for. Firms that retain a presence in foreign markets, either by exports or foreign direct investment, show the highest productivity growth, which contributes to improvements in national productivity.
Zhao, Liu, and Zhao (2010)	The contribution of outward direct investment to productivity changes with China, 1991-2007	International business theory	China's ODI in eight developed countries during the period 1991 to 2007.	Vector auto regression (VAR) decomposition analysis	Chinese OFDI has had beneficial spill-over effects on total factor productivity growth over the period of the study, and gains in efficiency have been the chief reason for this.
Yang, Chen, and Huang (2013)	Outward foreign direct investment and technical efficiency: Evidence from Taiwan's manufacturing firms	NA	Firm-level panel data from Taiwan's manufacturing industries from 1987 to 2000	Stochastic frontier analysis (SFA) model and propensity score matching	OFDI raises firm productivity through its effect on both the firm's technological endowments and technical efficiency
Masso and Vahter (2008)	Technological innovation and productivity in late-transition Estonia: econometric evidence from innovation surveys	NA	Firm-level data from Community Innovation Surveys (CIS3 and CIS4), combined with frim-level financial data from 1998–2000 and 2002–2004 in Estonia.	Structural model	Horizontal OFDI is positively related to the parent firm's productivity growth
Bertrand and Capron (2014)	Productivity enhancement at home via cross-border acquisitions: The roles of learning and contemporaneous domestic investment	International business theory	Pooled cross-section data from a sample of French acquiring and non-acquiring firms from 1993–2004	Ordinary least squares (OLS) model with robust standard errors (Huber–White–Sandwich estimator of variance)	Cross-border acquisitions can enhance the acquirers' productivity at home, and these domestic productivity gains will be greater when there are learning opportunities in the targets' host countries and when contemporaneous domestic productivity-enhancing investments are made by the acquirers in connection with the acquisitions.
Barba Navaretti, and Castellani (2004)	Investments abroad and performance at home: evidence from Italian multinationals	International business theory	A dataset includes both Italian multinationals and a random sample of Italian national firms during 1993-1997	Propensity score matching and DID	OFDI improves growth of total factor productivity and output, but generates no significant effects on employment.
Chen, Li, and Shapiro (2012)	International reverse spill-over effects on parent firms: Evidences from emerging-market MNEs in developed markets	International business theory	A panel dataset of 493 Emerging market MNEs over the period 2000–2008	Panel lagged Tobit estimation model	Emerging market MNEs that have subsidiaries in host developed markets richer in technological resources (measured by R&D investments and R&D employment) exhibit stronger technological capabilities at home.

Chen and Tang (2014)	The dragon is flying west: Micro-level evidence of Chinese outward direct investment	NA	A comprehensive dataset that covers close to 10,000 Chinese OFDI deals from 1998 to 2009	Propensity-score matching	OFDI is associated with better firm performance, including higher total factor productivity, employment, and export intensity, and greater product innovation.
Li, Strange, Ning, and Sutherland (2016)	Outward foreign direct investment and domestic innovation performance: Evidence from China	International business theory and regional innovation system theory	Balanced panel dataset for 30 provinces and municipalities in China during 2003-2011; OFDI and R&D data for Chinese multinationals	GMM regression	OFDI has a very significant impact on domestic innovation. Contingent factors - absorptive capability, foreign presence, and the competition intensity of local market moderate the impact of OFDI on innovation performance.
Pradhan and Singh (2009)	Outward FDI and knowledge flows: A study of the Indian automotive sector	International business theory	Panel data of 436 Indian automotive firms during 1988-2008	Tobit model regressions	Positive effects of OFDI on domestic R&D are found for both investment in developed and developing regions, but stronger in the former case. OFDI via IJV or WOS both tends to encourage domestic R&D, but the effect is stronger via IJV.
Chen and Yang (2013)	Impact of outward foreign direct investment on domestic R&D activity: Evidence from Taiwan's multinational enterprises in low-wage countries	NA	Panel data on Taiwanese manufacturing firms from 1992-2005	Propensity score matching	There is a positive relationship between OFDI and domestic R&D activities.
Chuang and Lin (1999)	Foreign direct investment, R&D and spill-over efficiency: Evidence from Taiwan's manufacturing firms.	NA	Taiwanese firm-level data	Heckman two-stage estimation method	OFDI substitutes to R&D activity, and has positive impact on firm productivity due to its significant effect of industry-wide technology spill-overs.
Branstetter (2006)	Is foreign direct investment a channel of knowledge spill-overs? Evidence from Japan's FDI in the United States	NA	Firm-level data set on Japanese MNEs' OFDI and innovative activity	Fixed effects negative binomial regressions	OFDI is a channel of technology spill-overs for Japanese MNEs undertaking direct investments in the United States.
Firm-level studies with insignificant results:					
Hijzen, Inui, and Todo (2007)	The effects of multinational production on domestic performance: Evidence from Japanese firms	NA	A large panel of Japanese firms for the period 1995-2002	Propensity score matching and DID	Japanese OFDI tends to strengthen the economic activities of Japanese firms in Japan in terms of both output and employment. However, no significant positive effect of OFDI on productivity has been found.
Lee, Chyi, Lin, and Wu (2013)	Do local industrial agglomeration and foreign direct investment to China enhance the productivity of Taiwanese firms?	NA	Data for 578 Taiwanese manufacturing multinationals and Taiwan industrial agglomeration indicator	Cross-sectional econometric model	Local industrial agglomerations exert a positive contribution to firm productivity, but OFDI in China has no significant effects on Taiwanese multinationals' TFP growth.

In the rest of this section, based on the theoretical lenses of RBV and IT, we first examine how OFDI affects EMEs' productivity in their home markets as compared with domestic firms that have not conducted OFDI. We then focus on the mechanisms with which state ownership, pre-OFDI absorptive capability and investment destination moderate this OFDI-led productivity gains.

2.1 OFDI and EMEs' productivity growth

In this study, we examine the relationship between OFDI and EMEs' TFP growth. Theoretically, the determinants of TFP growth include the creation, transmission and absorption of knowledge, factor supply and efficient allocation, efficient institutions, and effective market competition (Isaksson, 2007). As RBV has suggested, specialized, rare, and inimitable resources (e.g., technology, marketing resources, human capital, intermediaries and management capabilities) can not only derive from the firm itself, but also could be assembled and transferred across national boundaries (Barney, Ketchen, & Wright, 2011; Sirmon, Hitt, Ireland, & Gilbert, 2011; Meyer, Wright, & Pruthi, 2009), and OFDI is a key channel for the transfer, mobility and reallocation of resources across boundaries (Kogut & Chang, 1991). An MNE's productivity change thus can arise not only from the ownership of proprietary assets, but also from the ability to secure, or efficiently coordinate, the complementary assets possessed by other firms in host countries via OFDI (Cantwell, 1989; Dunning, 1988; Frost, 2001; Shan & Song, 1997; Teece, 1992). As later comers, EMEs, in contrast to developed country MNEs, are more likely to gain productivity premium via OFDI as they are based in less innovative developing regions, possess a relatively narrow range and intensity of knowledge competencies, and hence more urgently engage in OFDI to seek for resources and learning opportunities (Buckley et al., 2007).

EMEs' OFDI, especially that in technology-intensive countries, provides them with channels for accessing advanced technology and human capital, offering EMEs the possibility of gaining productivity spillover via reverse technology flows, linkages with suppliers and clients, employee training programmes, and learning from nearby firms (Fosfuri, Motta, & Rønde, 2001). Mathews' (2002) linkage-leverage-learning (LLL) model explains how EMEs obtain access to advanced intangible assets and gain productivity enhancement via OFDI. Specifically, the linkage via joint venture or strategic alliance in global value chains with foreign companies represents a fast and efficient way to access the resources that EMEs desire. Once linked, "latecomer" EMEs could utilize the global connections to leverage their own specific resources and learn about new resources. The greater the technological gap

between the leading and backward countries, the greater the potential for technological progress of the latecomer MNEs (Wang, Liu, Wei, & Wang, 2014). Second, OFDI's productivity effect derives from the technical efficiency progress via economies of scale in not only manufacturing, but also R&D, sales, and administration (Bertrand & Capron, 2015). OFDI facilitates increased specialization, which is beneficial for the parent firms as it reduces sunk costs and allows reallocation of resources to their best utilization (Görg, Hanley, & Strobl, 2008). OFDI also produces EMEs' productivity growth via bringing in lower-priced intermediaries, helping them acquire global capital (Frost, 2004; Jong-Sung & Khagram, 2005) and reorganizing global production. Third, Bitzer & Görg (2005) suggest that through OFDI, EMEs are able to improve their parent firm productivity as they get exposure to fierce international competition and best practice, similar to the idea of "learning-by-exporting" advocated by Clerides, Lach, and Tybout (1998).

