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Export Activity, R&D Investment And Foreign Ownership: Does It Matter For Productivity?

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Abstract

Purpose: The paper examines the impact of export activity on productivity and how this effect is moderated by R&D investment and foreign ownership.

Design/methodology/approach: A time-lag effect is taken into account when examining the proposed model. Data are collected from the Annual Industrial Survey of the National Bureau of Statistics of China. A dataset containing 117,340 firms across the sample period (2001-2007) are used to test the hypotheses.

Findings: The results indicate that while R&D investment plays a significant role in strengthening the positive effect of levels of export activity on a firm's productivity, foreign ownership surprisingly has a negative moderating role.

Originality/value: Scholarly interest in the links between export activity and productivity is on the rise. However, the bulk of research has been focused on understanding the effects of export activity on productivity at the country or industry level. Little has been done at the firm-level. Another gap in the literature is that the mechanism through which the impact of export activity can be leveraged to enhance the firm's productivity has been largely ignored. To address these issues, the study adopts the learning-by-exporting theory to examine the relationship between export and productivity at the firm-level and how R&D investment and foreign ownership may explain how learning can be leveraged to enhance the firm's productivity. Finally, these relationships are examined in the context of firms from an emerging market, China, which is especially relevant for the learning-by-exporting argument used in this study.

Export Activity, R&D Investment, and Foreign Ownership: Does it Matter for Productivity?

1. INTRODUCTION

The trend toward globalization combined with the increasing competition at home and/or limited domestic market opportunities has motivated many firms to start exporting. In addition, firms are often encouraged by policy-makers to export with the hope that the productivity of these firms will improve because of their exposure to export markets. Hence, as a growing number of firms have become more internationalized, it is important to understand how the export activities of the firm can influence its productivity. It has been argued that through exporting, firms are believed to be in a better position to "acquire knowledge of new production methods, inputs, and product designs from their international contacts, and this learning results in higher productivity for exporters relative to their more insulated domestic counterparts" (Aw, Chung, & Roberts, 2000), p. 65). Not surprisingly, various studies have investigated the relationship between exporting and productivity (De Loecker, 2007; García, Avella, & Fernández, 2012; Girma, Greenaway, & Kneller, 2004; Love & Roper, 2015; Love & Mansury, 2009; Suominen & Volpe Martincus, 2013; Thangavelu & Rajaguru, 2004). However, results seem to be inconclusive and sometimes even contradictory on whether higher levels of export activity (i.e., involvement in export operations in terms of export sales) result in higher levels of productivity (Girma et al., 2004; Wagner, 2007).

In this study productivity refers to the technology or production efficiency of a firm (Tse, Yu, & Zhu, 2017). Despite the fact that there has been no empirical consensus on this issue, the promise of productivity being boosted through exporting has strong implications for academics, practitioners, and policy-makers. In fact, this belief that export activity has a positive impact

on productivity is often cited as a key argument for governments to support and fund export promotion programs.

Research on the relationship between export and productivity has been linked to the self-selection and learning argument. The self-selection argument suggests that the reason why exporting firms exhibit higher levels of productivity is precisely because they are more productive and competitive from the outset, and therefore more capable of exporting (Wagner, 2007). On the other hand, the learning-by-exporting theory suggests that exporting firms become more productive as they learn from their international experience (Min & Smyth, 2014; Tse et al., 2017). Evidence from various studies seems to suggest that this is primarily due to the knowledge acquired from foreign markets (Rodriguez, 2009; Salomon & Shaver, 2005), stronger foreign competitors (Martins & Yang, 2009; Van Biesebroeck, 2005), and innovative technologies (Aw & Hwang, 1995; Vendrell-Herrero, Gomes, Mellahi, & Child, 2017).

While the self-selection argument has been widely used by economists, it has been questioned in the international business/marketing literature. This is particularly the case when focusing on firm's from emerging markets. It has been stressed that firms' from emerging markets face different challenges when internationalizing and that it is important to take these into account when developing theoretical frameworks (Aguzzoli, Lengler, Sousa, & Benito, 2020; Boso, Debrah, & Amankwah-Amoah, 2018; Kotabe & Kothari, 2016; Vendrell-Herrero, Darko, & Ghauri, 2019). For instance, Gomes, Vendrell-Herrero, Mellahi, Angwin, and Sousa (2018) find that the applicability of the self-selection theory to less developed economies is lower because these countries tend to exhibit higher levels of institutional voids/instability and corruption.

The literature, therefore, is characterized by these two different views regarding the relationship between export and productivity as well as by conflicting and inconclusive

findings. Not surprisingly, even the international economics literature highlights that the actual direction between exporting and productivity remain unclear (Golovko & Valentini, 2014) particularly in the context of an emerging market. Although the benefits of exporting for firms' competitiveness have been recognized (Alvarado, Lafuente, & Mora-Esquivel, 2019; Chen, Sousa, & He, 2016; Li, Liu, & Bustinza, 2019; Navarro-García, 2016), most empirical research examining the link between exporting and productivity have done so at the country or industry level. So far, little research has been done to investigate this issue at the firm-level (Tse et al., 2017), which gives rise to our first objective: to explore the link between exporting and productivity at the firm level in a context of emerging market firms. This leads to the first research question:

RQ1: Considering the firm level, what is the relationship between export activity and productivity in a context of emerging market firms?

Another gap in the literature is that most studies in the literature have largely ignored the mechanism through which this 'learning' can be leveraged to enhance a firm's productivity. This lack of knowledge on possible moderating effects limits our understanding on how a firm's productivity increases due to export activities. The need to include moderating effects to examine the link between exporting and productivity is also consistent with the learning-by-exporting theory. This theory emphasizes the importance of acquisition and conversion of knowledge acquired from the firm's export activities. Studies that examine only the direct link between exporting and productivity provide a misleading and overly simplistic view of the relationship (Tse et al., 2017). Hence, a key gap in the literature that needs to be examined is how can the learning effects be enhanced to improve the firm's productivity.

In this context, reports in the popular press have often highlighted the importance of foreign ownership and investment in R&D to increase the firm's competitiveness and productivity. For instance, it has been well documented that the Chinese government reverted its policies in order to attract foreign investors and ownership that allows the local firms to learn from their foreign counterparts and further accelerate the pace of introducing advanced technologies from abroad (Girma, Gong, Görg, Lancheros, & Krieger-Boden, 2015). Reports have also highlighted the key importance of R&D investment to boost productivity, particularly in today's environment as we suffer the economic shocks of COVID-19 (Baily, 2020). Hence, R&D investment and foreign ownership are predicted to play a crucial role to enhance the firm's productivity.

For the firm to be able to enhance these learning effects, it needs to invest in R&D so it can capitalize on knowledge acquisition by helping the firm with the assimilation and conversion of existing and new knowledge. R&D investment (i.e., the extent to which the firm invests in R&D activities to develop new processes and products) is therefore one of the most fundamental strategic actions a firm can undertake in order to compete in an increasingly globalized and competitive environment. A firm without appropriate R&D investment not only limits its capability to develop new processes and products but also restricts its capability to absorb new knowledge (Cohen & Levinthal, 1990; Oh & Barker III, 2018). This is also consistent with the organizational learning perspective, which acknowledges the firm's need for possessing a high level of absorptive capacity to exploit externally generated knowledge and to be able to enhance learning (Kotabe, Jiang, & Murray, 2011; Sousa, Li, & He, 2020).

Foreign ownership (i.e., the ratio between foreign capital and total capital) is another construct suggested to play a crucial role in enhancing these learning effects and which is also consistent with the organizational learning perspective. Foreign owners can help firms to benefit from access to technical and managerial expertise as well as exposure to a broad array of diversified knowledge (Calabrò, Torchia, Pukall, & Mussolino, 2013; Gaur & Delios, 2015). It can

influence managerial practices to be more open to change, better utilize resources, and improve personal skills to improve the firm's competitiveness. While the growth in the firm's export activity increases the knowledge base, it may also lead to difficulty in absorbing such external knowledge (Yeoh, 2004). Foreign ownership can help firms understand and decode foreign knowledge more quickly as well as identify the types of foreign knowledge that can best complement the firm's internal efforts. As such, we investigate how this learning effect can be enhanced through the moderating roles of R&D investment and foreign ownership. Thus, the second research question addressed is:

RQ2: How do the moderating roles of R&D investment and foreign ownership affect the link between export activity and productivity?

