Impact of Innovation Effort on Exports from Emerging Market Firms: Limitations Arising from Complementary Resource Constraints

Impact of Innovation Effort on Exports from Emerging Market Firms: Limitations Arising from Complementary Resource Constraints

Udichibarna Bose (*ubose@essex.ac.uk*)
Essex Business School, University of Essex, Colchester, United Kingdom

Abhijit Sengupta (*abhijit.sengupta@surrey.ac.uk*)
Surrey Business School, University of Surrey, Guildford, United Kingdom (Corresponding Author)

(Accepted Version, Multinational Business Review, December 2024)

Abstract

Purpose

We examine the impact of innovation effort on exports of resource constrained emerging market firms (EMFs), and boundary conditions imposed by complementary tangible and intangible resources on this relationship, using the lens of the Knowledge Based View (KBV).

Design/methodology/approach

Analysis is based on annualized data from 19,057 Indian firms over the period of 2009-2017, controlling for endogeneity and selection bias (using Heckman correction), firm-level controls, year and sectoral fixed effects, within robust Tobit and OLS regressions. Export intensity and R&D intensity are our key dependent and independent variables, respectively.

Findings

The baseline impact of innovation effort on exports is found to be a concave inverted U-shape, exhibiting decreasing returns. Availability of complementary resources significantly impacts the nature of this relationship by weakening it for more resource constrained firms. Faced with relatively greater scale-related constraints, the impact of innovation effort on exports disappears. Greater process-related constraints weaken the relationship as well.

Originality

Theoretically, these findings shed light on a nuanced relationship between a firm's search for knowledge assets and access to foreign markets within resource constrained emerging market contexts. The limitations in the use and applicability of the KBV for EMFs' internationalization success is highlighted, with suggested directions of future research.

Keywords: *Innovation effort, Emerging market firms, Exports, Internationalization, Knowledge Based View, Complementary resources*

1. INTRODUCTION

The literature on emerging market firms has increasingly focused on two parallel phenomena over the last two decades – one, on the growing tendency of emerging market firms (EMFs) to seek foreign markets, particularly by way of exports (Gaur et al., 2014; Luo and Tung, 2007; Ramamurti, 2012; Cuervo-Cazurra et al., 2019); and two, on the increasing innovative capabilities of EMFs with emerging markets transforming themselves as centers of global research and development (R&D) alongside their developed counterparts (Awate et al., 2015; Demirbag and Glaister, 2010; Govindarajan and Ramamurti, 2011; Mudambi, 2011). Scholars have naturally tended to connect these two, and as expected, their studies show that innovation and internationalization are closely related at the firm-level (Cassiman and Golovko, 2011; Saridakis et al., 2019; Singh, 2009). Yet, little attention has been paid to the fact that the act of innovation itself is a costly endeavor requiring sustained investment/effort, and the returns from such effort, particularly in international markets, may be contextualized by factors both internal and external to the firm.

Innovation-related activities such as R&D carried out internally or outsourced externally, are thought to provide firm specific valuable intangible resources, which are both valuable and imperfectly imitable (Foss et al., 2013). In the context of the Resource Based View (RBV) of the firm, knowledge based intangible resources when bundled with complementary tangibles and intangibles, become a key source of competitive advantage and contribute towards superior performance over competitors (Barney, 1991; Barney et al., 2001). Taking this argument further, the Knowledge Based View (KBV) of the firm considers "knowledge" to be the most important strategic resource that a firm can possess, as it acts as the "glue" that binds all other resources together (Grant, 2006; 1996a; 1996b; Pereira and Bamel, 2021). This latter view has been largely validated over the years, in as much as the knowledge assets of a firm does indeed provide it with significant competitive advantages (Bergh et al., 2024), including in foreign markets (Denicolai et al., 2014; Stoian et al., 2024).

While knowledge itself is a valuable resource, the *search* for this knowledge is costly, particularly for firms facing constraints within difficult institutional environments (Love and Roper, 2015). The cost is likely to be even higher when it must cater to stringent requirements and more intensive competition in international markets. Previous literature has shown that a firm's investment in knowledge acquisition can spill over into a firm's export performance – as the resulting intangibles, bundled with its existing tangible resources, help it to establish competitive advantage in new markets (Carnes et al., 2017; Cuervo-Cazurra et al., 2007; Denicolai et al., 2014). This research, however, has mostly been based within developed contexts, where both innovation-related activities are well entrenched institutionally, and which face relative abundance of complementary resources. However, the case of emerging market firms (EMFs) is different, given the overall resource constraints they face and the difficult institutional environments that they exist within (Kaufmann and Roesch, 2012; Ray et al., 2023; Wang and Ma, 2018; Wu et al., 2021). Both innovation and export outcomes are seen to remain suboptimal for many