As a complementary and interdependent construct of RBV in MNE study (Wang et al., 2012), IT's basic assumptions are that institutional isomorphic pressures that stem from industry, government, and societal exceptions (e.g., the norms, rules and standards on product quality, occupational safety, or environmental management) define firm activities, and those pressures applied to all firms in the same institution cause firms to exhibit similarity (DiMaggio and Powell, 1983). Following this, firms that operate over time with partners embedded in the same institutions may turn to be self-reinforcing and more difficult to change (Rangan, 2000; Rosenkopf & Almeida, 2003), but OFDI helps overcome the institutional constrains associated with geographically bounded search (Alcacer & Chung, 2002) and facilitates firms to gain new resources and economies of scales across multiple geographic settings (Salomon & Shaver, 2005). A firm's capability to evaluate, recognize and learn about resources in a given institution declines with geographic distance from that location, and OFDI is viewed as a channel to access resources which are often embedded in local knowledge clusters, from distant markets (Contractor, 2012). Second, defined as the rules and organs that drive the production climate (Ulubasoglu & Doucouliagos, 2004), more efficient institutions assist firms' productivity growth via the enforcement of property rights, supply of a developed financial system, and effective innovation system (Isaksson, 2007). OFDI thus provides EMEs with the opportunities to gain productivity effect via taking institutional advantages in host countries. Third, OFDI provides EMEs with channels for institutional arbitrage. This term has been commonly used in the international business literature as a practice of arranging activities in various institutional contexts in order to benefit from differences in regulatory systems (Chacar, Newburry & Vissa, 2010). In the context of OFDI, gains from institutional arbitrage opportunities with

legal and tax optimization could be expected.

Thus, in line with RBV and IT, OFDI provides EMEs with channels to

a) create, transfer and absorb knowledge;

b) reallocate resources and realize economies of scale;

c) access developed institutions and institutional infrastructure;

d) get exposed to international competition, and

all of which could contribute significantly to EMEs' productivity premium. Based on the above arguments, we hypothesize:

H1. OFDI generates a positive effect on EMEs' productivity.

However, as existing literature has stressed, OFDI not only yields benefits, but also is always associated with increased complexity, coordination needs, and resource trade-offs (Bertrand & Capron, 2015; Levinthal & Wu, 2010). It is not always the case that productivity benefits could outweigh the cost of foreign expansion, and the real story is that the productivity premium EMEs gain from OFDI could be moderated by resource and institutional conditions. We thus move forward to examine moderators of OFDI's productivity effect on EMEs. Three variables are chosen because they can significantly influence outcomes of EME investment activities based on our framework. Firstly, we choose state ownership as one moderating variable because this status represents EMEs' affiliation with government, and is the most important institutional factor influencing EMEs (Buckley et al., 2008; Cui & Jiang, 2012; Wang et al., 2012) due to state provision of institution-based resources to these firms (Hoskisson, Wright, Filatotchev, & Peng, 2013; Peng, 2003). Secondly, in line with Cohen and Levinthal (1990), Dai and Yu (2013), and Griffith, Redding and Van Reenen (2004) who suggest that a firm's valuable resources derive from intangible knowledge, our next moderating variable is absorptive capacity, measured by R&D to capture an EME's key valuable resources. This variable moderates the OFDI-productivity linkage as it can assist EMEs in recognizing, exploiting acquired global assets and making further innovations. Thirdly, investment destination, as a very important internationalization strategy determined by EMEs' resources and institutional background (Buckley et al., 2007;Cui & Jiang, 2009; Ramasamy et al., 2012), and can significantly moderate outcomes of EMEs' OFDI. Thus, we next describe in more detail the three

moderators, and our framework is represented by Figure 1.

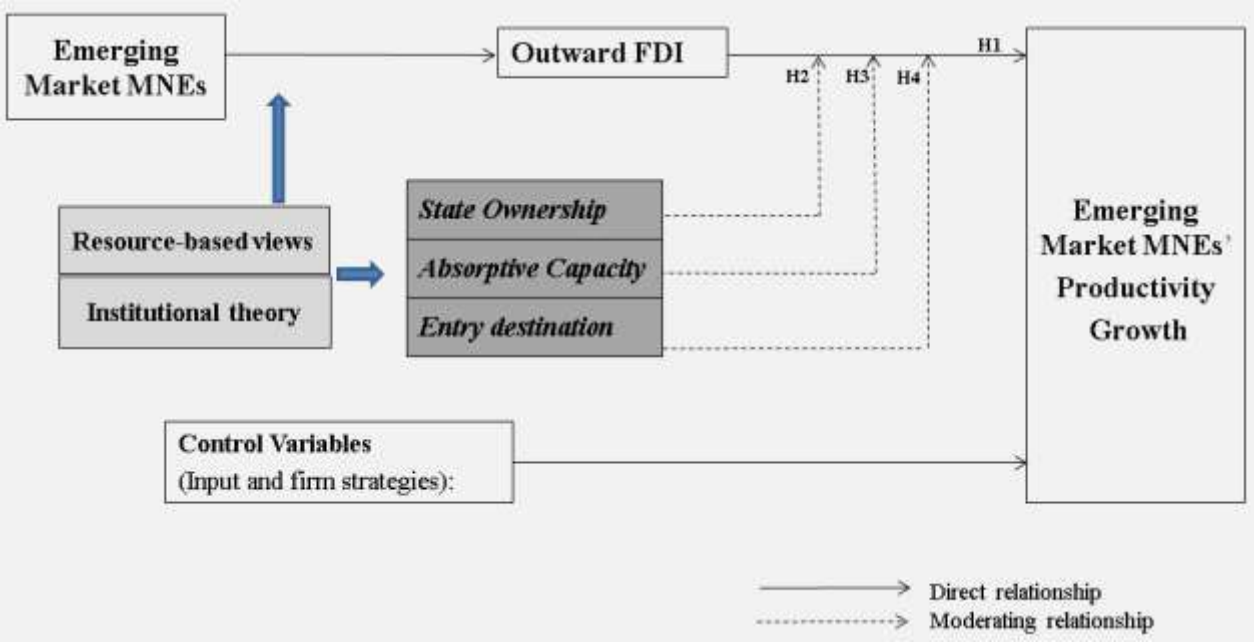

Figure 1: Theoretical framework and hypotheses

2.2 State ownership and OFDI's productivity effect on EMEs

A key assumption of RBV is that although managerial decisions are constrained by information asymmetry and causal ambiguity, they are driven by motives of efficiency and competitiveness (Capron & Chatain, 2008). Following this, EMEs' OFDI decisions should be economically justified, to get the maximum use of OFDI-led resource-based advantages (e.g., get access to technology, international markets, lower-priced intermediaries, economies of scale, and efficient institutional infrastructure), and positive productivity effects of OFDI can be expected. However, the state ownership, which turns the EMEs with it to be assets or parts of their home country institutions (Cui & Jiang, 2012), stimulates state-owned EMEs (SO-EMEs) to perform far from economically optimal, but as a serve of political goals (Wang et al., 2012). Under this condition, state ownership, as a paramount institutional factor, produces significant effects on EMEs' 1) resource dependence on governments and OFDI objectives and strategies; 2) resouce endownments, utilization and international competitive capability; and 3) potilical reputation and confronted pressures in host markets (Wang et al., 2012; Cui & Jiang, 2012; Chen & Young, 2010;

Rugman & Li, 2007). Therfore, based on RBV, the OFDI-productivity linke can be moderated by state ownership.