By addressing these two research questions, the study provides the following contributions to the literature. First, we address the need for more theoretical and empirical work on the interplay between exporting and productivity. We develop our conceptual model and hypotheses by adopting the arguments in the learning-by-exporting literature. To check the direction of the causality and to be consistent with the learning argument that exports lead to productivity, we draw a causal inference by taking a time-lag effect into account. In particular, we lag the independent variable, moderating variables, and control variables one year to the dependent variable (i.e. productivity). By doing so, we examine how the previous export activities (at time *t-1*) affect the current firm productivity (at time *t*). Moreover, past studies have focused on examining the link between export activity and productivity at the country or industry level (Tse et al., 2017), which has been criticized, as these findings may not be adequate in guiding a firm's strategies (Salomon & Shaver, 2005). This study, therefore,

examines this issue at the firm-level, thereby providing more accurate and relevant information for the firm's strategic decision-making process.

Second, we examine the moderating effects of constructs, which can enhance this learning effect of exporting on productivity. By doing so, we examine how this learning can be stimulated. While prior research has tended to examine the effect directly (Araújo & Salerno, 2015; Moen, Benum, & Gjærum, 2018), we argue that knowledge acquisition via learning-by exporting is a necessary but insufficient condition for learning to take place. From an organizational learning perspective, firms need to have the ability to exploit this externally generated knowledge for learning to take place (Aguilera, 2007; Zahra & George, 2002). As a result, our aim is to go beyond the direct link effect of learning-by exporting and go one-step further in uncovering the underlying process of how this learning can be leveraged in order to further stimulate the impact of export activities on productivity. Specifically, we postulate that a firm's productivity can be enhanced through the moderating roles of R&D investment and foreign ownership. Moreover, analysing these relationships in a longitudinal study allows us to capture the dynamic processes of how the interacting effects of export activity, R&D investment, and foreign ownership on the firm's productivity change over time. We test our hypotheses by using a dataset containing 60,301 firms each year across a 7-year period. Operational and financial information about these firms is derived from a rich firm-level panel constructed from the Annual Industrial Survey (AIS) of the National Bureau of Statistics of China.

Finally, using China as a research setting is particularly important for the learning-by-exporting argument used in this study. Whilst firms from developed markets might be more capable of learning from their own competitive and sophisticated markets, and thus develop higher levels of productivity that enable them to enter export markets with differentiated offers, this may not be the case for emerging-market firms such as those located in countries like China. For

instance, Stiglitz and Greenwald (2014) argue that what separates emerging or developing countries from more developed countries is a knowledge gap, which can be reduced by the firm operating in foreign markets. Moreover, the applicability of self-selection theory in the context of emerging markets has been questioned in the literature (Gomes et al., 2018). On the other hand, learning effects are very important for firms from emerging-market countries, as they tend to gain more from exposure to international export markets as well as being further away from the technological frontier (Araújo & Salerno, 2015; Blalock & Gertler, 2004). As such, the learning-by-exporting theory adopted in this study seems to be particularly appropriate for exporting firms from emerging-market contexts like China, as they are more likely to benefit from the knowledge acquired by operating in foreign markets.

2. THEORY AND HYPOTHESES

2.1. Theoretical Background

2.1.1 The Export – Productivity link: Learning-by-exporting

The idea that exporting may provide the firm with important advantages as a consequence of their contacts with foreign buyers, customers, competitors, and suppliers began to be explored in detail in the 1970s for what has become known as the Uppsala Internationalization Process Model (Johanson & Vahlne, 1977; Johanson & Wiedersheim-Paul, 1975). While exporting may provide the firm with important advantages and opportunities, it can also have some negative consequences, especially in the early stages, when the firm suffers from the liability of outsidership and foreignness (Johanson & Vahlne, 2009) thereby hindering their competiveness in the foreign market. In order to overcome the liability of foreignness, firms need to acquire market knowledge through experience from practical operations abroad (Delios & Beamish, 2001; Johanson & Vahlne, 1990; Sandberg, 2013). Learning and knowledge are

two concepts that play a major role in the Uppsala model. A key assumption is that acquiring knowledge is fundamental to a firm's internationalization, and that the accumulation of knowledge derived from activity in the foreign market is crucial to the learning process (Johanson & Vahlne, 2009). As such, exports are likely to result in increased knowledge and the development of new capabilities through the accumulation of experience gained from exporting (Forsgren, 2002; Hessels & van Stel, 2011; Sousa et al., 2020; Sousa, Martinez-Lopez, & Coelho, 2008).

Although the international business literature has highlighted the importance of learning from exporting, empirical research on the link between export activity and productivity is still in its early stages in the international business literature. Research on this topic has been mainly in the international economics literature but has often focused on examining the link between export activity and productivity at the country or industry level. This has been criticized, as for the most part firms engage in trade, not industries or countries, which suggests that inferences from the more macro level might not be appropriate in guiding firm strategies (Salomon & Shaver, 2005).

The learning-by-exporting literature provides a theoretical basis to examine these effects at the firm-level. The basic argument in the learning-by-exporting literature is that firms entering export markets acquire knowledge, which should enhance its productivity (De Loecker, 2007; Rodriguez, 2009; Salomon & Shaver, 2005; Tse et al., 2017). Scholars have argued that exporters learn from their foreign operations because of the knowledge spillovers from repeated interactions and information exchange with foreign distributors, customers, and competitors (Chen, Sousa, & He, 2019; García et al., 2012; Lindstrand, Eriksson, & Sharma, 2009).

Increased productivity becomes an outcome of learning-by-exporting as firms may use this new knowledge to improve or develop new production processes. Firms exporting to foreign markets increase their technological knowledge by accessing new channels of technology and learning, which facilitates their access to technical information and product development practices (Clerides, Lach, & Tybout, 1998; Yeoh, 2004). This is notably the case for firms from technologically lagging countries, which have a greater opportunity to learn, compared to firms from more technologically developed countries (Chang & Chung, 2017; Gomes et al., 2018; Salomon & Jin, 2008).

The core of this explanation has roots in the organizational learning theory, where trade is viewed as a process of learning and knowledge accumulation that allows the firm to improve both product and processes and thus remain competitive (Love & Ganotakis, 2013; Yeoh, 2004). More specifically, organizational learning studies argue that organizations learn by interacting with the environments that surround them. Exposure to foreign markets leads to a greater learning, which puts firms in a better position to adapt in the face of new customer demands, technological advances, and the external environment (Cassiman & Golovko, 2011; Salomon & Shaver, 2005), resulting in better productivity (Tse et al., 2017). The concept of learning-by-exporting is also closely linked with the concept of learning-by-doing: by performing an activity repeatedly over time, a firm accumulates knowledge and learns how to do it in an effective manner (Love & Máñez, 2019). The idea is that learning evolves over time because experience is cumulative. As firms increase their export activities they also accumulate knowledge and must learn how to satisfy foreign customers with different quality standards and short lead times. These productivity-enhancing learning effects are linked to the persistence of the export activity (Andersson & Lööf, 2009) and can be beneficial, especially for firms in emerging markets as their foreign customers can often be more demanding and have higher quality standards and stricter deadlines.

The rationale supporting the learning-by-exporting argument and the fact that export activity leads to improvement in productivity can be summarized in following main points: first, exposure to foreign knowledge and contacts helps improve firm productivity; second, to successfully compete in foreign markets, the firm is forced to be more efficient and effective; third, increase in efficiency and quality improvements are due to better access to state-of-the-art machinery; fourth, foreign customers seek products with more quality and lower prices, creating an incentive for exporters to become more efficient; fifth, improvements in the firm's capabilities as a consequence of better access to technology and the possibility of cooperation with foreign firms in the productive chain, and sixth, economies of scale whereby fixed costs can be recovered over a larger sales volume (Araújo & Salerno, 2015; Love & Roper, 2015). Moreover, in the case of firms from less developed economies, foreign customers may be more willing to share knowledge of the latest design specifications and production techniques that might otherwise be unobtainable (Blalock & Gertler, 2004), resulting in improved productivity.

