**Unpacking the Relationship between OFDI and Innovation Performance:**

**The Moderating Effect of contextual Factors**

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**Abstract:** The outward direct investment undertaking by Chinese multinational enterprises has risen remarkably in the last decades. This study investigates the moderating role of contextual factors and examines their impact on the association between OFDI and innovation performance of parent firms based on a sample of Chinese firms. The results suggest that undertaking OFDI enables Chinese firms to enlarge their knowledge base and resource pool and leads to the improvement in innovation performance of the parent companies at the home country. The finding also reveals the moderating effects of contextual factors, such as location and industries, and prior international experience on the relationship between OFDI and innovation performance.

**I. Introduction**

Along with the rapid globalization and intensified integration of the world economy, outward foreign direct investment (OFDI) is a commonly adopted internationalisation strategy and has long been recognize as an effective channel for firms to acquire advanced foreign innovation. The rise of FDI flow worldwide over the past thirty years has been remarkable, from US$50 billion per year in 1985 to US$ 1.35 trillion in 2012 (UNCTAD, 2013). As the world’s largest recipient of FDI (52 per cent of global FDI flow), developing economies has also become an important play in investing OFDI with outflows reached US$ 426 billion in 2012, accounting for 31 per cent of the world total and nearly doubled compared to the figures in 2008 (UNCTAC, 2009, 2013). MNEs from developing countries, especially emerging economies (EEs), have actively invested in developed economies through acquisition in order to access key assets, resources and leading-edge technologies (Ramamurthi and Singh, 2009; Liu and Buck, 2009; Luo and Tung, 2007). By investing in foreign markets, EE firms are expected to avoid domestic price wars and at the same time reinforce their competitive advantages by acquiring advanced know-how from host countries (Rui and Yip, 2008; Lu, et al., 2011; Deng; 2012).

In line with the rapid economic growth, OFDI undertaken by Chinese multinational enterprises (MNEs) has risen markedly. The total FDI by Chinese firms exceeded 77.2 Billion USD in 2012, which was increased about 2.5 times compare to the value in 2007. [[1]](#footnote-1) In the OFDI ranking list, China has successfully moved up from sixth to third place, after the United States and Japan. Yet the technological gap between China and developed countries remains profound. For example, the R&D intensity in China is still low in comparison with OECD countries. The year of 2008 recorded the ratio of R&D in GDP at 1.47 percentages, which is still far behind OECD average at 2.37 percentages.[[2]](#footnote-2) Majority of Chinese MNEs, except for giant firms like Huaiwei or ZTE, are still recognised as followers in innovation. Compared to MNEs from developed economies that have been characterised by technologically advanced productions, efficient managerial system and highly skilled personnel, EE MNEs typically lack intangible resources, such as advanced technologies, marketing techniques, established brands. Therefore rather than purely exploring the potential overseas market, one of the underlying characteristics of Chinese OFDI is the motive to learn about new technologies and use such a mechanism to upgrade their innovation capabilities, particularly for those firms operating in a county with a rich knowledge pool.

Despite research on Chinese OFDI has proliferated broadly and rapidly in recent years, most studies mainly focus on the determinants, motives and entry selections (Cui and Jiang, 2012; Lu et al., 2014; Morck et al., 2008; Wang, et al., 2012; Witt and Lewin, 2007). Research on the outcomes of OFDI, especially the innovation gains of the parent firms remains scarce. Our understanding of the impact of EE OFDI on the creation of ground-breaking innovation is limited. This study aims to fill this gap by investigating the impact of Chinese OFDI on the innovation performance of parent firms. The high level of cross-border acquisition activities undertaken by Chinese firms has made it an interesting case to examine association between OFDI and innovation. Specifically, examine the extent to which Chinese OFDI contributes to upgrade Chinese firms’ technological capabilities that are not available in the home market.

Our study makes a number of contributions to the existing literature. First, based on a panel data analysis of firms with overseas investment in Guangdong province of China, we are able to assess the important role of OFDI in fostering innovation and technological capability upgrading and provide valuable empirical evidence on whether Chinese MNEs have achieved their strategic objectives through OFDI. Second, extending OFDI location pattern theory to EE MNEs context (Dunning, 1980), the current study compares the extent of reverse knowledge flows induced by OFDI locating in developed countries to that in developing countries. In so doing, we are able to account for the impact of location heterogeneity on innovation performance. Third, rather than merely examining the effect of OFDI on the innovation performance of parent companies, we go a step further to estimate the conditions that ensure Chinese MNEs to successfully learn from foreign technology leaders via overseas investment. The results reveal that the impact of OFDI on innovation is contingent on investment motives and contextual factors, thus providing new insights into the interrelationship between OFDI, investment motivation and host country context.

In next section, we begin by discussing some of the recent features of OFDI and revers technology transfer. Section III will lay out the model explanation, followed by introducing data and variables used in the empirical analysis. Results and corresponding interpretations will be presented in Section VI, whereas Part 6 concludes.

**II. Theoretical background and hypotheses**

A firm’s core resources and capabilities are crucial in gaining competitive advantage and sustaining growth (Wernerfelt, 1984; Barney, 1991). Among those resources, knowledge is considered the most significant intangible asset (Grant, 1996a) which enables the firm to sustain competitive advantage and gain superior performance (Kogut and Zander, 1992; Winter and Szulanski, 2001). Yet knowledge creation is neither automatic, nor isolative process. It is a complex and interactive learning requires organisations to exert continuous efforts on accumulating internal knowledge and accessing diversified external sources of knowledge (Dogson, 1993; Fagerberg, 2005). Knowledge learning consists of learning-by-using (Rosenberg, 1982), learning-by-doing (Arrow, 1962), and learning-by interacting with other stakeholders (Lundvall, 1985; Lundvall and Vinding, 2004). From the perspective of organizational learning, operating in a foreign market provides MNEs from EEs with broader learning opportunities and allows them to develop diverse capabilities. Accessing to host country resources, such as new markets, new ideas, new cultures and new competition, results in the enhancement of competitive advantages. Especially in the context that most firms in EEs encounter limitations of developing new knowledge internally (Levitt and March, 1988; Nelson and Winter, 1982), external knowledge learning becomes an equally crucial channel (Cohen and Levinthal, 1994). Furthermore, FDI offers unique opportunity for EE MNEs to form global alliances which allow them to acquire advanced skills and technologies more efficiently from foreign partners or rivals. Nevertheless, given that host country offers opportunities and also tremendous uncertainties, the market and technology benefits to EE MNEs are not guaranteed. These firms need to learn how to respond to the highly uncertain environment and afford additional costs arise from unfamiliarity with the culture, institution and economic settings.