IT suggests that firms are under institutional pressures to adhere to the formal and informal rules in their institutional fields (DiMaggio & Powell, 1983; Scott, 1995), and their responses to institutional pressures vary according to firms' levels of resource dependence on the institution that exerts the pressure (Oliver, 1991). With high resource dependence, a firm is more likely to conform to the institutional pressures to avoid negative consequences (Salancik & Pfeffer, 1978). Thus according to IT, as state-owned (SO)-EMEs, in contrast with private EMEs, are politically affiliated with home-country governments and are highly dependent on the home-country institutions for critical resource inputs (Liang, Ren, & Sun, 2015), they are under more pressures to conform to, rather than resist the political and strategic purposes home country governments specify for OFDI. While pursuing their business objectives, SO-EMEs are always required to serve the political mandates of the state and align their interests with the home institutions rather than challenge these interests (Scott, 2002; Zhang, Zhou, & Ebbers, 2011). Under this condition, when internationalizing, SO-EMEs turn out to be a political actor seeking for political goals, but not profit-maximizing agencies, which goes against to RBV's assumptions (Buckley et al., 2007). On the contraty, private EMEs, with pressurs of survival, turn out to be eager for profits and efficiency. OFDI will be conducted to serve their corporate strategies and economic success, and once linked, private EMEs make all efforts to get access and utilize global resources. Empirical studies confirm that while private EMEs are likely to focus on seeking technology and markets, SOEs favor in investing in seeking natural resources, serving as a politcal actor for the nation's sustainable development (Buckley et al., 2007; Ramasamy et al., 2012; Wang et al., 2012; Luo & Thug, 2007). Furthermore, different from private EME managers who formulate internationalization strategy to pursue global assets and markets, many SO-EME managers are often directly appointed by the state after serving as government officials (Brockman et al., 2013; Fan, Wong, & Zhang, 2007) and their companies go global following the guidance and capital control by the home state (Cui & Jiang, 2012). Correspondingly, SO-EME managers are incentivized not just by the prospect of increasing economic performance but also by satisfying the state's political and social objectives in making OFDI strategies (Cuervo-Cazurra & Dau, 2009). Thus in conclusion, different from private EMEs' profit-driven OFDI, SO EMEs' OFDI are motivated not solely by self-interests, but also by the interests of the institutions they are affliated with. Private EMEs thus tend to be more incentive to exploit OFDI to access high-tech, efficiency, and international market, and then gain more productivity premium.

In addition, state ownership affects EMEs' resource endowments and thus influence the competition pressures they confroned with and the productivity effect thay gain from competition in host markets (Wang et al., 2012). As Bitzer and Görg (2005) suggest, international competition stimulates MNEs to transfer and absorb technologies, management skills, and produce productivity gains. However, with superb resources and unfair competitive advantages (Meyer et al., 2014), SO-EMEs, compared with private counterparts, have less incentive to international competition. SO-EMEs tend to be endowed with monopolistic resources from home governments, like capital from state-owned banks, and extra business chances provided by national corporations (Buckley et al., 2007; Amighini, Rabellotti, & Sanfilippo, 2013; Cui & Jiang, 2009; Luo, Xue, & Han, 2010). But the low-cost and easy-accessibility of public resources result in SO-EMEs' less sensitivity to market competition, and to the risk perception during OFDI (Cui & Jiang, 2012; Buckley et al., 2007). With perceived government backing combined with below-market cost of capital, SO-EMEs are able to bear short-term loss and misleading OFDI strategies (Ahmed, Mohamad, Tan, & Johnson, 2002). When making strategic decisions, SO-EMEs may seek the possibility of further government support, which may be available in unexpected adverse circumstances. Thus, the inequity of resource endowments generate negative effect on SO-EMEs' efficiency in competition, and further buffer the productivity gain SO-EMEs can get from global competition. At the same time, OFDI from SO-EMEs often encounter highly burdensome and bureaucratic administrative OFDI approval procedures as governments at various levels, seek to affect the direction, amount and scope of outward capital flows (Buckley et al., 2007). These will result in SO-EMEs' less incentive and ability to gain productivity benefits from OFDI.

Furthermore, because of SO-EMEs' affiliation with home institutions, when they invest overseas, they might be perceived by host-country institutions not simply as business entities, but also as political actors (Globerman & Shapiro, 2009;He & Lyles, 2008). Such a perception can pose challenges and more stressful institutional pressures to SO-EMEs' institutional processes in host countries (Luo & Rui, 2009; Peng et al., 2008). There can be concerns about the political rationale of SO-EMEs in attempted foreign acquisitions, such as CNOOC's failed acquisition of Unocal (Wan & Wong, 2009). From the host-country aspect, the state-driven objectives of SO-EMEs are often perceived as non-beneficial, or even harmful, to the host country (Globerman & Shapiro, 2009). Consequently, the institutional barrier for SO-EMEs to assume ownership and control in their investment in the host country will be high, which decreases the likelihood of productivity gain (Cui & Jiang, 2012).

Thus we conclude that as a representative of EMEs' affiliation with the government, state ownership

buffers EMEs' productivity gains from OFDI as it hinders EMEs' incentives to pursue profits and economic efficiency through OFDI, reduces EMEs' sensitivity to competition and produces higher institutional pressures and hazards in host countries, impeding the function of OFDI-led productivity growth mechanisms:

H2. State ownership moderates the effect of OFDI on an EME's productivity as such positive gains will be smaller for EMEs with state ownership than those without.

2.3 Absorptive capacity and OFDI's productivity effect on EMEs

RBV suggests that existing resources enable firms to develop dynamic capabilities, just as previous learning facilitates the learning and application of new, related knowledge (Barney, 2001; Deng, 2007; Teece, 2014). It is evident that EMEs invest overseas because they wish to acquire knowledge and learn new skills and capabilities in order to enhance their competitive advantages and productivity. But as Kokko and Kravtsova (2008) emphasize, technology diffusion and productivity premium are not automatic. Higher productivity gains should be expected for EMEs with higher R&D and absorptive capability, which helps them to better recognize the value of new information, assimilate and apply it to commercial ends (Cohen & Levinthal, 1990), or build the "ability to make effective use of technological knowledge in efforts to assimilate, use, adapt and change existing technologies" (Kim, 1997). Deng (2007) and Rui and Yip (2008) argue that the existing stock and quality of R&D influence the extent to which reverse transfer and spillover of knowledge take place within MNEs. Sawada (2010) also indicates that the productivity effect through technology spillovers depends on MNEs' absorptive capacity. Therefore, EMEs with strong absorptive capability are more likely to capitalize on their assets, recognize and absorb valuable knowledge, build up new resources via OFDI, and gain higher productivity premium (Zahra & George, 2002).

In addition, EMEs' absorptive capability serves in making the maximum utilization of the intermediaries and facilities in host countries. With strong R&D-based absorptive capability, EMEs are more capable of recognizing valuable intermediate inputs, reallocating resources optimally, coordinating efficient international production, exploiting well-developed host country institutional infrastructure (e.g., financial system, human capital, suppliers and clients, innovation center) and achieving economies of scale and productivity upgrade (Chen, Li & Shaprio, 2012; Bertrand & Capron, 2015; Görg, Hanley &

Strobl, 2008). At the same time, according to IT, EMEs need particular firm resources and capabilities to deal with host country institutional hazards (Cantwell, Dunning, & Lundan, 2010). As a kind of intangible firm specific resource, EMEs' absorptive capability assists them in dealing with host country institutional conflict, succeeding in host market competition, producing virtuous cycles for EMEs' resource utilization and regeneration, and thus stimulates efficiency and productivity enhancement.

Based on the above arguments, we hypothesize that:

H3. Absorptive capacity moderates the effect of OFDI on an EME's productivity as such positive gains will be greater, if an EME's pre-OFDI absorptive capacity is stronger.