2.1.2. R&D Investment and Foreign Ownership

In this study, R&D investment refers to the extent to which the firm invests in R&D activities to develop new processes and products. As firms from emerging markets have traditionally relied very little on innovation, investment in R&D activities is particularly relevant for these firms in order to narrow the knowledge gap and catch up with established firms based in advanced economies. Investment in R&D should provide the firm with opportunities to create and use new knowledge and technical information. Not surprisingly, it has been widely acknowledged that investment in R&D activities play a crucial role in the firm's competitiveness (Kafouros & Forsans, 2012) and are all the more important in today's globalized knowledge based economy. Studies have emphasized that R&D activities lead to

the creation of knowledge (D'Agostino & Santangelo, 2012; Un & Asakawa, 2015) and absorptive capacity (Hung & Chou, 2013; Tsinopoulos, Sousa, & Yan, 2018). However, it has been stressed that for firms to use external knowledge they need to invest in resources in order to develop the internal expertise (Cohen & Levinthal, 1994). As such, investment in R&D not only generates new information and creates new knowledge, but also enhances the firm's ability to assimilate and exploit existing and new information (Aw, Roberts, & Winston, 2007; Cohen & Levinthal, 1989; Lane, Koka, & Pathak, 2006).

According to the learning-by-exporting argument, firm's export activities lead to exposure to foreign knowledge and contacts, which in turn help improve the firm's productivity. However, the extent to which a firm can take advantage of this foreign knowledge and these contacts depends on the firm's capacity to assimilate and leverage knowledge external to them. In this context, R&D investment may play a moderating role in the export-productivity link by enhancing the firm's ability to assimilate and exploit new information from the export markets.

Foreign ownership refers to the percentage of total capital held by a foreign partner (i.e., the ratio between foreign capital and total capital). Past studies have suggested that the ownership structure is a key driver of the firm's competitiveness (Fitza & Tihanyi, 2017; Yang & Meyer, 2018). Anecdotal evidence suggests that foreign ownership provides the firm with access to more extensive networks as well as access to a wider range of know-how and foreign technology. It has been argued that firms with foreign ownership have superior technical, organizational, and financial resources (Douma, George, & Kabir, 2006). Moreover, it has been linked to the introduction of new processes and adoption of superior technologies (Dachs & Peters, 2014). The argument behind this notion is that exporters gain access to information about customers' needs and foreign markets through their foreign owners. As a result, exporters can embody the knowledge regarding the technological advancements and customers from

foreign markets into their own product development process (D'Angelo, Ganotakis, & Love, 2020).

The level of foreign ownership is particularly relevant for firms originating from emerging markets. Foreign owners may provide technical expertise and know how not readily available in the emerging market as well as facilitate access to new markets and new sources of external knowledge. Taking this into account, foreign ownership is also expected to play a significant moderating role in explaining the export-productivity link. As the learning-by-exporting argument emphasizes aspects such as exposure to foreign knowledge and the ability to compete in foreign market, these should be further enhanced by the fact that foreign ownership facilitates the access to superior technical, organizational and financial resources. The organizational learning theory also provides support for the role of foreign ownership. The organizational learning concept reflects the changes that occur in an organization when it acquires knowledge (Argote & Miron-Spektor, 2011). This knowledge is reflected in an array of changes and new awareness within the exporting company, including the information provided by foreign owners about customers and export market characteristics.

2.1.3. Conceptual model

While the learning-by-exporting argument has gained increased credibility among scholars, the literature has not yet reliably examined the mechanism through which this learning can be leveraged to enhance the firm's productivity. To fill this gap, we develop a model in which we examine how a firm's investment in R&D and its foreign ownership moderate the impact beween exporting and productivity gains.

Specifically, we postulate that firms may benefit more substantially from exporting activities by increasing their R&D investments (i.e., the extent to which the firm invests in R&D activities to develop new processes and products), which may ultimately lead to higher levels of productivity. The expectation is that not all exporters are equally able to learn from the interactions with the foreign market. It is necessary to understand the heterogeneity of firms' in-house technological capabilities to assimilate new information (Aw et al., 2007). Investment in R&D allows the creation of firm-specific knowledge that enables the firm to screen, appraise, understand and be in a better position to assimilate and integrate externally generated knowledge with the firm's existing knowledge (Rothaermel & Alexandre, 2009). Therefore, firms with high levels of R&D investments stand to benefit most since they are better equipped to translate and leverage the knowledge inputs obtained from the foreign market into increased levels of productivity.

Similarly, learning-by-exporting effects should be linked to firm ownership, as different types of owners and decision makers are likely to exert differing amounts of influence on the learning process (Tse et al., 2017). To improve the firm's competitiveness foreign owners have an incentive to provide firms with access to their networks and resources (Filatotchev, Stephan, & Jindra, 2008). As such, foreign owners provide access to more extensive networks, a wider range of know-how, and foreign technology. This is particularly the case for firms from less developed markets since they tend to start from a lower knowledge base. These firms have a greater knowledge gap and stand to reap the greatest return from exposure to the new knowledge provided by foreign owners. Assuming bounded rationality and limited access to resources and international networks, emerging market firms may not be able to access and assimilate as much necessary information as foreign owners can (Deng, Jean, & Sinkovics, 2017). In these cases, foreign owners may be in a better position to help the firms identify, assimilate, and understand more quickly the types of knowledge obtained during their export

activities. This ability to decode and understand foreign knowledge more quickly also helps to deal with the potential problem of information overload and over-stretching the capacity of the firm's management. Overall, these advantages should enhance the learning effects gained during the firm's export activities and thereby improve its productivity.

To sum up, our study proposes that a firm's export activity affects its productivity. However, we further assert that this impact is contingent on the firm's R&D investment and its foreign ownership. Consequently, we propose the following research framework, as shown in Figure 1.

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2.2. Research Hypotheses

The argument that exporting firms not only benefit by increasing their revenue base but also by learning from foreign markets has been proposed by several scholars (Chang & Chung, 2017; Fernandes & Isgut, 2015; Vendrell-Herrero et al., 2017). By being exposed to foreign knowledge and contacts, exporting firms, especially from emerging markets such as China, are expected to have higher productivity than non-exporting counterparts. This is due to the learning-by-exporting process whereby exporting firms, especially those with higher absorptive capacity (Silva, Afonso, & Africano, 2012), obtain new knowledge, routines, capabilities, processes, product designs, technology, and/or production techniques through their involvement in foreign markets and interaction with foreign competitors and customers (Fernandes & Isgut, 2005; Martins & Yang, 2009; Van Biesebroeck, 2005).

Exposure to more competitive environments, international markets, and best practices, drives exporting firms to become more efficient than non-exporting domestic firms, especially those operating in protected environments (Aw & Hwang, 1995). This view is particularly applicable in the case of exporting firms from emerging markets, as these are more likely to learn and benefit from their experience in foreign and more sophisticated markets (Ciravegna, Lopez, & Kundu, 2014). This is consistent with the view that home market characteristics are an important factor influencing the learning ability of internationalized firms (Cuervo-Cazurra, Ciravegna, Melgarejo, & Lopez, 2018; Wang & Ma, 2018).

This learning-by-exporting argument advocated by some scholars (Min & Smyth, 2014; Tse et al., 2017) is in line with the resource-based-view (RBV), that firm performance is mostly explained by differences in resource levels and the way these are reconfigured to increase firm productivity and competitiveness (Wernerfelt, 1984). As exporting firms are able to reach a higher threshold in terms of productivity as a result of their international trade activities, they are more likely to enter into a 'virtuous cycle' by becoming more capable to sell to new international markets and subsequently become even more productive (Ganotakis & Love, 2012). Thus, we propose the following baseline hypothesis:

Baseline hypothesis: *Higher levels of export activity increase the productivity level of exporting firms*

While the baseline hypothesis predicts a positive relationship between export activity and productivity, we expect this relationship to be moderated by the firm's level of R&D investment. In this study R&D investment refers to the extent to which the firm invests in R&D activities to develop new processes and products. It has been considered as the most prominent

resource to create new knowledge and absorptive capacity (Hung & Chou, 2013). As export activity is expected to have a positive influence on the firm's productivity due to knowledge spillovers that may arise from interaction with other firms and customers from foreign markets, the impact of R&D investment has the potential to strengthen this positive impact on the firm's productivity. This is particularly the case of firms with more knowledge-based capabilities like high innovation capacity, as these are more capable of learning by exporting (Tse et al., 2017). Results from Wu, Wang, Hong, Piperopoulos, and Zhuo (2016) study of Chinese internationalized firms corroborate this view by demonstrating that firms with greater absorptive capacity (measured as R&D expenditure) seem to be able to learn the most from exporting.