EMFs, and the link between the effort put into innovation and exports is likely to be complex and dependent on several contextual factors. Internal factors which may affect this relationship include scarcity in financial, capital, and human resources (Singh, 2009), alongside sub-optimal innovation capabilities (Zhang et al., 2007). And external factors include difficulties in the distribution processes, lack of the necessary orientation in foreign markets (Kolbe et al., 2022), weak infrastructure and presence of institutional voids in the legal, political, economic spheres leading to market failures (Meyer et al., 2009), and a lack of well-developed innovation ecosystem (Adner and Kapoor, 2010; Lopez-Vega and Lakemon, 2022).

Thus, it becomes questionable whether the conceptual linkages between knowledge and internationalization, as often articulated on the basis of the KBV (Grant and Phene, 2021; Stoian et al., 2024), can be generalized to emerging markets. First, it is not clear to what extent the *effort* put into acquiring new knowledge *translates into* competitive advantages for EMFs in international markets. Second, even if it does, are there differences within EMFs which result in some benefiting more from the knowledge acquisition effort than others? Thus, while many EMFs are increasingly making their presence felt in international markets by being innovative (Lopez-Vega and Lakemond, 2022; Love and Roper, 2015), a crucial question remains unanswered – is focusing on innovation the primary driver for succeeding in international markets (Ray et al., 2023)? Innovation is a knowledge driven phenomenon, and the KBV positions the stock of knowledge of a firm to be its key strategic resource (Denicolai et al., 2014). Yet resource centric theories such as the KBV (or the RBV, from which it is derived) ignore the cost of searching for and acquiring the strategic resource in question, in this case knowledge. The fact that this search itself may be "sub-optimal" for resource constrained firms is often ignored, both conceptually and empirically, thus making it imperative to explore the linkage between innovation effort and internationalization for EMFs, as we do in this paper.

This paper thus asks the following questions: (a) Given the severe resource constraints the EMFs face, to what extent does an EMF's innovation effort enable its export outcomes? (b) How is this relationship contextualized by an EMF's existing resource endowments? Unlike previous literature (Denicolai et al., 2014; Stoian et al., 2024), we focus on an EMF's innovation effort, rather than on its knowledge stock, and examine its returns on its exports at the margin. This distinction is critical as we claim that under resource constraints, an EMF's search for new knowledge is sub-optimal, that is, additional investments into innovation is unlikely to result in optimal knowledge outcomes, which in turn impacts its ability to exploit international markets through exports (Carnes et al., 2017; Cuervo-Cazurra et al., 2007).

We use the Indian context to unpack the complexities of this relationship. Using a panel data of 84,764 firm-year observations for 19,057 Indian firms over the period of 2009-2017, we establish that the overall relationship between innovation effort and export intensity is contingent on the availability of complimentary tangible and intangible resources. For relatively more resource scarce firms, it is either

non-existent or very weak. However, for relatively richer firms, the relationship is non-linear and exhibits an upper bound, thus establishing the availability of key complementary assets as a critical boundary condition.

Our primary theoretical contribution lies in shedding light on the limitations of the KBV within the internationalization literature in two ways. First, we point out the weakness in the assumed positive causal linkage between knowledge acquisition and internationalization success, focusing on the context of emerging market firms facing resource constraints. Second, we identify a set of boundary conditions which govern these weak links, based on the levels and nature of complementary resources. Our findings add nuance and complexity to the general assumption that focusing on innovation effort leads to advantages in foreign markets (Cassiman and Golovko, 2011; Filippetti et al., 2011; Denicolai et al., 2014), as entrenched in the KBV literature. While prior KBV-based papers focused on the stock of knowledge, our contribution lies in diverting attention to the *path* that a resource constrained EMF can take towards higher stocks of knowledge and its consequences.

Thus, our findings highlight the impact of bundling knowledge creation *effort*, a key determinant of this path, with the slack in key complementary assets of EMFs, in determining competitive advantage in foreign markets, a relatively understudied area in international business (Carnes et al., 2017; Cuervo-Cazurra et al., 2007; Pereira and Bamel, 2021). While emerging nations are increasingly witnessing the growth of export-led high technology sectors spurred by both domestic and foreign investments, our paper opens up new avenues of research for exploring mechanisms through which the KBV is relevant for EMFs and their competitiveness abroad (Falk and de Lemos, 2019). While findings from previous studies are mixed and seem to vary across sectors and countries (Carboni and Medda, 2018; Falk and de Lemos, 2019; Gashi et al., 2014; Máñez et al., 2015; Li and Ding, 2017), this paper anchors the heterogeneity in the innovation-internationalization relationship to firm-level heterogeneity in resource allocations, thus bounding the generalizability of the KBV in resource constrained contexts.