2.4 Investment destination and OFDI's productivity effect on EMEs

RBV suggests that valuable resources are tacit and likely to be sticky or embedded in geographically-bounded clusters (Barney, 2001; Buckley, et al., 2008; Cantwell & Iammarino, 2000). Here, resources include not only R&D capabilities, but also organizational processes, diverse functional skills (e.g., marketing, commerial), managerial best practices, as well as learning opportunities from comeptitive interactions and institutional systems (Alcacer & Oxley, 2014). Such resources generate positive impacts on a firms' productivity growth. As an important channel for accessing resources, OFDI's location is therefore essential in determining the learning appotunities and the extent to which EMEs will access those resources and gain productivity premium (Bertrand & Capron, 2015). A more significant productivity premium can be expected via conducting OFDI in more devloped countries for the following reasons.

Intetrnational business scholars have stressed the role of technological or competitive gap between the home country of investment firms and the targeted host country. There are more oppprtunities to benefit from knowledge and resources that do not exist in the home country when an MNE invests in a country that is more advanced than its own (Cantwell & Janne, 1999; Kogut & Chang, 1991). While developing countries, as latecomers, are cheap labor and natural resource abundant (Dunning, 1988), developed countries are rich in technology, as R&D has always been considered a domain of firms in technologically advanced and economically developed countries. Thus compared with OFDI in developing countries which probably provides EMEs with economies of scale, OFDI in developed countries are expected to offer EMEs more productivity premium via access to and reverse transfer of

technologies. Empirically, Griffith et al. (2006) find that U.K. firms with a greater R&D presence in the United Stats enjoy higher productivity. In addition, networks that are conducive to innovation (e.g., research labs, researchers, technology-generating facilities) are geographically bouned in developed markets and cannot be easily replicated in other locations (Almeida & Kogut, 1999), which indicates that OFDI in developed countries can better stimulate EMEs' creation of new knowledge.

Additionally, as OFDI in both developing and developed countries assists in reallocating resouces and generating economies of scale, OFDI in developed countries is expected to offer EMEs more productivity premium, via providing a high level of local density of specialized resources, agglomeration economies, specialized labor and intermediate inputs (Head, Ries & Swenson, 1995). At the same time, recent economic studies suggest that productivity premium is likely to be greater when investing in a country whose market is more competitive than EMEs' home market (Herrerias & Orts, 2012). In developed economies, institutional frameworks foster and stimulate market-based competition and firms' strategic innovation. Firms' primary challenge is to develop competitive resources and capabilities to outperform competitors in the market place (Peng, 2003). Well-developed institutioal systems and institutional infrastructure in developed countries also facicilitate the productivity enhancement. As shown by Alcacer and Chung (2002), OFDI privides investing firms with opportunites to access not only resources in specific firms, but also those embedded in firms' broader insittutioanl environment and ecosystem. In contrast, developing countries often lack sufficient market-supporting political, legal, and economic institutions (Hoskisson et al., 2013), and this works as a location-disadvantage restricting the formulation of local firms' capabilities (Khanna & Rivkin, 2001).

We thus posit that EMEs' OFDI in developed countries provides them with more opportunities to access technology, specialized intermediate inputs, comeptitive markets and well-developed institutional infrastucture, and hence better capabilities and higher productivity premium gains can be expected. Formally, we have our fourth hypothesis.

H4. Investment destination moderates the effect of OFDI on an EME's productivity as such positive gains will be greater if the firm invests in an OECD country compared with a non-OECD country.

3. Methodology

3.1 Data

We test the OFDI-led productivity change hypothesis relying on two disaggregated datasets. One is derived from the Annual Manufacturing Enterprises Survey conducted by China's National Bureau of Statistics. This dataset covers all SO-EMEs and non-SO-EMEs whose annual sales exceed RMB 5 million[1]. The data used in this paper ranges from 2002 to 2008[2], covering more than 180,000 firms in 2002 and more than 410,000 firms in 2008. This dataset includes three major accounting statements - the balance sheet, cash flow statement and income statement, incorporating more than 100 useful variables[3].

However, noisy observations still exist in this dataset because of non-standardized financial statements or report errors from some firms. We clean the sample and remove the outliers by using the following filtering criteria. First, following Feenstra, Li and Yu (2014), observations with missing primary financial variables (such as total asset, gross industrial output value and net fixed assets) are omitted. Second, firms with fewer than 8 workers are excluded from the sample because they are under a different legal regime (Brandt, Van Biesebroeck & Zhang, 2012; Yu, 2015). Furthermore, observations satisfying the following criteria are excluded according to the basic rules of the Generally Accepted Accounting Principles: (a) Liquid assets are greater than total assets; (b) Fixed assets are greater than total assets; (c) Net fixed assets are greater than total assets; (d) An invalid founded time exists (i.e., the opening month is earlier than January or later than December.); (e) The firm's identification number is missing.

The second dataset used in our paper comes from China's Ministry of Commerce. It covers rich information of EMEs that have conducted non-financial OFDI, including parent firm names, registration addresses, investment destinations, foreign subsidiary names, approval dates[4] and business scopes. All

[1] In fact, the aggregated data on the industrial sector in the annual China's Statistical Yearbook and China's Industry Economy Statistical Yearbook are compiled from this data set.

[2] When estimating the probability to invest abroad in one year, we would use firms' production data in the previous year, namely when the previous year is 2001, we would also utilize firms' production data in 2001. Thus more exactly speaking, the production data utilized in this paper range from 2001 to 2008.

[3] Because the intermediary input variable is missing in 2008, we impute this variable using a conventional method. According to China's Statistical Yearbook, value added = total output - intermediary input + value added tax payable. We can impute the missing data by the equation, intermediary input = total output - valued added + value added tax payable. Here we assume a firm's valued-added rate in 2008 equals to that in 2007. Depending on the value-added rate in 2007 and the total output in 2008, we can obtain firms' value added in 2008, and then firms' intermediary inputs in 2008 can be straightforwardly derived. Imputing the intermediary input data in 2008 helps extend the sample. If we only utilize the sample 2002-2007, our findings do not change significantly.

[4] Considering that the date on which an investment was approved differs from that on which the subsidiary was established, we spared no effort to search the internet (the information from the parent firm's website is labeled top priority) to confirm the exact date of subsidiary establishment. If the establishment date is unavailable, the year in which the investment was approved is used to approximate the year in which the subsidiary was established.

the EMEs engaging in non-financial OFDI from 2002 are covered in the dataset[5]. This enables us to investigate the OFDI-led productivity change at the country level.

Based on whether a firm invested abroad during the sample period, we divide the whole sample into two subsamples, i.e., one with firms having OFDI and the other with firms having no OFDI.

3.2 Measures

Following previous literature, we deploy TFP to capture EMEs' productivity change (Damijan, Polanec & Prasnikar, 2007), but we avoid the simple Solow residual approach as it is not reliable enough and would cause biased productivity estimation results (Olley & Pakes, 1992). Instead, following Dai and Yu (2013); De Loecker (2007); De Loecker et al. (2012); Markusen (2004); Yu (2015), we have augmented the traditional Olley and Pakes (1992) approach by introducing OFDI and export dummies when the production function is estimated, because EMEs with or without OFDI and export may confront with different production environments and resource allocation processes.

Compared with the traditional simple OLS method, our augmented Olley-Pakes approach in TFP measurement has many advantages. First, this method utilizes the function of real current-period capital stock and investment[6] as the proxy variable for current-period productivity[7], which effectively controls for the unobservable productivity shock in the production function estimation, and reduces the simultaneity bias. Second, firms' survival probability is considered in the estimation of the production function, and thus the selection bias that only productive enterprises could survive in the markets can be effectively corrected. Third, we take into account the role of exporting and OFDI status when estimating production function, which helps to alleviate the production function estimation bias arising from omitting influential variables in the production function (De Loecker, 2011; De Loecker et al., 2012).

An EME's OFDI status is measured based on whether the firm has conducted OFDI. To estimate the impact of state ownership on the EME's productivity gain from OFDI, we distinguish between EMEs

[5] In 2002, the former Ministry of Foreign Trade and Economic Cooperation of China and China' National Bureau of Statistics jointly developed China's first Outward Foreign Direct Investment Statistical System.