Investment in R&D enables the firm to develop its technological knowledge, thereby enabling the firm to develop and produce new products and processes to better compete in the market (Berchicci, 2013; Kotlar, Fang, De Massis, & Frattini, 2014). It is also the source of process innovations that leads to lower costs (Yoshikawa, Rasheed, & Del Brio, 2010), thereby positively influencing the firm's productivity. Moreover, it allows the firm to recognize new opportunities in the market and to predict technological trends (Cohen & Levinthal, 1994). As suggested by Zhang, Li, Hitt, and Cui (2007), exporting firms need to invest in R&D capabilities in order to maximize innovation and enhance their competitiveness. This is the case because firms with more investment in R&D activities are more likely to recognize the value of new ideas and facilitate new technological knowledge assimilation, and take advantage of outside opportunities (Hung & Chou, 2013). By contrast, a firm with less investment in R&D activities is less likely to recognize and understand the value of new ideas and the capacity to assimilate new technology, which should weaken the relationship between export activity and the firm's productivity. The investment in R&D is particularly important for firms from emerging markets as they often start from a lower knowledge base and such investment allows

them to more easily bridge distant technological contexts, recognize and understand the value of external knowledge, and integrate and utilize knowledge (Wu et al., 2016). Thus, we propose the following:

Hypothesis 1: *R&D investment positively moderates the relationship between export activity and productivity.*

Research suggests that ownership plays a key role in the firm's operations and significantly influences its strategic choices (Chen, Ding, & Wu, 2014; Gaur & Delios, 2015). In this study we focus on foreign ownership and assess its importance in the firm's export activity and consequent impact on its productivity. Foreign investors undertake greater risk by investing in foreign firms and as a result it is likely that they expect this greater risk to be rewarded with significant returns. Consistent with this argument, past research has found a positive association between foreign ownership and firm performance (Calabrò et al., 2013; Yoshikawa & Phan, 2003). The main goal of foreign owners is to maximize the returns on their investment (Yoshikawa et al., 2010). Hence, it is reasonable to expect that they will exercise influence on the firms in which they invest to increase their productivity.

Moreover, recent studies have found that foreign ownership signals better products, technology, governance, and management in emerging markets (Chen et al., 2014; Cole, Elliott, & Strobl, 2008; Yildiz & Fey, 2012). The presence of foreign investors in exporting firms can help local firms to benefit from knowledge spillovers and contribute to a better understanding of foreign markets, as well as provide access to extensive networks of business partners (Calabrò et al., 2013). Furthermore, foreign ownership provides the firm with access to lower cost financing and technical and managerial expertise (Gaur & Delios, 2015). In this context, it is likely that

the presence of foreign investors will have a positive influence because it has been shown that domestic firms with foreign ownership can benefit and take advantage of knowledge flow from their foreign partners (Zhang, Li, Li, & Zhou, 2010). In addition, as foreign ownership increases, it reduces the likelihood of opportunistic behavior on the part of the local partner (Hamel, 1991) and stimulates greater knowledge transfer (Li, Zhou, & Zajac, 2009).

Finally, foreign owners may also affect learning at lower levels in the organization via exchange of personnel, training, improvement of the organizational structure, and systems upgrades (Filatotchev, Wright, Uhlenbruck, Tihanyi, & Hoskisson, 2003). Thus, the presence of foreign investors in firms from less developed markets has been associated with positive effects such as high learning and high efficiency governance. This should further help the firm to more rapidly learn and more efficiently deal with the information obtained during their export activities. As a result, we expect that the benefits of foreign ownership are likely to further strengthen the positive impact that export activity has on the firm's productivity. Therefore, we propose the following:

Hypothesis 2: Foreign ownership positively moderates the relationship between export activity and productivity.

3. METHOD

3.1. Emerging market context

The emerging market context is a central tenet of our main argument and it was chosen in response to recent calls from several scholars advocating the need for international business/marketing studies to contextualize and develop theory suitable for emerging markets

(Teagarden, Von Glinow, & Mellahi, 2018). The adoption of the learning-by-exporting argument as opposed to the self-selection theory, which argues that firms that are productive from the outset are those that are more capable of entering export markets (Melitz, 2003), is mostly due to the fact that learning-by-exporting is more important for exporting firms from emerging markets than for those from developed markets. We argue that this is the case because of the nature of the business environment in emerging markets, which is characterized by weaker institutional levels of development and supporting infrastructures, limiting the ability for firms from such contexts to access technological, managerial, and manufacturing know-how in the domestic market. As such, emerging market firms have to resort to international markets in order to access such capabilities (Baldwin, 2016).

China is a particularly interesting research setting for our study for the following reasons: first, China is the world's leading emerging economy; second, over the last few decades Chinese export firms have evolved from playing a marginal role to a major role on the global stage; third, Chinese government continues to encourage firms to internationalize; fourth, the economic growth that China achieved in the last few decades is largely due to the dramatic growth of inward foreign direct investment (Bhaumik, Driffield, & Zhou, 2016; Wang & Kafouros, 2009); fifth, Chinese firms have significantly increased their investment in R&D activities; and sixth, the Chinese government continues to make considerable effort to improve firms' productivity.

3.2. Data

The unit of analysis in this study is at firm-year level. Our dataset is compiled from the National Bureau of Statistics (NBS) of China. First, we used data reported by manufacturing firms from the NBS Annual Industrial Survey (AIS) database. AIS is a proprietary dataset, which is

collected by the NBS. Firms are under legal requirement to complete this survey and all information is monitored by the Government. It provides a full sample of Chinese manufacturing firms that have annual sales revenue greater than 30 million Chinese RMB. AIS is a firm-level panel dataset that includes both state-owned enterprises (SOEs) and non-SOEs, and reports a rich set of financial and operational information. The information asked in AIS is all factual (e.g., annual sales revenue) and does not consist of any perceptual questions. This characteristic of AIS minimizes the risk of Common Method Variance. Therefore, AIS has a high degree of consistency and internal accuracy.

Second, we compiled an unbalanced dataset for the period 2001-2007. As China joined the World Trade Organization in 2001, it removes many barriers to trade manufacturing products and strengthens access to foreign markets. Moreover, the global financial crisis in 2008[1] substantially decreased the survival rates of manufacturing firms and reduced China's inward FDI. In the same year, the Chinese government removed tax incentives to foreign affiliated firms based on a new tax regime, which led to the exit of some foreign firms. Following recent international business and management studies (e.g., (Tse et al., 2017; Xia & Liu, 2017), we used AIS data during this time period to ensure that our findings were not subject to these large events.

Third, the sample for this study includes only exporting firms. The data consists of approximately 75% domestic and 25% foreign affiliated manufacturing exporting firms between 2001 and 2007. These firms account for approximately 98% of all Chinese manufacturing exporters in an aggregated trade data.

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[1]Studies often use 2007 as an endpoint to avoid "having the analysis confounded by the global financial crisis that erupted in 2008" (Haveman, Jia, Shi, & Wang, 2017), p.78).

In sum, our sample is an unbalanced dataset for manufacturing exporting firms from 2001 to 2007. In the summary statistics and regression analysis we took a one-year lag of key explanatory variables (at time $t-1$) to the dependent variable (at time t). This leaves us with 233,128 observations for 117,340 firms in our final sample.

3.3. Measures

3.3.1. Dependent variable

Following Tse et al. (2017), the outcome variable in this study is measured by total factor productivity (TFP). Consistent with our definition of the construct, this measurement captures the technology or production efficiency of a firm. We realise the potential for the heterogeneity problem using OLS TFP estimates by adopting Olley and Pakes (1996) estimation (denoted by TFP OP) in this study, which is a well-established TFP estimation method. TFP OP is considered econometrically efficient because the semi-parametric methods used in TFP OP can solve the endogeneity issue associated with selection bias and simultaneity. Therefore, we interpret findings based on results of TFP OP.