2. BACKGROUND AND HYPOTHESES

The processes of innovation and export-led internationalization among EMFs are active areas of research, where a theoretical consensus is yet to be reached. Researchers continue to debate on whether established theories, largely built upon the experience of multinational enterprises (MNEs) in developed economies, continue to be relevant for EMFs, or whether new theoretical paradigms ought to be explored to understand these, often inter-connected phenomena (Cirera et al., 2015). From a theoretical perspective, both resource centric views (RBV and KBV) and the literature on emerging market institutions recognize that EMFs generally are characterized by a set of unique features and their operations need to be contextualized to the environment they operate in.

First, while the RBV and the KBV point towards the importance of a unique bundling of valuable resources and capabilities for competitive advantage (Barney et al., 2001) it is increasingly clear that EMFs tend to be at a relative *resource disadvantage* compared to their advanced economy counterparts (Cuervo-Cazurra, 2012). The literature has pointed towards several such domestic constraints applicable for EMFs. These may include financial constraints leading to low levels of capital access (Scheela et al., 2015), factor market constraints leading to low productivity (Meyer and Grosse, 2019), technological constraints such as lack of access to newest advances in technology and other high-quality inputs (Child, 2016; Cao et al., 2013; Scheela et al., 2015), as well as lower overall levels of tangible and intangible assets (Awate et al., 2015; Cuervo-Cazurra, 2007).

Second, the corresponding lack of institutional support only exacerbates the resource scarcity and access problem that EMFs face (Meyer et al., 2009; Meyer and Peng, 2016). Institutional weaknesses include deficiencies in governmental and legal support, as well as weak enforcement of existing regulation and bureaucratic inefficiencies. Institutional weaknesses also imply that *access* to high quality complementary resources is difficult for most. These include inputs and raw materials of high quality and specifications, which are difficult to obtain domestically, and are critical for both innovation activities and exports. Due to constraints on availability of skilled human resources and bureaucratic hurdles (Gashi et al., 2014), they also suffer from lack of absorptive capacity and lower productivity in general (Zhang et al., 2007) lowering their ability to exploit new knowledge (Meyer et al., 2009). Additionally, given that the innovation networks are structured fundamentally differently in case of EMFs as compared to their counterparts in developed countries, and corresponding weaknesses within local innovation ecosystems (Adner and Kapoor, 2010), the innovative capabilities of the former develop more slowly and with greater difficulty (Awate et al., 2015), following alternative pathways (Lopez-Vega and Lakemond, 2022). This is even true for EMFs for whom the traditional sources of new knowledge have been through collaborations with developed country firms or recruitment of staff trained abroad (Filatotchev et al., 2009; Wright et al., 2012).

The role of quality of complementary resources available to EMFs is crucial, when it comes to competing in international markets (Landau et al., 2016; LiPuma et al., 2013). EMFs often seek to compete in both domestic and foreign markets using resources which are "ordinary" rather than "superior" (Child, 2019). Thus, even as EMFs are increasingly able to invest in innovation, the lack of complementary resources of sufficient high quality can hinder the efficiency of the underlying innovation processes. The domestic market of the EMF absorbs this limitation of resource quality to a great degree, given that its local competitors are likely to face the same problems. However, exporting to foreign markets with "below-par" resources becomes relatively more difficult for firms facing such constraints. All these lead to high levels of uncertainty and instability in markets, which EMFs have to factor in while managing daily operations and longer-term strategy (Acemoglu and Johnson, 2005; Hoskisson et al., 2000; Hoskisson et al., 2013). Thus, resource constraints are likely to affect an EMF's

ability to carry out both innovation and export activities effectively (Child, 2019; Hoskisson et al., 2013).

Innovation, viewed from a strategy perspective, is closely linked to unique resource and capability bundling, as indicated by the RBV (Anand et al., 2021). The KBV takes this further in two ways. First, it argues that the stock of knowledge itself is a unique strategic resource for the firm, far more valuable and harder to imitate than the other resources, due to its unique historical conditions surrounding its development (Grant, 1996b; Pereira and Bamel, 2021). Second, knowledge helps to bind other resources in path dependent outcomes in ways which are unique to a firm, thus creating valuable and difficult to imitate resource bundles (Grant, 1996a; 1996b). While the importance of the stock of knowledge to a firm is well appreciated, both for developed and emerging contexts, the literature has ignored the importance of the *path* that a firm takes to reach that stock, and role of institutional weaknesses and resource constraints on this path.