[6] We adopt the perpetual inventory method as the law of motion for real capital and real investment. The nominal and real capital stock constructed following Brandt et al. (2012). We depend on the firm's own information in the dataset to construct firm's real depreciation ratio.

[7] Here is an implicit assumption, namely, firms which are more productive now would have higher expected return rates, and hence those firms would invest more in that period. Under a few assumptions of production technology, (Pakes, 1996) has verified this implicit assumption.

with state ownership and those without for further comparison (Amighini et al., 2013; Cui & Jiang, 2012). Following Cohen and Levinthal (1989), we measure an EME's absorptive capability by its R&D. It is suggested that R&D not only generates innovations, but also develops an ability to identify, assimilate, and exploit knowledge from the environment (Zahra & Hayton, 2008). The investment destination dummy is composed by non- OECD countries (coded "0") and OECD countries (coded "1") (Buckley et al., 2008; Pradhan & Singh, 2008).

As suggested by the literature, we include firm features as our control variables, including the firm productivity (Helpman et al., 2004), inputs (capital, labor and intermediate inputs), firm-level strategies (pre-OFDI export and R&D decision), firm ownership (foreign-invested firm or state-owned enterprise), firm age (Wang, Hong, Kafouros, & Boateng, 2012), and the dummy variables for year and industries[8]. Head and Ries (2004) suggest that firms can adopt OFDI and export as substitutive or complementary strategy to engage in foreign markets. We therefore treat pre-OFDI export decision as one firm strategy that may influence the firm's OFDI decision. The R&D decision is another firm strategy that may affect the firm's OFDI decision. As Lu, Liu and Wang (2011) illustrate, firms in industries with higher levels of R&D intensity have higher probability to conduct strategic asset-seeking OFDI. Table 2 provides the correlation matrix of independent variables and associated summary statistics.

Table 2: Summary Statistics and Correlations

	1	2	3	4	5	6	7	8	9	10
1. Log(number of employees)	1									
2. Log(capital stock)	0.65	1								
3. Log(intermediate inputs)	0.57	0.70	1							

[8] In fact, to alleviate the influence of business cycle and control for the industry heterogeneity, we estimate the propensity score on a year-by-year and industry-by-industry basis.

4. Log(TFP)	0.13	0.25	0.20	1						
5. Firm age	0.26	0.21	0.04	0.04	1					
6. OFDI dummy	0.03	0.04	0.04	0.01	0.00	1				
7. Export dummy	0.27	0.16	0.19	0.08	-0.02	0.03	1			
8. R&D dummy	0.20	0.26	0.21	0.08	0.10	0.03	0.09	1		
9. SOE dummy	0.14	0.15	-0.10	0.08	0.43	-0.00	-0.10	0.05	1	
10. FIE dummy	0.17	0.21	0.17	0.12	-0.13	0.01	0.41	0.02	-0.16	1
Mean	4.67	9.75	9.74	1.91	10.90	0.001	0.25	0.11	0.08	0.20
Standard deviation	1.11	1.44	1.38	0.56	11.33	0.30	0.43	0.32	0.27	0.40

Note: We impute the missing R&D variable in 2004 with the average values in 2003 and 2005. R&D data in 2008 are not utilized in the following analysis, and hence not included here. All the variables summarized here range from 2002 to 2008 except for the R&D dummy. TFP presented in this table is calculated using an augmented Olley-Pakes approach.

3.3 Econometric Model

Disentangling correlations and causality in the OFDI-productivity growth nexus faces numerous challenges. As high productive firms are more likely to invest abroad, productivity growth may be endogenous and self-selected, and simple least squares estimation is invalid. Inspired by former literature (Bascle, 2008; Hamilton & Nickerson, 2003), we use propensity score matching to assess the causal effect of OFDI on parent firm productivity change. The matching technique creates the missing counter facts of firms that have foreign subsidiaries. It does so by pairing up a firm that conducts OFDI with a domestic plant (or several plants) with similar observable characteristics operating in the same sector and year, where similarities are determined on the basis of those plant features that have explanatory power in the OFDI decisions. Following De Loecker (2007) and Hayakawa, Matsuura, Motohashi and Obashi (2013), propensity score matching is employed combining with a difference-in-difference approach. The OFDL-led productivity effect is hence inferred from the average divergence in the productivity paths between each firm having OFDI and its matched control plants, starting from the pre-OFDI year. This strategy allows us to control for observable and time-invariant unobservable differences between OFDI firms and their control plants (Heckman, Ichimura & Todd, 1997).

The basic idea of propensity score matching is to take OFDI as a "treatment", and then the productivity effect of OFDI can be captured by the average treatment effect on the treated (ATT). We rescale the year that a firm just starts to invest abroad as period 0, and employ $s \geq 0$ to represent the number of years after a firm starts to invest abroad. Variable "$start_i = 1$" represents that firm i starts to invest abroad. Then the productivity effect of starting to invest abroad could be expressed as:

$$E(\omega_{is}^1 - \omega_{is}^0 \mid start_i = 1) = E(\omega_{is}^1 \mid start_i = 1) - \mathrm{E}(\omega_{is}^0 \mid start_i = 1) \qquad (1)$$

The productivity is denoted by ω^1 if a firm starts to invest abroad, and by ω^0 if it does not. Equation (3)

shows the average treated effect on the treated group (firms that start to invest abroad). The key point of getting the ATT is to find out the counter facts of the treated group, i.e. the control group. To achieve this purpose, propensity-score matching approach is utilized to construct the control group, following some previous studies (De Loecker, 2007;Imbens, 2004; Rosenbaum & Rubin, 1983). Based on the information prior to the year when the firm started to invest abroad, we have constructed the following model to estimate the propensity score:

$$\Pr(start_{i,0} = 1) = \Phi(\mathrm{h}(X_{i,-1})) \qquad (2)$$

where Φ represents the cumulative density function of a normal distribution. $X_{i,-1}$ refers to firm i's characteristics as our control variables which could predict whether this firm would invest abroad in the next period. Firm pre-OFDI productivity, inputs (capital, labor and intermediate inputs), firm-level strategies (pre-OFDI export and R&D decision), firm ownership (foreign-invested firm or state-owned enterprise), firm age[9], and the dummy variables for year and industries serve this purpose, as our above discussion in Section 4.

According to Becker and Ichino (2002) and De Loecker (2007), the following algorithms are employed to find out the control groups. Firstly, the observations are split into k equally spaced intervals depending on the propensity score[10]. Secondly, within each interval, we test whether the average propensity score of the experimental group (treated group) differs significantly from that of the control group. If the test fails in one interval, the interval would be split in half and be tested again until the average propensity scores of treated and control groups do not differ significantly in each interval. Thirdly, we test whether the means of the covariates do not differ significantly between treated and control groups within each interval, and this is to check whether the balancing condition is satisfied. If the balance condition is rejected, we will alter the functional form of the propensity score by adding higher-order covariates and interaction terms and redo the above steps. Fourthly, the nearest-neighbor matching method is employed to find out the counterfactual observations after the balancing condition is satisfied[11].

[9] Although there is an argument that the newness of the subsidiary could explain the improvement in firm productivity, our analysis still holds. Frist of all, it's true that subsidiaries started in different years probably take different technologies, but our estimation results still can show the positive productivity spillover effect through the backward linkage if parent firms benefit from engaging in OFDI. Furthermore, our analysis is to compare the productivity changes of parent firms with their counterfactuals (firms that operate in the same year and industry with the treatment group, but not engage in OFDI) rather than directly compare firms with OFDI in different years. Moreover, our sample ranges from 2002 to2007 (mainly between 2004 and 2007), and hence technologies used in a given manufacturing industry may be relatively similar during such a short time period. More importantly, our results still hold if we restrict the estimation sample to 2004-2007.

[10] The initial value of k is set to 2.