Empirically, previous studies suggest that FDI not only brings technology from parent companies to the host country via diffusion channels (Keller, 1997; Driffield and Love, 2007; Fu 2012), it is also likely that technologies absorbed by subsidiaries in the host countries would reversely flow back to the home country (Singh, 2007). A series of case studies has addressed the importance of revers technology transfer through overseas investment behaviours (Kuemmerle, 1997; lyles and Dhanaraj, 2004). There have been also attempts to link subsidiaries productivity to the parent company performance, which to certain extent captures the direct impact of knowledge flows (Harzing and Noorderhaven, 2006; Driffield et al, 2010; Marin and Giuliai, 2011). Griffith et al (2006) using the UK firm-level data demonstrated that the productivity of firms in UK is linked with their investment levels in US. The authors also suggest that an underlying desire in the internationalisation of production is not to exploit existing technology within the firm, but to acquire the leading-edge technology through learning-by-doing and learning-by-interacting within a host economy.

While the existing literature predominantly focuses on the nature and extent of knowledge flows associated with FDI from advanced economies, increasing attention has been paid to reverse technology transfer impelled by MNEs from emerging economies (Liu et al., 2005; Child and Rodrigues, 2005; Cheng and Ma, 2007; Buckley et al., 2007; Davies, 2009; Lima and Barros, 2009; Mihaupt, 2010). However, little is known about under what conditions reverse knowledge flows through OFDI in the context of emerging economies contribute to the innovation performance of EE firms. Given that not all multinationals land in foreign markets with conspicuous advantages, foreign market and environment embeds many elements, such as relatively rich knowledge pool and well established industry context, that influence the technological competence and growth of firms from EEs (Fosfuri and Motta 1999; Siotis, 1999; Christensen and Lundvall, 2004; Lazonick, 2005).

EE OFDI and host countries

The mechanisms in which host countries’ knowledge pool is linked with MNE parent firms have been intensively discussed (Gupta and Govindaraja, 1991, 2000; Birkinshaw and Morrison, 1995; Harzing and Noorderhave, 2006). A great attention has paid to the nature of the strategic location (host country) which outward investments target onto, and also the extent to which knowledge flows can be affected by the locality differences (Andersson et al., 2005, 2007; Driffield et al., 2010; Duanmu, 2012; Wang, 2012; Ramasamy, 2012). The location of OFDI has been used to explain the extent of innovation variation across parent firms (Gertler and Levitte, 2005; Duanmu, 2012; Wang, 2012). Local factors embedded in a host country are important in terms of explaining differences in the knowledge base (Lane and Lubatkin, 1998; Ahuja and Katila, 2001; Chadee et al., 2003). By differentiating OFDI locations, we argue that the knowledge pool of a developed economy accommodates the technology need of Chinese OFDI firms (Lane and Lubatkin, 1998). First, investing in developed countries enables EE firms to gain the proximity to advanced technology. With fully embedding in a foreign market, up-to-date technologies become accessible via direct acquiring, various collaborations, and mobility of skilled labours. In such circumstances, locations determine the extent and depth of knowledge acquisition, especially when local firms from host countries are the technological leaders. Second, operating in developed countries allows Chinese firms to overcome the liability of foreignness. They are able to gain more knowledge about the market by directly engaging in the customer networks. Understanding the market preferences and customer needs not only help EE MNEs to conquer the geographical and cultural barriers, but also guide them to design and produce host market-friendly products. In addition, it is commonly recognised that customers are more demanding and sophisticated in developed countries or high income countries than those in emerging markets. Higher requirements from the demand side will also push EE firms to become more innovative in order to compete with local firms. Overall, conducting investment overseas, especially in developed countries, opens a trajectory for Chinese firms to acquire advanced technology and upgrade their innovation capabilities. The linkages that are formed with local firms - supplier, customers or competitors – effectively stimulate knowledge diffusion including technological, managerial, and market knowledge. Therefore, EE firms investing in developed countries will learn more advanced technological and managerial knowledge than those locating in developing countries.

Hypothesis 1a: *Chinese firms’ OFDI in developed countries is positively associated with innovation performance.*

Motivation is central to knowledge learning. Firms with different investment motives may exhibit different levels of learning intent, hence resulting in different levels of innovation performance. Firms with knowledge seeking motives will be more willing and active in tapping into new technologies when operating in a host country and can enhance the impact of OFDI on innovation. If an EE firm is highly motivated to acquire new knowledge or advanced technology possessed by a foreign source, it will be better prepared to learn such knowledge. In other words, cross-border knowledge acquisition is likely to be more effective when EE firms are motivated to learn and seek external knowledge through OFDI. Prior studies (Dunning and Narula, 1996; Cantwell and Jane, 1999) developed a conceptual link between the motivation and technology diffusion of FDI in which the relationship between ‘diversity sourcing’ motives and knowledge spillovers was postulated. Existing studies have shown that knowledge-seeking or strategic-asset seeking is the most important motive for OFDI by EE firms (Luo and Tung, 2007; Lu et al, 2011; Deng, 2009; Yip and Rui, 2009). Motivated by knowledge exploration, EE firms tend to use OFDI as a means of accessing the already existing advanced technology in host countries. However, few studies have examined the link between knowledge-seeking motives and innovation performance. Little is known about the interrelationship between OFDI, knowledge exploration motives and innovation performance. We argue that the underlying knowledge-seeking motives of EE firms affect the effectiveness of knowledge exploration through OFDI (Driffield and Love, 2007). With technology-exploration purpose, firms from emerging countries are expected to be more actively engaged in learning and acquiring advanced technology, managerial capabilities and international brands, etc. We therefore consider the positive moderating effect of knowledge-seeking motives on the relationship between OFDI and innovation performance. This leads to the following hypothesis:

Hypothesis 1b: *the positive impact of OFDI in developed countries on innovation performance will be stronger for firms with knowledge-exploration motives than those without.*

OFDI and in-house innovation in different industries

In-house R&D not only directly causes the divergence of firms’ innovation performance, it also determines the extent to which a firm would benefit from external knowledge sourcing activities (Cohen and Levinthal, 1989). Despite several studies have discovered that in-house R&D and external knowledge sourcing are complementary in helping firms to become successful innovators (Cassiman and Veugelers, 2006; Lokshin et.al., 2008), another group of studies argues that greater expenditures in in-house R&D would inhibit a firm to allocate resources to alternative technology sourcing due to the hard budget constraints (Chesbrough, 2003; Howells et al., 2004; Fu, 2012). The later suggest that there is a substitutive effect between external knowledge sourcing activities and in-house R&D.