3.3.2. Independent variable and Moderators

Export activity. In line with earlier studies (Assadinia, Boso, Hultman, & Robson, 2019; Madsen & Moen, 2018; Sousa et al., 2020), we measured firm's involvement in export operations as the export sales growth, which is measured by (annual export sales at *time t –* annual export sales at *time t-1*)/ (annual export sales at *time t*). The scale of the annual value of exported products is 1,000 RMB.

R&D investment. Consistent with previous research (Barge-Gil & López, 2014), firm R&D activity is measured by the ratio of the R&D expenditure over number of employees. The scale of R&D expenditure is 1,000 RMB. This measurement captures the level of a firm's R&D investment and provides a direct assessment on the extent to which the firm commits to R&D activities by investing in improved materials or craftsmanship to develop new or incrementally improved products and/or advances in processes.

Degree of foreign ownership. As there is an indicator in AIS clarifying the total amount of foreign capital for each firm, we are able to generate a foreign ownership measurement to capture the foreign capital intensity. To measure degree of foreign ownership, we divided foreign capital by total capital. It offers a more precise measurement on the extent to which foreign firms are financially committed to the focal firms than does the dummy measurement (i.e., yes/no foreign investment).

3.3.3. Control variables

Firm size is an important variable to take into account, because firm engagement in innovation activities may vary across SMEs and large-sized firms. We measured it as the natural logarithms transformed number of employees. We also accounted for the effect of firm's age on firm productivity. In addition, we controlled for international experience, as it can play an important role in the firm's export activities (Chen et al., 2016; Sousa & Bradley, 2006; Sousa et al., 2008). It is measured by the natural logarithms of the number of years that a firm engaged in the exporting activity. Moreover, we controlled for industrial competitive intensity by composing Herfindahl index (HHI) in order to take home market characteristics into account. Furthermore, it is noteworthy that both the export activities and R&D activates could be substantially different across industry sectors, and there are vast differences across regions in China in terms of the level of economic development. In order to conduct multilevel linear

regression analysis, we used three-digit SIC code to classify 167 manufacturing industries. The geographical locations are identified by 31 province-level dummy variables.

3.4. Methods

In order to empirically examine the effect of innovation activities, exporting behaviour, and degree of foreign ownership on firm productivity, we form the estimator based on a firm-year unit. We employed six hierarchical models to test the hypotheses by putting the independent, moderating, and control variables into regression step by step. First, we predicted a model with control variables only (Model 1) and then included the key independent variable and control variables (Model 2: *Export*, number of employees, firm age, year dummy, industry random intercept, and region random intercept). Next, we entered one moderator (*R&D investment*) and the other moderator (*degree of foreign ownership*) into Models 3 and 4, respectively. Moreover, we estimated the hypothesized two-way interactions between export activity and R&D investment in Model 5. Finally, we estimated the hypothesized two-way interaction terms between export activity and degree of foreign ownership in Model 6 (the linear interaction term $Export \times Foreign$).

We adopt a multilevel mixed linear model to address unobserved heterogeneity in the impact of export activity on the productivity of manufacturing firms due to the cross-province and cross-industry nature of our dataset. This method is used in order to take the hierarchical structure of our dataset into account, which denotes that the clustering of the firm level data are first within an industry and second within a province. We found that the residual variances at levels 1 and 2 in the random intercept model with all variables are statistically significant (p<0.01), which justifies the choice of multilevel modelling with province and industry effects. Table 1 shows descriptive statistics, VIF values, and correlations amongst all variables. Low

VIF values (ranging from 1.01 to 1.25) suggest that multicollinearity is not a concern in this study. Following Aiken and West (1991), we standardized independent and moderating variables to further reduce possible problems with multicollinearity.

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Insert Table 1 about here
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Moreover, it is important to ensure that there is a time difference between firm exporting activities (at time *t-1*) and productivity (at time *t*) in our analysis. This allows us to investigate how the previous export activities impact on the current firm productivity. Therefore, the measures of the independent variable, moderating variables, and control variables were lagged one year to dependent variable.

4. RESULTS

4.1. Hypotheses testing

Table 2 shows the results of models 1-6. The baseline hypothesis predicts that exporting activities have positive effects on the firm's productivity. As Table 2 (Model 6) shows, *Export* ($\beta = 0.047$, $p < 0.01$) was positively related to firm productivity. Therefore, the baseline hypothesis is supported. The R&D investment exhibited significant and positive relationships to productivity (see Table 2 Model 6, R&D: $\beta = 0.070$, $p < .01$). Degree of foreign ownership does present an inverted U-shaped effect on productivity (Degree of foreign ownership: $\beta = 0.005$, $p < 0.01$).

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Insert Table 2 about here
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The results of the regression analyses depicted in Model 6 of Table 2 provide information related to Hypotheses 1 and 2. Hypothesis 1 predicts that R&D investment strengthens the positive relationship between export activity and productivity. Hypothesis 2 proposes a positive effect of the two-way interaction between export activity and degree of foreign ownership on firm productivity. Two-way interaction terms are shown in Table 2 (Export × R&D investment: β=0.005, p<0.01; Export × Degree of Foreign Ownership: β= -0.008, p<0.01). Following Aiken and West's (1991) process for interpreting interaction effects and conducting simple slope analysis, we visualized the moderating effect of R&D investment on the relationship between Export activity and productivity in Figure 2 and the effect of degree of foreign ownership in Figure 3.

We tested the effect of export activity on productivity, conditional on different levels of R&D investment. In predicting productivity based on Model 6, shown in Figure 2, the slope of the round line for high R&D investment level is positive and significant at 0.01 level (t=17.16; p<0.01). The slope of the diamond for low R&D investment level is also positive and significant at 0.01 level (t=13.86; p<0.01). Shown in Figure 2, the slope of the round line is steeper than that of the diamond line, which suggests that a one standard deviation increase in Export in the round line (β=0.052) results in a higher level of productivity than the same increase in the diamond line (β=0.042). The difference between the slope of the round line (high R&D investment level) and that of the diamond line (low R&D investment level) is significant at 0.05 level (t=-2.33, p<0.05). Therefore, the increase of export level is associated with a higher level of productivity when the R&D investment level is high. In line with our

hypothesis, the effect of export activity on productivity is stronger when the R&D investment level is high, but weaker when the R&D investment level is low. Therefore, H_1 is supported.

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Insert Figure 2 about here
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We tested the effect of export activity on productivity, conditional on different levels of degree of foreign ownership. The slope of the round line for high degree of foreign ownership, presented in Figure 3, is positive and significant at 0.01 level (t=10.39; p<0.01). The slope of the diamond line for low degree of foreign ownership is positive and significant at 0.01 level (t=13.86; p<0.1). Shown in Figure 3, the slope of the round line is flatter than that of the diamond line, which suggests that a one standard deviation increase in *Export* in the round line (β=0.039) results in a lower level of productivity than the same increase in the diamond line (β=0.055). The difference between the slope of the round line (high foreign ownership level) and that of the diamond line (low foreign ownership level) is significant at 0.01 level (t=3.01, p<0.01). Therefore, the increase of export activity level is associated with a lower level of productivity of firms when the degree of foreign ownership is high. Contrary to our hypothesis, the effect of export activity on productivity is weaker when the degree of foreign ownership is high, but stronger when it is low. Hence, H_2 is refuted.

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Insert Figure 3 about here
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4.2. Additional analyses

Based on the final model (Model 6), we adopt three alternative estimation strategies to examine the consistency and robustness of our findings. (1) We use OLS to estimate Model 6 and report the regression results in Table 3. Results of Model 7 (Table 3) are consistent with those of the final model. (2) We recode productivity (TFP) to a categorical variable, then use an ordered probit model (Model 8) based on a simulation-based technique proposed by King, Tomz, and Wittenberg (2000). This method has been adopted widely in management studies (Laursen & Salter, 2014; Zelner, 2009). The categorical TFP was composed by classifying the value of TFP into different categories as follows: 0, when the mean value of TFP is lower than 5%, 10%, 25%, 50%, 75%, 90%, 95%, and when it is in the upper 5%. We apply the Stata code from King et al. (2000) and perform the simulation by taking the 1,000 times draws[2]. On the last two columns of Table 3, we present 95 percent of the simulated coefficients. The simulation results of Model 12 are highly consistent with those of Model 6. Therefore, the results of the simulation-based estimate lend strong support to our findings.