[11] After sorting the sample by the propensity score, we search the counterfactual observations for the treated group by searching upward and downward. In fact, we find two firms for each treated one. Some other matching methods are also utilized, such as finding out one or

After obtaining the control group, we pool all the years and industries together and calculate the average TFP difference between the treated and control groups. $C(\mathrm{i})$ denotes a set of firms that are matched to firm i, and N_i^C refers to the number of firms in $C(\mathrm{i})$. The weight of firm j that is matched to firm i is denoted as $w_{ij} = 1/N_i^c$. ω^1 and ω^c are the productivity of the treated firm and the firm in the control group respectively. Then the average treatment effect for year s on the treated can be written as follows:

$$ATT_{level}^{s} = \frac{1}{N_s}\sum_i \omega_{i,s}^1 - \sum_{j\in C(\mathrm{i})} w_{ij}\omega_{j,s}^c \tag{3}$$

The year-by-year productivity growth effect can be expressed as follows:

$$ATT_{growth}^{s} = \frac{1}{N_s}\sum_i [(\omega_{i,s}^1 - \omega_{i,s-1}^1) - \sum_{j\in C(\mathrm{i})} w_{ij}(\omega_{j,s}^c - \omega_{j,s-1}^c)] \tag{4}$$

It is obvious that the productivity effect estimated from Eq. (4) is actually the average difference of productivity growth between the treated group firms and the matched control group firms[12].

Next we combine the propensity score matching and DID approaches to produce a more precise estimation of the productivity effect of OFDI (Blundell & Dias, 2009). We compare an EME's productivity with its pre-OFDI level (s=−1), where DID^s denotes the productivity growth difference in period s compared to the pre-OFDI level, for the treated and control groups.

$$DID^{s} = \frac{1}{N_s}\sum_i [(\omega_{i,s}^1 - \omega_{i,-1}^1) - \sum_{j\in C(\mathrm{i})} w_{ij}(\omega_{j,s}^c - \omega_{j,-1}^c)] \tag{5}$$

Considering the advantage of controlling for the pre-OFDI level of productivity after propensity-score matching, we rely on the DID measure to produce our main estimation results.

4. Estimation Results

4.1 Results at the Overall Manufacturing Level

Table 3 demonstrates the estimation results at the overall manufacturing level. Panel (1) describes the impact of OFDI on the parent firm's level-value of productivity change over time, while panel (2) indicates the year-to-year productivity premium the new investor gathered over time. The results show

four counterfactual observations for each treated firm, but our main results do not change significantly.

[12] We adopt firms that never invest abroad in the sample period as the control group. There is an alternative way to choose the control group, i.e., treating firms that just do not invest abroad in the given year as the control group. However, the latter approach inevitably neglects the lagged effect of investing abroad in the previous years. Therefore our estimation results are based on the former approach.

that the productivity premium for EMEs that started to engage in OFDI increased gradually. Based on the DID approach, EMEs' average productivity gains from the first year to the third year after starting OFDI grew from 4.9% to 14.5%, which is similar to the pure level effect. Panel (3) shows that firms' year-to-year productivity growth after OFDI is significant except the second year after OFDI.[13] Thus our H1 is to a large extent supported.

Table 3 : Productivity Effect of OFDI——at the Overall Manufacturing Level[14]

s	0	1	2	3
(1) Results: TFP level	0.015	0.051***	0.080***	0.147***
Standard error	(0.011)	(0.015)	(0.023)	(0.039)
(2) Results: TFP growth: DID measure	0.014	0.049***	0.079***	0.145***
Standard error	(0.011)	(0.018)	(0.025)	(0.042)
(3) Results: TFP: year-to-year growth	0.014	0.030*	0.027	0.053*
Standard error	(0.011)	(0.017)	(0.021)	(0.029)
Number of treated units	1024	657	346	114

Note: This table reports the estimation results of OFDI's impacts on parent firms' productivity change. An augmented Olley-Pakes approach has been used here, and standard errors are reported in the parentheses. *, **, *** indicate significance level at 10%, 5% and 1%, respectively.

4.2 State ownership and OFDI's productivity effect on EMEs

To test our first hypothesis that state ownership moderates OFDI's productivity effect on EMEs, we split the sample into four groups based on state ownership[15] and EMEs' OFDI status and test whether there is a difference in productivity effects between private EMEs and SO-EMEs. We treat SO-EMEs (private EMEs) with no OFDI in the sample period as the control group for SO-EMES (private EMEs) that conduct OFDI in that year, and our matching approach is on a year-by-year and industry-by-industry basis. The estimation results are listed in Table 4 below.

Table 4 and Figure 2 show that OFDI indeed significantly contributes to the productivity growth for private EMES. Their productivity benefits increase from 1.8% in the first year to 15.2% in the third year after conducting OFDI. While for SO-EMEs, the productivity growth effect is not significant. Therefore

[13] This finding is similar to the conclusion about the productivity effect of exporting by De Loecker (2007).

[14] In this table, the number of treated units is less than that of the treated ones after matching. There are several reasons for this situation. First, production information prior to the year when firms started to invest abroad is needed for matching, and firms with missing pre-OFDI information are omitted. Second, firms that cannot be matched are dropped because of the violation of the balance condition hypothesis. Third, when calculating TFP with the augmented Olley-Pakes approach, firms with missing covariates are deleted. These are also the cases for later estimations.

[15] By the official definition reported in *China Statistical Yearbook (2008),* SO-EMEs include firms such as domestic SO-EMEs (code: 110), state-owned joint venture firms (141), and state-owned and collective joint venture firms (143), but exclude state-owned limited corporations (151), based on the registration type.

H2 is supported.

4.3 Absorptive capacity and OFDI's productivity effect on EMEs

To test whether a firm's absorptive capability matters, we split the sample into four groups according to whether firms have conducted OFDI and whether they have had pre-OFDI R&D[16]. The matching approach is conducted on a year-by-year and industry-by-industry basis. We treat firms with (without) positive R&D expenditure before year t as the control group for firms that starting OFDI in year t and with (without) positive R&D before year t respectively[17]. Table 8 illustrates the corresponding estimation results, and Figure 3 shows the comparative role of absorptive capability in moderating OFDI's productivity effect.

Table 4 and Figure 2 show on average OFDI promotes the parent firm's productivity growth no matter whether it has pre-OFDI R&D or not. However, the productivity effect differentiates significantly according to firms' absorptive capability. Based on the estimation results of TFP, for EMEs that have positive pre-OFDI R&D expenditure, the productivity premiums are highly significant, and OFDI engagement brings in 2.1% higher productivity growth in the first year, than firms without OFDI. Till the third year after (s=3) starting OFDI, the productivity premium for EMEs with strong absorptive capacity turns to be larger and reached 16.9%. However, for firms without pre-OFDI R&D, the productivity growth benefits brought by OFDI are only significant in early years (the first and second year after OFDI, i.e., only significant when s=1 & 2), and their productivity growth rate is noticeably lower than EMEs with positive pre-OFDI R&D expenditure. Thus H3 is supported.

4.4 Investment Destination and OFDI's productivity effect on EMEs

We test H4 by distinguishing EMEs that conduct OFDI in OECD countries only[18] from those in non-

[16] To be accurate, for those that have never invested abroad, we split them based on whether they had R&D prior to that year within each industry for each year.

[17] An alternative method to test the role of absorptive capability in moderating the productivity effect of OFDI is to directly split the matched results from Section 5.1 into two groups by firms' pre-OFDI R&D status. But it may overestimate the productivity effect for firms that had pre-OFDI R&D, compared to our approach.

[18] Members of OECD countries used in this paper are restricted to those that had joined OECD before 2009, because of our sample period. For more information about the list of OECD members, please refer to http://www.oecd.org/about/membersandpartners/list-oecd-member-countries.htm

OECD countries only [19]. Our results in Table 4 and Figure 2 support H4 by demonstrating that OFDI's productivity effect significantly exists no matter EMEs invest in OECD or non-OECD countries, but this OFDI-led productivity gain is clearly higher if investing in OECD countries. Hence, H4 is supported.