Through OFDI, Chinese MNEs are able to access external complementarity technology assets and talents that help parent companies break through the innovation bottleneck and result in greater returns than merely relying on internal efforts (Fu, 2012). However, neither in-house R&D nor acquisitions through OFDI are costless. Although undertaking OFDI stimulates cross-border knowledge flows by bringing parent company external know-how, a considerable investment budget is needed beforehand. Optimising inputs in in-house R&D and OFDI at the same time would become impossible when a firm is facing hard budget constraints. This is particularly true for EE MNEs, such as China. While OFDI may compensate for weak technology capability, there may be a trade-off between investing in-house R&D and undertaking OFDI. In other words, OFDI may be treated as a replacement to in-house R&D as an alternative external technological sourcing (Cantwell, 1989; Chesbrough, 2003). Hence, we propose

Hypothesis 2a: *OFDI in developed countries reduces the importance of the focal firms’ in-house R&D in innovation performance and compensates for firms with weak technological capability.*

Apart from the locality and motives of OFDI, the industry context is another factor affecting the learning behaviour of EE firms. Although a high-tech industry offers followers from EE more knowledge contents to learn in terms of both width and depth compared to low-tech sectors, the complexity of these contents and the existing technology gap between developed countries and EE should not be ignored. The sophistication of technological contents in high-tech industries requires learners to equip with certain level of learning capability such as experiences in relevant industries, qualified R&D personnel and organisational absorptive capacity. Moreover, participating in high-tech competition with technology frontier is a costly process accompanied with lots of uncertainties and risks. Such risky and costly nature of learning in high-tech industry impedes EE firms learning and acquiring knowledge through OFDI.

With less intensive technological contents, knowledge learning behaviours in low-tech sectors are more likely to succeed compare to high-tech sectors where great technological sophistication, heightened competitive intensity, high level of uncertainty are presence (Amadbile, 1997). Such nature of low-tech industries would allow Chinese followers to neutralize the competitive advantages of the leader because technology gap is smaller and catching-up by is easier through investing directly in the external technology. Hence, low-tech firms tend to choose the ‘external sourcing’ strategy as a replacement effort for innovation. We assume that the substitution effect between in-house R&D and external technology sourcing through OFDI will be stronger in low-tech industries than that in high-tech sectors. This leads to the following hypothesis:

Hypothesis 2b: *the substitution effect between OFDI in developed countries and in-house R&D will be stronger for firms operating in low-industries than those in high-tech industries.*

OFDI and exporting experience

Innovation is a cumulative process and depends on the history of individuals or organizations involved (Dosi, 1988; Pavitt, 2005). Prior international experience is needed to understand the tacit components of foreign technology (Desai, 1989; Lall, 1989; Moway and Oxley, 1995). Muehlfeld et al. (2012) stress that the ability to learn through OFDI affiliates influences the extent of knowledge flows. Cross-border knowledge diffusion will not happen automatically due to the inevitable culture barriers and knowledge integration challenges which firms face in their internationalisation process (Kafouros et al., 2012). In this regard, international experience is required to facilitate knowledge learning through OFDI.

From the learning perspective, prior international experience allows firms to improve their understanding and competence in foreign markets, build relational assets and develop foreign market entry capability that helps mitigate information asymmetry and uncertainty associated with OFDI. In addition, learning-by exporting has been widely acknowledged as a mechanism to develop capabilities for partner formation, faster progress (Reuber and Fischer, 1997; Teece, et al., 1997; Zollo and Winter, 2002) and cross cultural adjustment (Takeuchi et al, 2005). Therefore, adequate international experience through exporting will help firms successfully enter an international market and compete with foreign rivals (Wagner, 2007; Ito and Wakasugi, 2007), which implies a complementary effect between prior international experience and OFDI on innovation performance. Meanwhile, by engaging in international production chain through exporting, Chinese firms are able to accumulate technological capability. In addition, such an internationalisation process also helps firms to strengthen international breadth and depth of subsidiary networks that eventually help them to overcome potential barriers. The greater the Chinese firm embedded in global networks the more likely it is to better identify compatible technology source, assimilate and integrate the external knowledge, especially in high-tech industry where tacit knowledge accounts for a large part of the core technology.

Hypothesis 3a: *the positive impact of OFDI in developed countries on innovation performance will be stronger for Chinese firms with previous international experience.*

Hypothesis 3b: *the complementarity between international experience and OFDI in developed countries will be stronger for firms operating in high-tech industries.*

**III. Empirical model**

Innovation performance measured by the ratio of new products to the total sales is explained by several aspects of firm behaviours and characteristics. Our interest here is not so much to re-address the contribution of R&D inputs to innovation performance, which has already been extensively examined in previous studies (Kleinknecht and Mohnen, 2002), but rather to examine the impacts of knowledge exploration OFDI and have a detailed estimation on moderators that are crucial to foster innovation performance through OFDI by Chinese firms. The following equation summarizes our estimations.



 (1)

Innovation performance of firm *i* in year *t* is observed only if strictly positive, as shown in equation (1). Firms’ OFDI properties and R&D expenditures are defined as explanatory variables and a moderator that determine the firms’ new product sales. A set of control variables that captures firm and industry specifics is also included. EXP equals to the ratio of exports to total sales. The motivation of a firm’s investment behaviour is captured by TECH, which takes value 1 if acquiring advanced technology is its underlying motivation. SOE dummy will be given value 1 if states or government holds a firm’s majority (greater than 50 percentages) ownership. Age is calculated by the number of years a firm has been established until 2009. Hitech dummy equals 1 if a firm belongs to High-tech industry[[3]](#footnote-3).  and  are the coefficients for explanatory and firms specific variables. The error term  can be decomposed into three orthogonal components.

 (2)

 indicates the time-invariant individual effects which are unobserved by the econometrician but known to the firms (such as managerial ability or organizational ability). captures the time effects which represent all the unobservable characteristics of time period *t*, constant for all the cross-sectional units in the sample. In addition, is idiosyncratic error that varies over time and individuals. It is assumed that are uncorrelated with past values of the explanatory variables. Having considered the fact that it allows us to keep time-invariant variables, the Random effects model will be adopted in our estimations (Greene, 2003).

Using the locality to explain the heterogeneous innovation performance of Chinese firms, we decompose firms’ OFDI into developed countries and into developing countries.[[4]](#footnote-4) Depd and Depi denotes if a firm’s OFDI destination is investing in a developed or developing economy, respectively. The impact of OFDI on parent firms’ innovation performance may be moderated by factors such as firms’ overseas investment motivation (TECHit), prior experiences (EXPit), in-house R&D intensity(R&Dit) and industrial specificities. The moderating effects of these factors will be shown by the estimated coefficient of interaction terms. A full model is then expanded to

(3)

Removing the time-invariants (such as SOE, Hitech and ω) with fixed effect approach will not affect the consistency of other coefficients in (3) if the specification is a linear relationship and there are no serious correlations between explanatory variables. Yet with the censored observation on the dependent variable, fixed effect is not possible to device a consistent estimator (Maddala, 1987) and therefore this current study chose to adopt a Random Tobit methodology.

**IV Data**

The firm-level data used in the empirical analysis were from Guangdong province in China and collected by Technology and Management Centre for Development, University of Oxford in 2010.[[5]](#footnote-5) Guangdong Province is located on the shore of South China Sea, adjacent to Hong Kong SAR. It shares the largest proportion of China's total economic output. The exports of Guangdong accounted for more than 25% of China's exports[[6]](#footnote-6). In addition, the amount of overseas investment from Guangdong is the largest among all provinces in China. Guangdong oversea investment in 2010 accounted for 19.3% of the stock of China’s OFDI. Hence, it represents an ideal research setting to examine the impact of OFDI on innovation performance.