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Insert Table 3 about here
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5. DISCUSSION AND IMPLICATIONS

5.1. Theoretical implications

The purpose of this paper is to address two research questions: (a) considering the firm level, what is the relationship between export activity and productivity in a context of emerging

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[2] The simulated coefficients of 95 percent (1,000 times draws) confidence intervals are available upon requests.

market firms? and (b) how do the moderating roles of R&D investment and foreign ownership affect the link between export activity and productivity?

To answer our first research question we adopted the learning-by exporting theory and examined the export-productivity link in the context of an emerging market. Our results support the view that exporting activities lead to higher levels of productivity. As most empirical research examining the link between exporting and productivity has been done at the country or industry level (Tse et al., 2017), our focus on the firm-level provides managers with information that is more immediately useful to them and is therefore more adequate in guiding the firm's strategies (Salomon & Shaver, 2005). Moreover, the selection of firms from an emerging market, namely China, to test this model is particularly relevant for the learning-by-exporting theory and also addresses the recent call made by Teagarden et al. (2018) for more studies to test the applicability of established theories in emerging markets.

To answer our second question we investigated how this learning effect of exporting can be further enhanced by investment in R&D and the degree of foreign ownership. By doing so, we extend the learning-by-exporting literature (D'Angelo et al., 2020; Love & Ganotakis, 2013) by proposing and testing a moderation model, thereby uncovering the underlying learning process that moderates the impact of export activities on productivity. Considering that the extant literature tends to focus on the direct impact of exporting on productivity, the inclusion of contingency effects provides new insights into the mechanisms by which firms increase their productivity.

Evidence from our study demonstrates that it is crucial for firms to invest in R&D, which can facilitate knowledge assimilation and implementation, thereby enhancing its positive influence. This is consistent with the view that the positive outcomes of acquiring external knowledge are contingent on the firm possessing underlying technological capabilities (Penner-Hahn &

Shaver, 2005). R&D is used as a way to help the firm translate, exploit, and leverage the knowledge inputs obtained externally in order to better position firms from an emerging market to compete with incumbent firms from developed economies. The notion behind this idea is that investment in R&D activities leads to the creation of knowledge (D'Agostino & Santangelo, 2012; Un & Asakawa, 2015). As this happens, firms will be in a better position to compete in other markets (Kotlar et al., 2014). This is particularly important for export firms from emerging markets such as China, as these firms usually lack innovative capabilities to compete with firms from more advanced economies.

Regarding the impact of foreign ownership, little is known about how it can affect the firm's learning mechanisms from exporting (Tse et al., 2017). Our findings support the view that foreign ownership has a positive direct impact on firm productivity, as foreign owners may bring new resources and capabilities to the host firm (Griffith, Redding, & Simpson, 2004). However, our results do not provide support for our hypothesis 2, i.e., that foreign ownership positively moderates the relationship between export activity and productivity. Though somewhat surprising, a possible reason may be related to the specific institutional context of China's relational society, in which the dynamics of government-business relationships are characterized by preferential policies developed to support government-business relations with the aim of enhancing firm growth and competitiveness (Tian, Wang, Xie, Jiao, & Jiao, 2019). As such, firms with higher levels of foreign ownership are not only able to benefit from the knowledge and resources brought by these foreign investors but through the development of trust and strong political ties that are also able to benefit from the ´supporting hand' of the government (Wu, 1997). The extant literature has widely acknowledged that the government policies are particularly useful in facilitating expansion and boosting the competitiveness of Chinese firms in foreign markets (Chin, Liu, & Yang, 2016). As argued by some scholars, "China is seeking the development of world-class multinational companies with a full range of

competencies to explore and exploit opportunities around the world," to learn from foreign markets (Alon, Child, Li, & McIntyre, 2011), pp. 192), and to engage in strategic asset seeking (Schüler-Zhou & Schüller, 2009). This 'supporting hand' is likely to be provided only to Chinese firms with low or no foreign ownership, because foreign firms often bring competition to local firms domestically and internationally (Xia and Liu, 2017). Our results portrayed in Figure 3 seem to indicate that, indeed, whilst Chinese exporting firms with lower degrees of foreign ownership exhibit higher levels of productivity gains derived from higher levels of export activity, than do firms with higher degrees of foreign ownership. Nonetheless, this issue warrants further research attention.

Lastly, in order to be consistent with the learning argument a causal inference is drawn by taking a time-lag effect into account that allows us to check the direction of causality and provides further assurance of our results. Moreover, by examining these relationships in greater depth and using a large panel data set across a 7-year period, we unveil the underlying process that shows how investment in R&D and degree of foreign ownership affects the export-productivity link. This addresses recent calls for studies to go beyond cross-sectional analyses and assess longitudinal changes, thereby enabling us to test causality effects (Vendrell-Herrero et al., 2017).

5.2. Practical implications

The results also have important implications for managers and policy makers. First, the findings clearly show that exporting has a positive impact on productivity. As such, firms are encouraged to export and policy-makers should develop policies to facilitate and stimulate firms entering foreign markets. This is particularly relevant in the case of export firms from

emerging markets such as China. It is expected that by targeting more advanced economies, managers of firms from emerging economies are more likely to benefit from the knowledge acquired by operating in those contexts. The notion that firms from emerging markets can achieve higher levels of productivity by operating in developed markets should also be of interest to policy makers. As a result, policy makers from developing countries should provide support for national firms to enter more advanced economies. Public policies to provide support for export firms from emerging markets should include access to funding and market knowledge about foreign target markets.

Second, the positive moderating impact of R&D investment shows managers the need to support these investments. Although R&D investments could reduce the financial resources available to the firm to dedicate to other activities, managers should view this investment as a key factor in the firm's competitiveness that significantly enhances its productivity. The investment in R&D in export firms can be done by supporting think tanks and research labs. To encourage the firm to invest in R&D, policy makers should also develop policies, which support these investments (e.g. loans at reduced rates, subsidies and tax breaks). Moreover, policy makers, particularly from developing countries, should encourage the exchange of knowledge and technology amongst exporters, universities and research institutes.

Third, the direct positive effect of foreign ownership on productivity should motivate local governments, particularly in emerging markets such as China, to encourage a certain degree of foreign ownership, as it may help firms to be more competitive and productive. However, the negative moderating role of foreign ownership on productivity also suggests that some caution is necessary regarding this aspect. In this case, it would make sense to encourage managers and policy-makers to pay attention to the liabilities of foreign ownership to firms operating mainly in the domestic market.

To finish, the world has changed significantly over the course of the last few years. Exporting firms competing in fast-changing international markets, increasingly face a diverse set of complex economic, political, social and technological challenges like Brexit, the US-China economic-political relations, social movement activists like 'black lives matter', various climate-related threats, and the digital transformation. Such challenges can be exacerbated in firms possessing foreign ownership, as the decision-making process is no longer solely driven by productivity and competitive reasons, but also by political uncertainties that will, for instance, determine the extent to which firms should simply continue exporting or should rather establish production facilities in more import-protected markets. The global digitalization of markets also compels traditional exporting firms to adopt quickly digitized business processes supported by industry 4.0 technologies (e.g. cloud computing, internet-of-things, big data, etc.) to support their rapid international expansion. By lowering the costs of, production, communication and transactions costs, digitization is opening up new possibilities for even smaller exporting firms, with or without foreign ownership, to develop international marketing agility capabilities, to be able to avoid environmental threats and rapidly seize international opportunities without losing focus and momentum (Gomes, Sousa, & Vendrell-Herrero, 2020).

5.3. Limitations and directions for future research

As with other studies, there are limitations, which should be acknowledged. First, our sample focuses on Chinese firms and though the emerging market focus is relevant, caution should be exercised in generalizing our findings because they are restricted to within-country variance. Although we think that our logic has broader applicability in terms of geographical scope and should help understand the role of firm ownership and R&D activities on the productivity of exporting firms, future studies may test this model in other developing countries to verify the external validity of our findings.