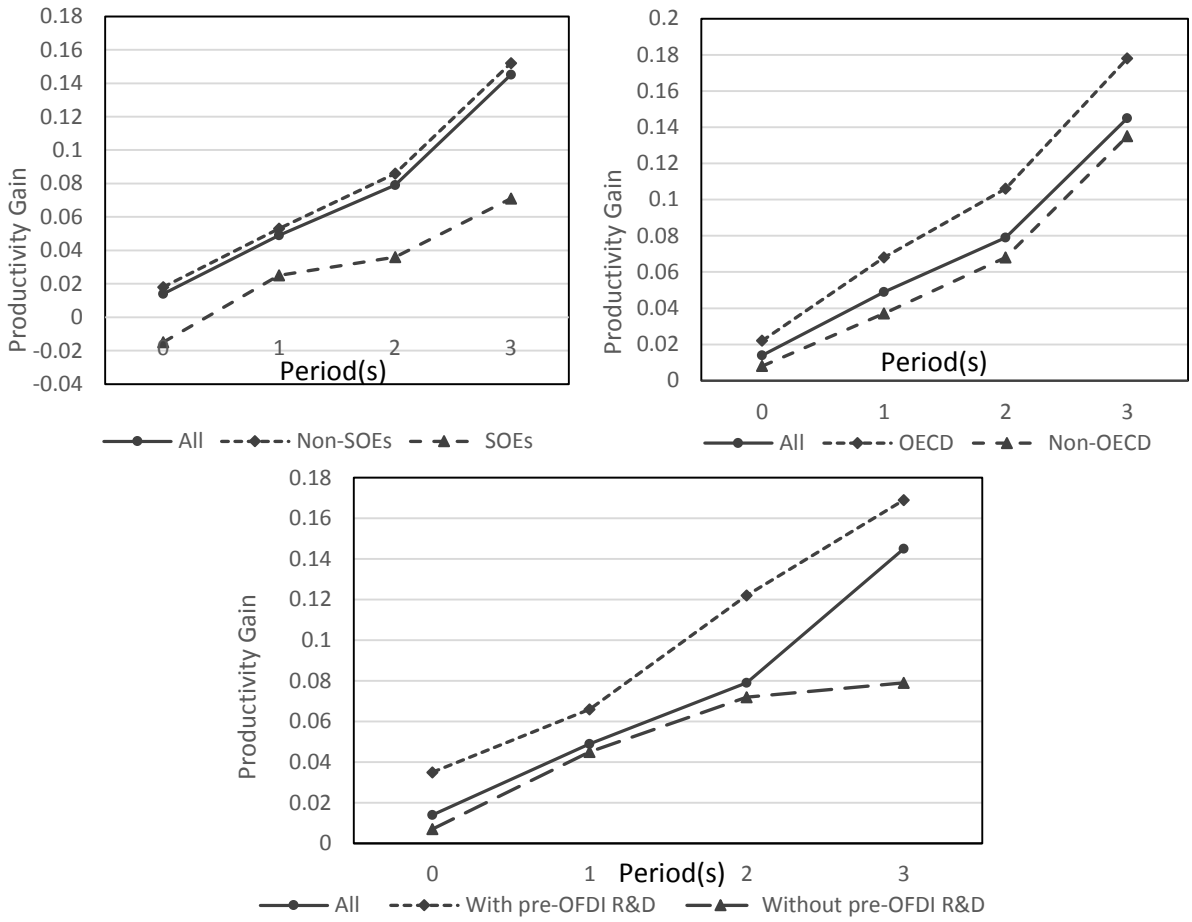

Figure 2: Moderating effect of state ownership, absorptive capacity and investment destination

Table 4: Instantaneous and Long-run Productivity Effect of OFDI

By State Ownership				
s	0	1	2	3
(A) Results for SO-EMEs				
(1) Results: TFP: DID measure	-0.015	0.025	0.036	0.11
Standard error	(0.026)	(0.041)	(0.147)	(0.131)

[19] In order to get rid of the mixed effect generated by firms that invest both in OECD countries and in non-OECD countries during the starting year, we drop all the observations of those firms in this section.

(2) Results: TFP: year-to-year growth	-0.015	0.046	-0.014	0.073
Standard error	(0.026)	(0.063)	(0.94)	(0.109)
Number of treated units	54	37	29	11
(B) Results for private EMES				
(1) Results: TFP: DID measure	0.018*	0.053***	0.086***	0.152***
Standard error	(0.010)	(0.018)	(0.024)	(0.041)
(2) Results: TFP: year-to-year growth	0.018*	0.026*	0.031	0.058**
Standard error	(0.010)	(0.014)	(0.020)	(0.029)
Number of treated units	916	598	302	97
By Pre-OFDI R&D status				
(C) Results for firms with pre-OFDI R&D				
(1) Results: TFP: DID measure	0.035**	0.066***	0.122***	0.169***
Standard error	(0.014)	(0.022)	(0.030)	(0.050)
(2) Results: TFP: year-to-year growth	0.035**	0.028	0.048*	0.049
Standard error	(0.014)	(0.019)	(0.027)	(0.036)
Number of treated units	447	283	146	51
(D) Results for firms without pre-OFDI R&D				
(1) Results: TFP: DID measure	0.007	0.045*	0.072*	0.079
Standard error	(0.012)	(0.026)	(0.037)	(0.061)
(2) Results: TFP: year-to-year growth	0.007	0.031	0.029	0.011
Standard error	(0.012)	(0.019)	(0.030)	(0.039)
Number of treated units	521	321	174	55
By Investment Destination				
(E) Results for firms starting to invest only in OECD countries				
(1) Results: TFP: DID measure	0.022*	0.068***	0.106***	0.178***
Standard error	(0.012)	(0.018)	(0.025)	(0.041)
(2) Results: TFP: year-to-year growth	0.022*	0.039*	0.033	0.055*
Standard error	(0.012)	(0.021)	(0.022)	(0.032)
Number of treated units	394	201	102	25
(F) Results for firms starting to invest only in non-OECD countries				
(1) Results: TFP: DID measure	0.008	0.037*	0.068**	0.135**
Standard error	(0.010)	(0.021)	(0.028)	(0.059)
(2) Results: TFP: year-to-year growth	0.008	0.024	0.026	0.052*
Standard error	(0.010)	(0.016)	(0.019)	(0.028)
Number of treated units	509	332	201	85

Note: This table reports the productivity effect of starting to invest abroad grouped by ownership, absorptive capacity and investment destination of parent firms. An augmented Olley-Pakes approach has been used here, and standard errors are reported in the parentheses. *, **, *** indicate significance level at 10%, 5% and 1%, respectively.

5. Robustness Check and Further Analysis

5.1 An Alternative Measure of Total Factor Productivity

In order to check whether our above estimation results are robust to different productivity estimation methods, we have re-estimated firms' productivity effect using the Levinsohn and Petrin (2003) approach (LP method). This method employs an EME's intermediate inputs as a proxy for unobservable

productivity, to control for the correlation between firms' inputs decisions and invisible productivity, thus solving the simultaneity bias when estimating the production function. After the firm-level productivity estimation, we test the OFDI-led productivity effect using the same method in Section 3, and the results are similar to those in Section 4[20].

5.2 Investment Destination Measured by Patent Application Per Capita

To test whether our estimation results of Section 4 are robust to different criteria of the host country division, we have divided our sample into two groups based on host counties' technology levels measured by patent applications per capita. We have averaged each host country's patent applications per capita during the period 2002-2008, and then compared them with the overall average, to evaluate whether a country is high-tech or low-tech (a country with above-total-average patent application per capita will be labeled as a high-tech country and otherwise a low-tech country). The estimation results[21] are again similar to those in Section 4.

5.3 One-Step System GMM Approach to Estimate the OFDI's Productivity Effect

Given the flexibility of one-step system-GMM, according to Blundell and Bond (1998) and Yu (2015), we have examined OFDI-led productivity growth directly without the pre-estimation of EMEs' productivity[22]. Thus the coefficients of inputs and OFDI in production function are estimated simultaneously, as an extra robustness check.

The results[23] show that at the overall manufacturing level, OFDI indeed promotes EMEs' productivity growth. But the productivity effect is moderated by firm heterogeneity and investment strategy. EMEs that have pre-OFDI R&D and non-SOE ownership gain more OFDI-led productivity growth. At the same time, investing in OECD countries helps EMEs gain higher productivity premium. In all the estimation specifications, SO-EMEs are less efficient.