One unique feature of this dataset is that a series of questions in relation to firms’ internalisation behaviour and strategies were included in the survey. It also covers with a wide range of information about technological activities and innovation performance. After eliminating missing values, we are left with a three years balanced panel, 561 observations from 25 industries for the period of 2007 to 2009.

[Insert Table 1]

Table 1 gives the summary of variables in the empirical estimation. The dependent variable in the innovation equation (1) is measured by the log of sales of new products per employee. Following the existing literature, R&D spending enters the innovation function because of its direct linkage with innovation outputs as well as its indirect effect playing as a moderator. Firms were asked to report their annual in-house R&D expenditures in the survey and the values are transformed in logarithms. Among the full sample, more than 80 percentages of firms recognise themselves as innovator, regardless of being a product, process, or managerial innovator.

The respondents were asked to report information of OFDI, including investment motives and host destinations. Having a list of countries, we differentiate these investment destinations into developed or developing countries based on R&D/GDP ratio[[7]](#footnote-7). The mean values of OFDI\_Depd and OFDI\_Depi, 0.09 and 0.05 respectively shown in Table 1, suggest that Chinese MNEs tend to choose developed nations as their investment market. The descriptive statistics also show that acquiring foreign knowledge to upgrade organizational capability is one of the primary motives of Chinese MNEs.

In addition, a category of firm and industry specifics are captured by a set of control variables. The number of total employees, in logarithm serves as an indicator of the scale. With larger scale of production, firms possess relatively adequate resources and are therefore more likely to invest and succeed in innovation (Katrak, 1997). Ownership may act as a crucial factor to innovation in the case of China, as it affects the motivation to innovate and the continuity of business strategy. State-owned enterprises (SOEs) are usually with large investment subsidies and tax incentives from the government. Yet the effect of SOEs on innovation output is ambiguous, given that they are also characterised as ones that inherited many inefficiencies from the formal central-planned economy and are reluctant to undertake changes. EXP measures the value of exports in total sales. It is believed that firms with prior exporting experience are better in response to foreign customer needs and preferences. Intensive experiences on exporting also help firm to gain and accumulate knowledge about the foreignness of the markets. Positive moderating effects of EXP on new product sales are expected. Age is calculated as the number of years evolved since the enterprise started production, up to 2010. Young firms are in general perceived to be more dynamic and innovative (Katrak, 1997), therefore a negatively affect innovation performance. Innovation activities tend to be relatively more intensive in the technologically more advanced industries, such as pharmaceuticals, electrical equipment, and electronics. Control variable Hi-tech categorise firms which are from high-technology industries. Sector dummies are also included to control for industry specifics. The correlation matrix of variables is presented in table 2.

 [Insert Table 2]

**V. Empirical results**

We now turn to the results of econometric analysis which estimate how OFDI affects the innovation performance of Chinese firms in the presence of several moderators. Given the censored nature of new product sales, the Random Tobit (RM) is adopted as our main estimation method. We have estimated the innovation equation (3) with different specifications based upon different sources of moderating effects: R&D (Model 1), exporting experiences (Model 2) and technology-seeking motivation (Model 3). The full model is presented in Model 4.

Before interpreting the empirical results, several specification issues are worth noting. Firstly, the sample firms operate their investments in either developing or developed countries. The variable OFDI would therefore be dropped out in models where both developing and developed OFDI are present to avoid the perfect multicollinearity. Secondly, the motivation of international operation is not confined to OFDI firms. Answers given by those without overseas investment would be perceived as if they could engage in OFDI. Dummy variable technology-exploration (TECH) therefore enters in the model separately without causing full rank problem. Thirdly, the full model is subject to another potential collinearity due to the presence of a series interaction, which is reflected by substantially high standard errors in sub-sample of Low-tech firms in Table 3 especially for variables containing OFDI\_Depi. Nevertheless, the statistical inferences with respect to other variables in the equation will remain efficient.

Table 3 reports the estimated coefficients and standard errors are include in the parentheses. The results are presented in full sample, as well as dividing into High-tech and Low-tech firms. The significance of correlation coefficients ‘Rho’ at 1 percent throughout all sub-samples suggests that the bias caused by the right censoring natural of new product sales exists and Tobit model generates more consistent results compared to Ordinary Linear Square approach. The lower panel of Tables 3 gives the corresponding conditional marginal effects of selected variables. R&D expenditure, as one of the major source of innovation, is shown to have significant positive impacts on sales of new products. Firms that spend 1 percentage more in R&D have approximate 3.5 - 5.0 percentage-points higher of new product sales. The contribution of R&D to innovation is consistent across all specifications as shown from model 1 to model 4 in Table 3. Similar consistent estimators are found for SOEs, except for the sub sample of high-tech industry. Firms with major state ownership tend to be less innovative compare to firms having other ownership structures, about 11-17 percentage-points lower in the new product sales if a firms is state owned. In accordance with previous studies (Javorcik, 2004; Hou and Mohnen, 2013) this evidence reflects the inefficiency in Chinese SOEs. OFDI motivation determines the level of innovation performance but such effect is only confirmed within firms in the High-tech industries. Despite prior exporting experiences do not directly correlated with a firm’s sales from new products and the coefficients of EXP do not exhibit statistically significant effects, different signs of the estimates appeared across different industry context, positive for High-tech and negative for Low-tech industries. The longer a firm operates the more experiences it would accumulate. Age shows a positive effect across all specifications but the impact on innovation sales are not significant different from younger firms. Similarly, the effects of large-sized firms are statistically the same compared to small-sized ones.

[Insert Table 3]

As a knowledge acquisition channel, OFDI help firm learn and acquire advanced know-how from foreign technological frontiers. Table 4 present the conditional marginal effects of OFDI on new product sales. The marginal effects are computed based on Model 5 in Table 3 with controlling for the interactive effects between OFDI and moderators.[[8]](#footnote-8) Clearly, conducting investments in foreign country stimulate the innovation performance of parent firms. However, such positive effects only confirmed when Chinese firms conduct their OFDI in developed countries (Hypothesis 1a). The marginal effect of having OFDI in developed countries is significant at 0.01 and investing OFDI in developed markets increases almost 10 percentage points of the sales due to the new products holding other factors - the potential moderating effects of R&D, export and motivations - equal. It is also shown that firms operating in high-tech industry have the highest marginal elasticity of R&D. With controlling for its potential moderating effect, the marginal return of R&D to the new product sales in high-tech sectors is about 2.1 percentage points higher than the ones in low-tech sectors. Moreover, Chinese firms in high-tech industries with a technology-exploration motive increases the sales due to new product by 8.5 percentage points, although such significant effects do not hold for other groups. Given the likely collinearity existing between interactions and individual explanatory variables, the effects of EXP and TECH might have been partially captured by the interactions in which EXP and TECH appear. Therefore, the estimated marginal effects are not statistically significant in a sense their role is to moderate the effects of OFDI and indirectly influence the innovation performance of parent firms.