Second, future studies are encouraged to explore further the impact of foreign ownership. While we do not have the data to test this, it would be interesting to determine if the country of origin of the foreign owners plays a significant role in this relationship. Third, we identified two constructs to explain the effect of exporting on productivity. Future research could explore other factors that may influence the firm's productivity. For instance, future studies could investigate the effect of the institutional environment in facilitating or hindering the willingness of foreign owners to invest in local firms, and their consequent effect on the productivity of exporting firms from different contexts. While this study focuses on moderating effect, researchers are also encouraged to explore mediating effects and to investigate the process of enhancing the firm's productivity. Overall, it is believed that this study makes a significant contribution to the literature and hopefully encourages future researchers to continue to explore this important issue and extend our contributions.

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Figure 1: Conceptual Model
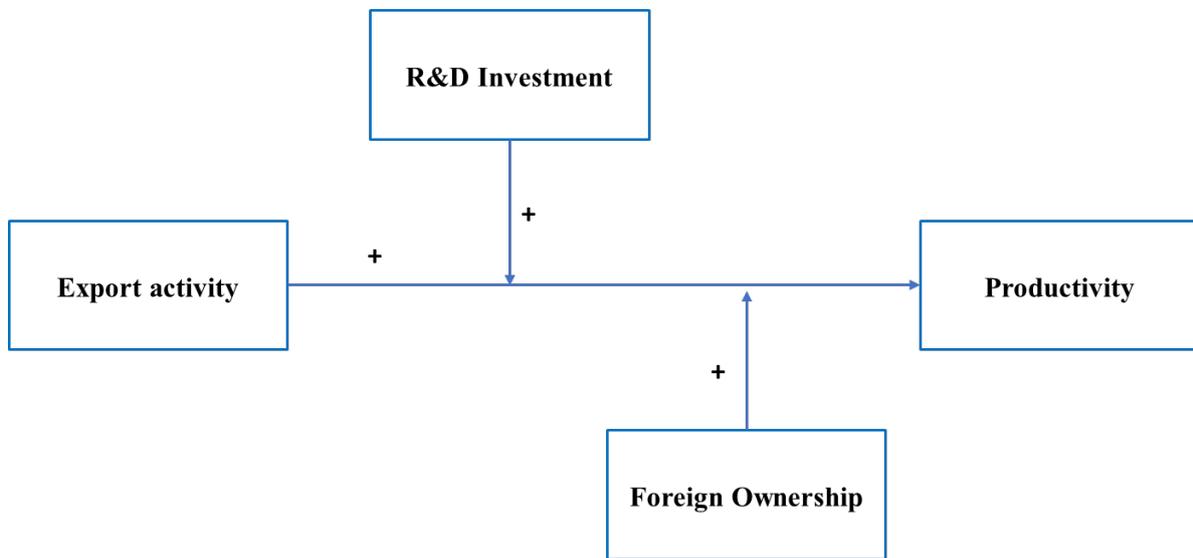
Figure 2 Moderating Effects of R&D Investment on the Relationship between Export Activity and Productivity
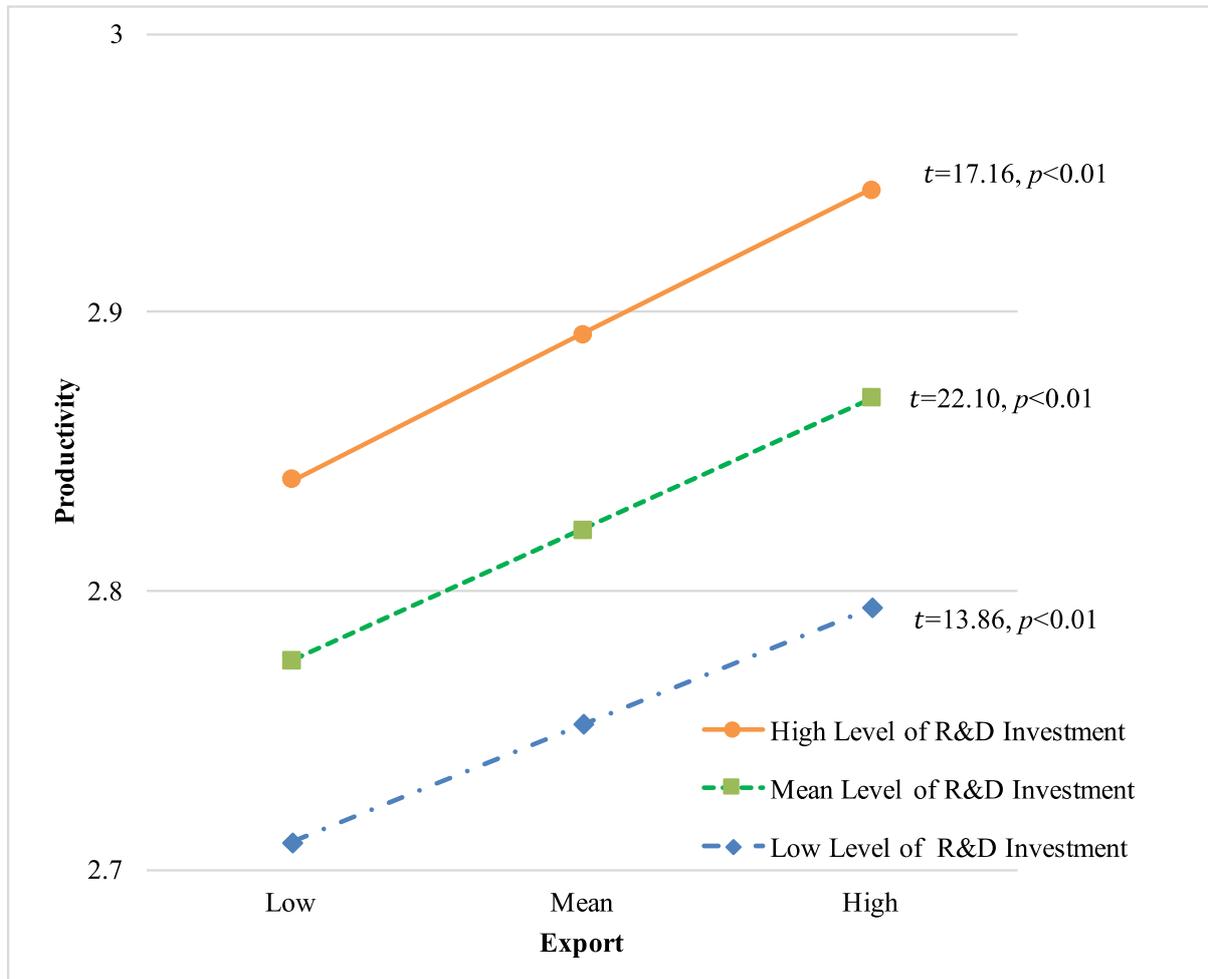
Notes: The figure shows the simple slope of export level on productivity at ± 1 SD from the mean of R&D Investment.