5.4 Absorptive capacity and OFDI's productivity effect in non-technology-intensive industries

[20] The detailed results are not reported due to space limitation, but are available upon request.

[21] The detailed results are not reported there due to space limitation, but available upon request.

[22] In fact, this is to treat OFDI as a component of TFP, and explicitly test whether starting to invest abroad can promote parent firms' productivity keeping other production factors unchanged.

[23] The detailed results are not reported here due to space limitation, but available upon request.

To check whether firms' absorptive capacity moderates OFDI's productivity in non-technology-intensive industries, we have conducted another test for OFDI's productivity effect in non-technology-intensive industries. Based on the same estimation methods above, we find that firms with pre-OFDI R&D become more productive than those without after investing in non-technology-intensive industries abroad[24]. This indicates that absorptive capacity does play a role in productivity improvement not only for firms seeking for advanced technology but also for those seeking for resources.

6. Discussion and Conclusion

Given the mixed empirical results about the impact of OFDI on EMEs' productivity change, we contribute to the literature by establishing a novel theoretical framework combining RBV and IT, and assessing whether there exists a positive OFDI-EMEs' productivity growth nexus. The moderating effect of firm heterogeneity in terms of state ownership, absorptive capacity and investment destination has been considered. An augmented Olley and Pakes' (1992) semi-parametric approach has been used as the TFP measurement to control for omitted variable bias and the propensity-score matching and difference-in-difference (DID) approaches have been combined to test out conceptual framework. We feel that this study has the following theoretical, policy and managerial implications.

6.1 Theoretical Implications

First, we have focused on an emerging economy context and added to an under-researched area by combing RBV and IT to predict EMEs' productivity gain from OFDI (Hoskisson et al., 2013; Peng et al., 2008). Existing research about OFDI' productivity effect on EMEs tends to be based on a general literature review or "international business theory", and the empirical results are mixed (Cozza, Rabellotti & Sanfilippo; 2015; Zhao, Liu & Zhao, 2010; Lee, Chyi, Lin & Wu, 2013; Yang, Chen & Huang, 2013; Hijzen, Inui & Todo, 2007). Given the distinctive resource-based and institutional characteristics of EMEs (Wang et al., 2012; Hoskisson, Wright, Filatotchev, & Peng, 2013), we argue that OFDI-led productivity growth can be expected for EMEs as OFDI helps EMEs 1) create, transfer and absorb knowledge; 2) reallocate resources and realize economies of scale; 3) access developed institutions and institutional infrastructure; 4) get exposed to international competition. This argument has been supported by our estimation results, and our study thus contributes by confirming the existence of a

[24] The results are available upon request.

positive OFDI-EMEs' productivity growth nexus (Lee, Chyi, Lin & Wu, 2013; Masso & Vahter, 2008; Chen, Li & Shapiro; 2012; Chen & Tang, 2014; Li, Strange, Ning & Sutherland, 2016).

Unlike previous studies that treat OFDI-EMEs' productivity growth as a direct linkage (Herzer, 2011), our second contribution lies in identifying and documenting the role of firm heterogeneity in moderating OFDI's productivity effect. Our overarching argument is that although EMEs turn to be generally more productive after they conduct OFDI, this productivity effect varies depending on EME heterogeneity: 1) An EME without state ownership gains more positive productivity premium via OFDI than that with state ownership; 2) The stronger the EME's absorptive capacity, the more positive productivity premium it can get from OFDI; 3) An EME investing in developed countries gains more from OFDI-led productivity enhancement. Our new theoretical framework extends the existing literature as it does not just look at the direct impact of OFDI on firm productivity, but also examines how the OFDI-productivity relationship is altered when firm heterogeneity is introduced. This makes an original contribution to the ongoing debate about OFDI's productivity effect.

Third, we find evidence that private EMEs can gain positive productivity premium via OFDI while SO-EMEs cannot. This result challenges RBV which indicates that SO-EMEs with more institution-based resources should perform better in global markets (Wang et al., 2012), and supports our argument that IT is needed to explain EMEs' productivity gains from OFDI. With affiliation to governments, SO-EMEs are confronted with more stressful home country institutional pressures as their high resource-dependence on home country governments pushes them into serving for national politic goals. At the same time, being recognized as political actors, host country institutions exert huge pressures on SO-EMEs, preventing them from performing resource-augmenting activities effectively (Cui & Jiang, 2012).

Fourth, we enrich the existing literature related to absorptive capability by recognizing its positive moderating effect on the OFDI-EMEs' productivity linkage, based on both RBV and IT. We confirm the role absorptive capability plays in shaping EMEs' recognition, assimilation and application to commercial ends of external valuable knowledge and information (Barney, 2001; Deng, 2007). Apart from that, our work suggests that EMEs' absorptive capability works as resource-based capabilities, assisting EMEs in dealing with host country institutional pressures and surviving in asset-intensive developed institutions. Finally, the moderating effect of OFDI destination has also been identified. In line with both RBV and IT, we demonstrate that developed countries with agglomerated high-tech and well-developed institutional infrastructure (Hoskisson et al., 2013), offer EMEs with more possibilities for

productivity enhancement.

6.2 Policy and managerial implications

Our findings have important practical implications for EMEs' productivity-augmenting OFDI activities, as well as emerging economies' OFDI and R&D policies. Firstly, emerging economy governments need to realize that government intervention may sometimes be counter-productive. State ownership often implies that EMEs are supplied with institution-based resources. While this may offer EMEs specific advantages when they internationalize, this support may lead to low productivity if SO-EMEs behave as political actors, and are hence insensitive to market competition. It may be more useful for emerging economy governments to unfasten the political shackles for SO-EMEs, helping and encouraging EMEs to compete effectively in the global market via supplying market and network information, rather than providing excessive financial support.

Secondly, emerging economy governments need to pay more attention to the development of their institutional infrastructure including the construction of R&D centers and cultivation of human capital, to enhance emerging economy firms' absorptive capability. This not only facilitates domestic innovations, but also enlarges OFDI's productivity effect on EMEs.

Thirdly, our findings send EME managers a clear message that productivity premium EMEs can gain from OFDI is by no means automatic, and it varies significantly with firm-level heterogeneity, including firm specific resources, institutional background and corresponding OFDI strategies. Following this, when formulating OFDI strategies and decisions, managers should be aware of their firms' features, strengths, and their investment purposes (asset-, market-, resource-, or efficiency-seeking), to maximize the benefits they can achieve from OFDI. For instance, an EME that has neither pre-OFDI R&D nor significant human capital may not acquire high-tech firms.

6.3 Limitations and future research directions

As with all studies, our work has several limitations, which provide opportunities for future research. First, our dataset lacks detailed information on EMEs' entry strategies. This hindered our ability to investigate the role of entry strategy as a moderator for the OFDI-productivity nexus. Existing literature indicates that entry strategy differences affect subsidiaries' managerial pattern, corporate culture, technique-learning channels, and their OFDI results (Nocke & Yeaple, 2007). However, the impact of

entry strategy on EME productivity is not straightforward. OFDI via either greenfield or M&A brings in costs as well as channels for EMEs' productivity growth (Pradhan & Singh, 2008; Dikova & Brouthers, 2016), but quantitative studies which simply measure entry strategy as greenfield or M&A cannot fully uncover the real productivity effect of OFDI entry strategy, let alone thoroughly explore the mechanisms with which different entry strategies moderate this effect. Future research of this topic via a qualitative method is sorely needed and strongly encouraged. Second, as our study is conducted based on data from 2002-2008, we cannot figure out the impact of the 2008 financial crisis on the relationship between OFDI and EMEs' productivity growth. The financial crisis, with its associated credit crunch, has affected institutional environments, economic entities and EMEs' OFDI abilities (Sauvant, Maschek & McAllister, 2010). For future research, it would be interesting to find out how the financial crisis affects EMEs' OFDI trajectories and results. Another limitation of this study lies in the absence of detailed subsidiary level data. Thus, further subsidiary-level studies in our topic are highly encouraged, to clearly track the mechanisms with which EMEs' OFDI enhance parent firms' productivity (Rugman, Verbeke & Nguyen, 2011).

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