[Insert Table 4]

In spite of the confirmed association between OFDI and innovation performance, the presence of moderators further reinforce the technological sourcing function of OFDI. The moderating effects are captured by the interaction terms in Model 1, Model 2 and Model 3 (Table 3). The estimates of Depd\_OFDI\*R&D are negative with 0.01 significance level in particular for the Low-tech firms which show the lowest magnitude, -0.065. Other two moderators, investment motives and exporting experience, display positive moderating effects to the OFDI conducting in developed countries. Nevertheless, these effects only appear in the sample of High-tech firms while the estimates for Low-tech group are positive but not statistically significant. Throughout all specification, there are no moderating effects observed from OFDI locating in developing countries.

**VI. Discussion**

By means of quantitative analysis on the outcome of potential innovation gains, our results suggest that participating in OFDI would enable Chinese firms to enlarge their knowledge base and resource pool and lead to the improvement of innovation performance. It is also revealed that OFDI operating in developed countries is likely to lead to a higher level of new product sales. Through forming various linkages with technological frontiers in the advanced countries, Chinese MNEs can acquire intangible knowledge such as efficient managerial skills and market strategies which would consequently contribute to the technological capabilities and innovation performance of the focal firms (Kyriakopoulos and Moorman, 2004). We have obtained evidence which suggests that adopted as a catch up strategy by Chinese firms, OFDI in developed countries enables Chinese firms to acquire advanced know-how and reinforce their innovativeness.

*The role of OFDI in explaining innovation: do host countries and motives matter?*

The significant sign of OFDI\_Depd in Table 3 verified hypothesis 1 that a positive association between Chinese firms’ OFDI in developed countries and their innovation performance.[[9]](#footnote-9) Host countries matter in a sense they provide different knowledge bases for EE firms to learn and acquire. By means of directly operating in developed countries, EE MNEs are expected to gain the proximity advantages that help them overcome foreignness barriers, understand the customer needs and establish various linkages with technology leaders. Closer to leaders also allow EE followers access to other strategic resources such as technology information and skilled engineers. Knowledge pool in a developing country is relatively smaller compared to developed ones, therefore cannot provide EE MNEs better environment to learn and innovate. Although there may exist some competition effect in the developing market which push MNEs to innovation, our findings do not show such effect. In consistent with previous studies (e.g. Lane and Lubatkin, 1998), our results indicate that countries with a higher R&D in GDP ratio are able to provide the technology needs of Chinese followers (Lane and Lubatkin, 1998).

The underlying motives are recognized as an important factor affecting the effectiveness of OFDI location on innovation performance. Firms with strong and clear investment motives arrive at foreign markets with high levels of willingness to learn. Despite it is only significant among High-tech sectors, Chinese firms with knowledge seeking motives perform better regarding new products. Meanwhile, as shown from the coefficient of interaction term ‘OFDI\_Depd\*Tech’ in Model 3 for the full sample, technology-exploration motivation tends to further strengthen the positive association of OFDI in developed countries and innovation intensity of parent firms. Knowledge exploration motives encourage them tapping into new technologies while operating in developed countries and eventually enhance the impact of OFDI on innovation. Thus, the positive impact of OFDI in developed countries on innovation performance will be stronger for firms with a knowledge exploration motive of OFDI than those without as proposed in Hypothesis 1b.

*R&D and OFDI: is there a substitution?*

When OFDI is interacted with the R&D intensity of Chinese firms, negative moderating effects appeared and it indicates that higher expenditures of in-house R&D reduce the innovation gains in associate with OFDI. Nevertheless, the negative moderator role of R&D does not alter its function as one of the direct inputs that stimulate the new product sales. Coefficient-wise (OFDI\_Depd\*R&D), it can also be understood as a substitutive relationship in which OFDI is to compensate for firms with weak internal technological capability. OFDI brings Chinese MNEs foreign technology asses, but it is does not come without cost. On contrary, OFDI usually needs firms to be able to afford a considerable amount of investment fund beforehand. For EE MNEs, lack of enough financial resources is a common case and optimising inputs in in-house R&D and OFDI would be difficult to achieve. With severe hard budget constraints, Chinese MNEs may acquire foreign technologies through OFDI to compensate for the weak internal technological capability (Fu, 2012). Hence the positive effect of OFDI invested in developed countries reduces the importance of the focal firm’s technological capability in innovation performance (Hypothesis 2a).

The complex technological contents of High-tech industry and the inevitable technology gaps between EE and developed countries have impede the Chinese followers to learn from technological leaders in the same industry. Followers in these industries have to undertake high risks and uncertainties and therefore less likely to succeed (Amadbile, 1997). In the event of learning in Low-tech industries, Chinese MNEs are allowed to neutralize the competitive advantages of the leader because technology gap is smaller and catching-up is easier. This explains why the right panel of Table 3 compares the estimations with high-tech and low-tech sectors in which the interaction term ‘OFDI\_Depd\*R&D’ is only significant for high-tech sector firms. This evidence confirms hypothesis 2b that the substitution effect between OFDI in developed countries and in-house R&D will be stronger for firms operating in high-tech industries than those in low-tech industries.

*Previous exporting experience and OFDI: the presence of positive moderating effects*

The capacity of purposefully assimilate the acquired knowledge will depend on the prior international experiences of the investing firms. In line with previous studies (Wagner, 2007; Ito and Wakasugi, 2007), exporting experiences help Chinese firms accumulation adequate international experience that ensure successfully enter an international market and compete with foreign rivals. The finding has revealed a complementarity between export and OFDI operating in developed countries, implying that previous international experience enhances the positive impact of OFDI investing in developed countries (Hypothesis 3a). Internationalisation via exporting strengthens the breadth and depth of subsidiary networks that eventually help them to overcome potential cross-border investment barriers. The greater the Chinese firm engaged in global value chain the more likely it is to better identify, assimilate and integrate the knowledge flowing via OFDI. In addition, it is observed that the complementary effect between OFDI and EXP is more profound for the Chinese firms in a high-tech industry where tacit knowledge accounts for a large part of the core technology (Hypothesis 3b).

*Robustness check[[10]](#footnote-10)*

Although the random methodology has taken into account the potential bias urged by random components in the errors, the possible endogeneity induced by the unobserved factors existing in the error term may also cause inconsistencies. We tried to employ fixed effect method to correct the endogenous bias caused by the time-invariants. After deriving the mean deviations of variables to be estimated, observed time-invariants such as SOEs and Hitech are cancelled out in the objective function.