Figure 3 Moderating Effects of Degree of Foreign Ownership on the Relationship between Export Activity and Productivity
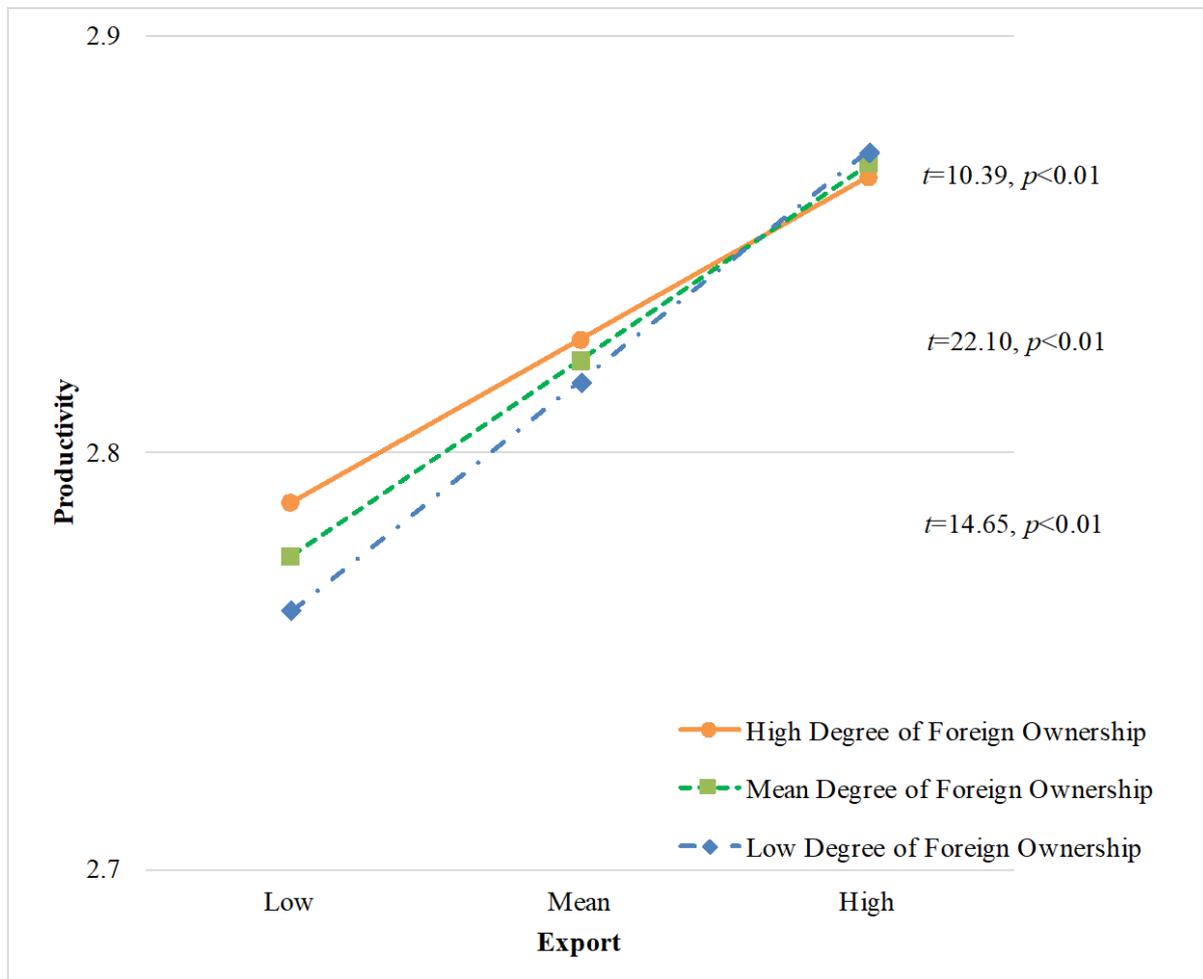
Notes: The figure shows the simple slope of export level on productivity at ±1 SD from the mean of degree of foreign ownership.

Table 1 Descriptive Statistics

	Variable	Mean	Std. Dev.	Min	Max	VIF	1	2	3	4	5	6	7
1	Productivity OP (*t*)	2.67	1.15	-12.51	16.51								
2	Export (*t-1*)	0.45	1.24	-0.67	3.78	1.04	0.03*						
3	R&D Investment (*t-1*)	0.46	3.16	0.00	269.23	1.01	0.07*	0.03*					
4	Degree of Foreign Ownership (*t-1*)	0.16	0.33	0	1	1.06	0.02*	-0.01*	0.02*				
5	Age (*t-1*)	2.05	0.79	0	6	1.15	0.07*	-0.01*	0.02*	-0.12*			
6	Firm Size (*t-1*)	5.17	1.09	2	8	1.15	0.00*	0.00*	-0.02*	-0.01*	0.27*		
7	International Experience	3.85	2.10	1	7	1.19	0.04*	-0.04*	0.01	0.14*	0.20*	0.28*	
8	Competitive Intensity	98.95	210.24	0	10000	1.04	-0.01*	0.01	0.02*	-0.02*	0.07*	0.01	-0.07*
9	Year	2005.54	1.90	2002	2007	1.08							
10	Industry	282.94	92	131	429	1.01							
11	Province	35.05	9	11	65	1.03							

Notes: Number of Observation=233,128. * All correlations are significant at the 5% level.

Table 2 Estimate of Firm Productivity based on Unbalanced Sample Using TFP OP [†], Multilevel Random Intercept Model

DV	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
				TFP_OP		
Intercept	2.501***	2.499***	2.493***	2.492***	2.492***	2.492***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Main Effect						
Export		0.046***	0.046***	0.046***	0.047***	0.047***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Moderator						
R&D Investment			0.070***	0.070***	0.070***	0.073***
			(0.00)	(0.00)	(0.00)	(0.00)
Degree of Foreign Ownership				0.005*	0.005*	0.005*
				(0.00)	(0.00)	(0.00)
Two way interaction					0.005*	0.005*
					(0.00)	(0.00)
Export × R&D Investment						-0.008***
						(0.00)
Export × Degree of Foreign Ownership		0.046***	0.046***	0.046***	0.047***	0.047***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Controls						
Age	0.114***	0.115***	0.121***	0.122***	0.122***	0.122***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Firm Size	-0.056***	-0.057***	-0.055***	-0.055***	-0.055***	-0.055***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
International Experience	0.023***	0.023***	0.020***	0.019***	0.019***	0.019***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Competitive Intensity	0.000	0.000	0.000+	0.000*	0.000*	0.000*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Random effect parameters (variance)						
Industry Dummy	-0.257***	-0.258***	-0.292***	-0.292***	-0.292***	-0.293***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Regional Dummy	-0.718***	-0.719***	-0.857***	-0.857***	-0.857***	-0.857***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Residual	-0.014***	-0.015***	-0.029***	-0.029***	-0.029***	-0.029***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Year Dummy	Included	Included	Included	Included	Included	Included
Number of industry groups	167	167	167	167	167	167
Number of province groups	31	31	31	31	31	31
Number of Observations	233128	233128	233128	233128	233128	233128
Log likelihood	-619897.3	-619453.5	-327019.8	-326991.0	-326988.4	-326975.9
Wald Chi-squared	5570.656	6470.392	4754.383	4758.618	4763.960	4789.494
p-value for Chi^2	0.000	0.000	0.000	0.000	0.000	0.000
AIC	1239820.6	1238935.1	654069.7	654014.0	654010.8	653987.8
BIC	1239963.5	1239089.0	654225.1	654179.8	654186.9	654174.2

Notes: Standard errors in parentheses * $p<0.05$ ** $p<0.01$ *** $p<0.001$

[†] 7-year dummies are included to control for year-specific heterogeneity. 31 regions include 22 provinces, 4 province-level municipalities, and 5 minority autonomous regions across China

Table 3 Robustness Check of Firm Productivity based on Unbalanced Sample Using TFP OP †, Alternative Estimate Strategy

DV	Model 7 OLS	Model 8 Simulation
Intercept	2.692***	--
	(0.04)	--
Main Effect		
Export	0.048***	0.044***
	(0.00)	(0.00)
Moderator		
R&D Investment	0.079***	0.079***
	(0.00)	(0.00)
Degree of Foreign Ownership	0.005*	0.014***
	(0.00)	(0.00)
Two way interaction		
Export × R&D Investment	0.007**	0.008***
	(0.00)	(0.00)
Export × Degree of Foreign Ownership	-0.008**	-0.006***
	(0.00)	(0.00)
Controls		
Age	0.124***	0.123***
	(0.00)	(0.00)
Firm Size	-0.061***	-0.078***
	(0.00)	(0.00)
International Experience	0.019***	0.017***
	(0.00)	(0.00)
Competitive Intensity	0.000	0.000
	(0.00)	(0.00)
Random effect parameters (variance)		
Industry Dummy	Included	Included
Regional Dummy	Included	Included
Year Dummy	Included	Included
Number of industry groups	Included	Included
Number of province groups	Included	Included
Number of Observations	233128	233128
Log likelihood	-328525.6	-420735.81
Wald Chi-squared		65985.97
p-value for Chi^2	0.000	0.000
AIC	657473.2	841457.7
BIC	659659.1	841457.7

Notes: Standard errors in parentheses * $p<0.05$ ** $p<0.01$ *** $p<0.001$

† 7-year dummies are included to control for year-specific heterogeneity. 31 regions include 22 provinces, 4 province-level municipalities, and 5 minority autonomous regions across China