[Insert Table 5]

Table 5 tabulates the estimation results of controlling for the individual fixed components, which is equivalent to removein equation (2). In general, the results are consistent with the Random Tobit models. R&D as a critical source of innovation contributes consistently to the new product sales of Chinese firms. Similar to the results in Table 4, the estimates for OFDI\_Depd is statistically significant at 10 percent level, which again proves that having OFDI operating in developed nations fosters the new product sales of parent firms in China. Also, there is a scale effect shown for the full sample and firms in high-tech industries. Technology-seeking motivation positively links to the innovation outcome of Chinese firms, while the replacement effect of R&D appears only in the sub sample of high-tech industries. The complementary effect between OFDI and prior international experiences disappeared in the fixed effect results. One possible explanation attributes to the limited variation of the mean deviation that has been used in the fixed effects specification, which as a consequence could reduce the explanatory power of variables.

**VII. Final remarks**

While existing research on OFDI from emerging economies has identified that knowledge exploration is one of the most important investment motives, a few studies have examined whether such motive and under what conditions OFDI contributes to innovation performance. Little attention has placed on the contextual factors which affects the effectiveness of OFDI. Using panel data for a sample of Chinese firms in Guangdong Province, this study identifies the moderating role of contextual factors, and examines their impact on the association between OFDI and innovation performance of parent firms. Specifically, we link the impact of OFDI to firm and industry characteristics. The findings suggest that apart from locality concern, several factors exhibit moderating impact of OFDI on the innovation performance of Chinese firms. First, different motivations shape the adoption of different investment strategies and innovation path that a firm would eventually follow. With explicit technology-exploration purpose, firms are likely to be more effective in deploying resources and thereby induce a higher likelihood of technology learning and cross-country technology transfer than firms with other motives. Meanwhile, being knowledge-exploring tends to strengthen the positive effect of OFDI invested in developed countries on innovation intensity of investing firms. Second, although it is has directly contributed to new product sales, greater expenditures in internal R&D would inhibit a firm to allocate resources to alternative technology sourcing due to the inevitable hard budget constraints. Unlike the firms in developed economies, Chinese firms often lack sufficient financial sources to invest in innovation. Most of them are unable to participate in multiple innovation acquisition activities. Investing in R&D or OFDI would be considered as substitutive strategies rather than complementary. In addition, a complementary relationship is observed between export intensity and OFDI. With a series of constraints such as culture differences, adaptation difficulties and capacity limits, Chinese firms need to firstly gain internationalization experiences to ensure the success of foreign operations. Prior exporting experiences have equipped firms with the necessary abilities to overcome the potential barriers, while OFDI here is interpreted in two ways: widening up the international technological acquisition channels for Chinese firms and, at the same time, facilitating them to accumulate international experiences that reinforce the contribution of OFDI to innovation.

The findings of our research have important policy implications. We suggest that governments should develop more effective industry and innovation policies in directing firms to acquire advanced technology from developed countries. Policies may also need to be more fine-grained in terms of the countries and industries for which EE firms are able to boost innovation through international knowledge flows. Further consideration should be given to the extent to which bilateral agreements between home and developed host country governments can facilitate cross-border knowledge diffusion. From a managerial perspective, the strength of this research lies in helping MNEs originally from emerging countries to better understand the contextual factors in influencing the cross-border technology flows. In particular, our findings help managers of EE MNEs understand the conditions necessary to achieve knowledge exploration motives and show that investment destinations and industry context are important contingency factors for latecomers to catch up through engaging OFDI. Hence, managers should carefully evaluate contextual factors when making investment decisions.

Due to the fact that the current research is based on a short panel covering only three years, the lag effects of R&D and other determinants, such as the OFDI impact, to innovation cannot be controlled efficiently. Therefore, a longer period panel would be more ideal to produce more consistent findings in investigation of OFDI and innovation. Also with a long period observation would allow us to apply more comprehensive econometric methods such as dynamic analysis to address the path-dependent nature of innovation process. Another limitation of the current research lies in the limited number of OFDI firms in our sample, especially those conducting investment in developing countries. OFDI firms in our sample invest in either developed or developing countries. We have not been able to cover MNEs that carry out cross-border investment in both developed and developing countries. Including firms with geographically broader investment behaviours would provide more comprehensive insights and implications for policy-making.

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Table 1. Summary of variables

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **Definition** | **Mean** | **Std. Dev.** |
| **Dependent variable** |  |  |  |
| Inno | New product sales/total sales | 0.230 | 0.325 |
| Inno Dum | Value 1 if a firms is an innovator | 0.836 | 0.371 |
| **Explanatory variable** |  |  |  |
| OFDI | Value 1 if a firm has OFDI investment | 0.143 | 0.350 |
| Depd\_OFDI | Value 1 if a firm’s OFDI operates in developed countries, 0 otherwise. | 0.085 | 0.278 |
| Depi\_OFDI | Value 1 if a firm’s OFDI operates in developing countries, 0 otherwise. | 0.053 | 0.244 |
| **Moderators** |  |  |  |
| R&D | Annual R&D expenditure, in log | 3.297 | 3.288 |
| EXP  | Ratio of export in total sales | 0.077 | 0.189 |
| TECH | Value 1 if a firm’s OFDI motivation is knowledge-exploration, 0 otherwise  | 0.108 | 0.310 |
|  |  |  |  |
| **Control variables** |  |  |  |
| SOEs | Value 1 if a firm is state-owned, 0 otherwise.  | 0.069 | 0.253 |
| Age | The age of a firm, in years | 13.328 | 8.542 |
| Scale | Number of total employees, in log | 5.561 | 2.010 |
| Group | Value 1 if a firm is part of a group company, 0 otherwise | 0.243 | 0.430 |
| Hitech | Value 1 if a firm is in high-tech or intermediate-tech industries | 0.265 | 0.441 |
| Sector Dum | Sector dummies | included |
| No. observations | Total number of observation, 3 years | 567 (pooled) |

Table 2 correlations between OFDI and innovativeness

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **OFDI DUM** | **Depd\_OFDI** | **Depi\_OFDI** | **R&D** | **EXP** | **TECH** | **SOE** | **Age** | **Scale** | **Hitech** |
| OFDI Dum | 1.000 |  |  |  |  |  |  |  |  |  |
| OFDI\_Depd | 0.745 | 1.000 |  |  |  |  |  |  |  |  |
| OFDI\_Depi | 0.579 | -0.072 | 1.000 |  |  |  |  |  |  |  |
| R&D | 0.165 | 0.237 | -0.054 | 1.000 |  |  |  |  |  |  |
| EXP | 0.020 | -0.059 | 0.022 | -0.175 | 1.000 |  |  |  |  |  |
| TECH | 0.075 | 0.088 | 0.029 | 0.004 | -0.077 | 1.000 |  |  |  |  |
| SOE | 0.188 | 0.143 | 0.123 | 0.153 | -0.091 | 0.054 | 1.000 |  |  |  |
| Age | 0.071 | 0.037 | 0.068 | 0.163 | -0.112 | 0.103 | 0.482 | 1.000 |  |  |
| Scale | 0.170 | 0.118 | 0.124 | 0.354 | -0.032 | 0.006 | 0.259 | 0.315 | 1.000 |  |
| Hitech | 0.134 | 0.123 | 0.075 | 0.188 | -0.065 | 0.090 | 0.108 | 0.019 | -0.004 | 1.000 |

Table 3 Random Tobit estimation results

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Full Sample** | **High-tech Firms** | **Low -tech Firms** |
|  **VARIABLES** | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 1** | **Model 2** | **Model 3** | **Model 4** | **Model 1** | **Model 2** | **Model 3** | **Model 4** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| R&D | 0.111\*\*\* | 0.102\*\*\* | 0.101\*\*\* | 0.110\*\*\* | 0.121\*\*\* | 0.114\*\*\* | 0.112\*\*\* | 0.120\*\*\* | 0.107\*\*\* | 0.097\*\*\* | 0.096\*\*\* | 0.106\*\*\* |
|  | (0.009) | (0.008) | (0.008) | (0.008) | (0.014) | (0.014) | (0.013) | (0.014) | (0.011) | (0.010) | (0.010) | (0.011) |
| EXP | 0.026 | 0.011 | 0.022 | 0.024 | 0.150 | 0.098 | 0.130 | 0.123 | 0.000 | -0.007 | -0.005 | -0.001 |
|  | (0.108) | (0.108) | (0.107) | (0.108) | (0.243) | (0.259) | (0.235) | (0.259) | (0.125) | (0.126) | (0.124) | (0.124) |
| TECH | 0.052 | 0.058 | 0.037 | 0.023 | 0.195\*\* | 0.192\*\* | 0.168\* | 0.137 | -0.026 | -0.014 | -0.023 | -0.022 |
|  | (0.061) | (0.061) | (0.062) | (0.062) | (0.098) | (0.095) | (0.097) | (0.098) | (0.080) | (0.080) | (0.082) | (0.082) |
| SOEs | -0.350\*\* | -0.391\*\* | -0.372\*\* | -0.337\*\* | -0.254 | -0.279 | -0.262 | -0.230 | -0.583\*\* | -0.549\* | -0.558\* | -0.595\*\* |
|  | (0.155) | (0.155) | (0.155) | (0.154) | (0.204) | (0.180) | (0.181) | (0.201) | (0.292) | (0.309) | (0.311) | (0.293) |
| Age | 0.004 | 0.005 | 0.005 | 0.004 | 0.001 | 0.001 | 0.001 | 0.001 | 0.008 | 0.008 | 0.009 | 0.009 |
|  | (0.004) | (0.004) | (0.004) | (0.004) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.005) | (0.006) | (0.006) |
| Scale | -0.010 | -0.005 | -0.004 | -0.009 | -0.014 | -0.009 | -0.008 | -0.013 | -0.010 | -0.005 | -0.003 | -0.008 |
|  | (0.010) | (0.009) | (0.009) | (0.010) | (0.013) | (0.012) | (0.012) | (0.013) | (0.015) | (0.015) | (0.015) | (0.015) |
| Hi-tech | 0.052 | 0.063 | 0.072 | 0.054 |  |  |  |  |  |  |  |  |
|  | (0.066) | (0.065) | (0.065) | (0.065) |  |  |  |  |  |  |  |  |
| Depd\_OFDI | 0.470\*\*\* | 0.047 | -0.033 | 0.291\* | 0.334\* | -0.042 | -0.146 | 0.185 | 0.601\*\*\* | 0.176 | 0.105 | 0.531\*\* |
|  | (0.123) | (0.075) | (0.093) | (0.167) | (0.184) | (0.088) | (0.123) | (0.245) | (0.173) | (0.131) | (0.143) | (0.247) |
| Depi\_OFDI | 0.227\* | -0.010 | 0.051 | 0.022 | 0.260 | -0.023 | 0.107 | -0.060 | -0.015 | 0.026 | -0.001 | 0.151 |
|  | (0.128) | (0.091) | (0.107) | (0.224) | (0.168) | (0.114) | (0.161) | (0.289) | (0.256) | (0.250) | (0.150) | (0.313) |
| Depd\_OFDI\*R&D | -0.052\*\*\* |  |  | -0.049\*\*\* | -0.044\*\* |  |  | -0.045\* | -0.065\*\* |  |  | -0.062\*\* |
|  | (0.016) |  |  | (0.018) | (0.023) |  |  | (0.027) | (0.025) |  |  | (0.026) |
| Depi\_OFDI\*R&D | -0.026 |  |  | 0.000 | -0.012 |  |  | 0.018 | -0.002 |  |  | -0.026 |
|  | (0.027) |  |  | (0.037) | (0.044) |  |  | (0.053) | (0.045) |  |  | (1.200) |
| Depd\_OFDI\*EXP |  | 1.975\* |  | 0.867 |  | 2.761\* |  | 1.524 |  | 0.685 |  | -0.162 |
|  |  | (1.081) |  | (1.124) |  | (1.657) |  | (1.784) |  | (1.672) |  | (1.686) |
| Depi\_OFDI\*EXP |  | 1.594 |  | 1.083 |  | 1.848 |  | 1.321 |  | -69.019 |  | -3.259 |
|  |  | (2.382) |  | (2.466) |  | (2.344) |  | (2.928) |  | (363.523) |  | (10,504.462) |
| Depd\_OFDI\*TEC |  |  | 0.275\*\* | 0.209\* |  |  | 0.288\* | 0.248 |  |  | 0.177 | 0.101 |
|  |  |  | (0.123) | (0.124) |  |  | (0.170) | (0.167) |  |  | (0.182) | (0.185) |
| Depi\_OFDI\*TEC |  |  | -0.048 | 0.233 |  |  | -0.085 | 0.341 |  |  | -2.108 | -1.715 |
|  |  |  | (0.166) | (0.267) |  |  | (0.203) | (0.341) |  |  | (1,281.874) | (222.883) |
| Constant | -0.744\*\* | -0.711\*\*\* | -0.690\*\*\* | -0.748\*\* | -0.427\*\*\* | -0.409\*\*\* | -0.381\*\*\* | -0.395\*\*\* | -0.701\*\*\* | -0.710\*\*\* | -0.675\*\*\* | -0.680\*\*\* |
|  | (0.299) | (0.273) | (0.251) | (0.306) | (0.115) | (0.110) | (0.111) | (0.114) | (0.256) | (0.255) | (0.235) | (0.246) |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| Rho | 0.895\*\*\* | 0.896\*\*\* | 0.892\*\*\* | 0.893\*\*\* | 0.922\*\*\* | 0.923\*\*\* | 0.918\*\*\* | 0.921\*\*\* | 0.879\*\*\* | 0.880\*\*\* | 0.877\*\*\* | 0.880\*\*\* |
|  | (0.017) | (0.017) | 0.018 | 0.018 | (0.021) | (0.021) | (0.022) | (0.022) | (0.026) | (0.026) | (0.027) | (0.026) |
| **Marginal effects** |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| R&D[[11]](#footnote-11) | 0.035\*\*\* | 0.038\*\*\* | 0.035\*\*\* | 0.038\*\*\* | 0.047\*\*\* | 0.050\*\*\* | 0.048\*\*\* | 0.050\*\*\* | 0.030\*\*\* | 0.032\*\*\* | 0.029\*\*\* | 0.031\*\*\* |
|  | (0.003) | (0.003) | (0.003) | (0.003) | (0.007) | (0.008) | (0.007) | (0.008) | (0.004) | (0.004) | (0.005) | (0.004) |
| SOE | -0.144\*\*\* | -0.121\*\* | -0.138\*\*\* | -0.119\*\* | -0.142\* | -0.117 | -0.136\* | -0.124 | -0.171\* | -0.180\*\* | -0.166\* | -0.174\* |
|  | (0.054) | (0.054) | (0.053) | (0.054) | (0.084) | (0.091) | (0.082) | (0.091) | (0.092) | (0.087) | (0.094) | (0.092) |
| OFDI |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| Observations | 567 | 567 | 567 | 567 | 198 | 198 | 198 | 198 | 369 | 369 | 369 | 369 |
| Number of id | 189 | 189 | 189 | 189 | 66 | 66 | 66 | 66 | 123 | 123 | 123 | 123 |

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The standard errors for marginal effects computed by using Delta method

Table 4 Conditional marginal effects with controlling for the interactive effects in Model 5, at the means values

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Full** | **Hitech** | **Low-tech** |
|  | **Coef.** | **Std. Err.** | **Coef.** | **Std. Err.** | **Coef.** | **Std. Err.** |
|  |  |  |  |  |  |  |
| R&D | 0.037\*\*\* | 0.003 | 0.050\*\*\* | 0.007 | 0.029\*\*\* | 0.07 |
| Export | 0.053 | 0.066 | 0.184 | 0.176 | -0.041 | 123.365 |
| Tech | 0.018 | 0.021 | 0.085\*\* | 0.042 | -0.025 | 2.511 |
| Developed | 0.100\*\*\* | 0.032 | 0.093\* | 0.056 | 0.110\*\* | 0.050 |
| Developing  | 0.072 | 0.064 | 0.116 | 0.083 | -0.261 | 242.252 |

Standard errors in parentheses and computed with Delta method

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 5 Robustness check: marginal effects with fixed effects estimation, at the mean (same specification as Model 5 in Table 3)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Full** | **Hitech** | **Low-tech** |
|  | **Coef.** | **Std. Err.** | **Coef.** | **Std. Err.** | **Coef.** | **Std. Err.** |
| R&D[[12]](#footnote-12) | 0.059\*\*\* | 0.007 | 0.063\*\*\* | 0.012 | 0.059\*\*\* | 0.009 |
| OFDI | 0.049 | 0.035 | -0.005 | 0.049 | 0.094\* | 0.049 |
| Depd\_OFDI\*R&D | -0.018 | 0.012 | -0.064\* | 0.034 | -0.018 | 0.018 |
| Depd\_OFDI\*Exp | 0.224 | 0.881 | 1.320 | 3.122 | -1.112 | 1.084 |
| Depd\_OFDI\*Tech | 0.216\*\* | 0.095 | 0.086 | 0.156 | 0.334\*\*\* | 0.123 |
|  |  |  |  |  |  |  |
| R&D | 0.057\*\*\* | 0.007 | 0.058\*\*\* | 0.014 | 0.058\*\*\* | 0.008 |
| Export | 0.092 | 0.136 | 0.265 | 0.521 | -0.017 | 0.262 |
| Tech | 0.026\*\* | 0.011 | 0.065\* | 0.035 | 0.020\*\*\* | 0.007 |
| Developed | 0.153\*\* | 0.072 | 0.299 | 0.206 | 0.131 | 0.092 |
| Developing  | -0.018 | 0.103 | 0.297 | 0.211 | -0.019 | 0.504 |

Standard errors in parentheses and computed with Delta method

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

1. Data source: National Bureau of statistics of China. http://data.stats.gov.cn/index. [↑](#footnote-ref-1)
2. Values of R&D spending in GDP ratio for China are obtained from China Statistical Yearbook on Science and Technology, National Bureau Statistics of China (2009) while corresponding values for OECD countries are obtained from OECD science and technology database (2009). [↑](#footnote-ref-2)
3. The classification of High-tech industry is based on OCED ISIC Rev. 3 Technology Intensity Definition [↑](#footnote-ref-3)
4. The classification of developed and developing countries here is based on the R&D spending in GDP ratio of the host country. One will be accounted as developed country if the R&D by GDP is above 1 percentage, otherwise will be classified as a developing country. The reason of using R&D in GDP ratio here is to try to focus more on the knowledge spillover potentials of a destination country rather than merely relying on the income-level of a country. Investing in technology intensive economy accommodates relatively larger-sized knowledge pool for Chinese MNEs to learn and assimilate. Although income level is in the upper rank, the potential of technology learning would be limited if one country’s growth is based a resource-driven model, such as countries in the Middle East. There are several cases which firms invest in multiple markets. However, these destinations always fall into the same category based on the developed/developing nation classification criteria given in footnote 4. [↑](#footnote-ref-4)
5. The implementation of the survey received tremendously supports from Guangdong Commission of Foreign Trade & Economic Cooperation as well as the Guangdong Research Institute for International Strategies. [↑](#footnote-ref-5)
6. China Statistical Yearbook 2010, National Bureau of Statistics of China. http://www.stats.gov.cn [↑](#footnote-ref-6)
7. Given that some developed economies are resources-based growth, it is more rational to divide OFDI hosting countries by their R&D/GDP ratio, which is particularly relevant for technology exploration OFDI. [↑](#footnote-ref-7)
8. The marginal effects of explanatory variables on the new product sales are calculated at the corresponding means conditional on the uncensored sample, with taking into account the moderating effects of R&D, export and technology motivation. In horizontal row 2 - 4 we report the conditional marginal effects of R&D, Depd\_OFDI and Depi\_OFDI. For example, when computing the marginal effects of R&D, we take into account all the terms where R&D appears, including R&D, Depd\_OFDI\*R&D and Depi\_OFDI\*R&D. In the horizontal row below Full model, the conditional marginal effect of Depd\_OFDI will take into account four terms simultaneously, which are Depd\_OFDI, Depd\_OFDI\*R&D, Depd\_OFDI\*Export and Depd\_OFDI\*Tech. Standard Errors are computed using the Delta method. [↑](#footnote-ref-8)
9. The exact marginal effect of Depd\_OFDI cannot be told by looking at the estimated coefficient of Depd\_OFDI alone. The interactive effect of Depd\_OFDI with other factors in the model should also be considered. The computation of the marginal effects is explained in the previous section. [↑](#footnote-ref-9)
10. Fixed effects estimations are computed based on Model 5 in Table 5 and Table 6. [↑](#footnote-ref-10)
11. Marginal effects of R&D here are calculated without taking into account the interaction terms. [↑](#footnote-ref-11)
12. Marginal effects of R&D here are calculated without taking into account the interaction terms. [↑](#footnote-ref-12)