2.1 Innovation effort and its impact on exports

Innovation is a core activity of many multinationals (Love and Roper, 2015), especially in high technology and research-intensive industries (Roper et al., 2008). While the role of R&D itself may be less significant in low technology sectors, nevertheless, it is generally accepted that having an innovation focus is beneficial for developing longer term competitive advantage for many (Beneito, 2006). The main pathways that lead to this are: one, through creation of new knowledge which can be harnessed to produce new outputs and set up new processes (Martín-de Castro et al., 2013; Vega-Jurado et al., 2008); and two, by increasing the absorptive capacity of the firm, which then enhances its ability to assess and acquire relevant knowledge externally (Cassiman and Veugelers, 2006).

The role of innovation in a firm's exports has been well studied, mostly in the context of developed economy firms (Falk and de Lemos, 2019; Love and Roper, 2015; Roper and Love, 2002; Saridakis et al., 2019). Several studies having showed a positive linkage between firm-level R&D intensity and its export intensity, but the impact has been seen to vary across sectors and across countries (Carboni and Medda, 2018; Falk and de Lemos, 2019; Máñez et al., 2015; Roper and Love, 2002). At the same time, several studies have also found no evidence of a direct link between the two (D'Angelo, 2012; Gashi et al., 2014), thus giving a mixed picture of the underlying relationship.

Apart from underlying heterogeneity among firms and sectors, an additional reason behind the mixed results is that the link between the two is fraught with endogeneity concerns. Both innovation and entry into foreign markets are costly, leading to self-selection of the most highly productive firms which are able to do both (Clerides et al., 1998). At the same time, it is not surprising that there is evidence of reverse causality as well, that is firms engaging in export behavior seem to enjoy positive spillovers into future innovation outcomes (Freixanet and Rialp, 2021; Golovko and Valentini, 2011).

However, understanding the net impact of innovation effort on exports, distilled of such confounding factors, is especially relevant in the context of resource constraints. Investing in innovation is a resource hungry activity, requiring dedicated skills, capabilities, and capital. Hence, it is not surprising that resource-scarce firms have traditionally demonstrated low levels of effort put into innovation (Awate et al., 2015). This traditionally included EMFs, although this has reversed significantly in recent years, with EMFs increasingly engaged in innovation related activities (Cantwell and Mudambi, 2005; Demirbag and Glaister, 2010).

Generating returns to innovation and subsequent value addition for foreign markets require additional complementary resources and an environment which is supportive of transfer and commercialization of new knowledge efficiently (Lakitan, 2013). Internally, firms would need a well-developed innovation funnel, experienced staff in product/service design and deployment, access to finance and raw materials among other key resources (Gonzáles et al., 2016; Teece, 2010). Externally, the institutional environment needs to support both innovation and export related activities, and reduce uncertainties, bureaucratic and other hurdles (Nelson and Nelson, 2002). Given that EMFs operate in environments where the chances of all internal and external factors to align seamlessly are low, it is likely that the efforts they put into innovation will only have a limited impact on their exports.

2.2 The emerging market context

There has been a gradual shift away from locating the low-value manufacturing and support services in emerging economies (Govindarajan and Ramamurti, 2011) towards high value innovation led activities. This shift has come from two directions (Cantwell and Mudambi, 2005). First, R&D and innovation activities are being located in emerging nations via MNE subsidiaries, taking advantage of lower cost of skilled workforce and complementary resources (Demirbag and Glaister, 2010). Second, domestic firms in emerging nations are focusing on international markets and consequently investing in innovation and R&D to catch up and compete with existing global players (Awate et al., 2015). Thus, a "key phenomenon of the early twenty-first century is the rise of emerging markets as players in extant global R&D networks" (Mudambi, 2011).

A limited number of studies have focused on the interlinkages between firm-level innovation-related outcomes and exports in EMFs in recent years, and factors affecting these linkages. For instance, Edeh et al. (2020) find that within the Nigerian context, product innovations are negatively linked to exports, while process innovations are positively linked to it. A significant proportion of recent studies on internationalization of EMFs have been focused on China. Dong et al. (2022) finds an underlying negative relationship between R&D investments and exports, and which reverses somewhat for foreign owned firms. But the relationship, when patents and inventions are considered instead of R&D investments, is weakly positive. Within the Peruvian context, the relationship between innovation outcomes and exports has been found to be positive as well (Ortigueira-Sánchez et al., 2022). Reddy

and Sasidharan (2023) examine the role of innovation effort on export market survival among Indian firms and find that those investing in R&D experience a lower probability of exiting the export market. Contextual factors such as firm size (Cieslik et al., 2015), production performance (Ortigueira-Sánchez et al., 2022) and time horizon (Hwang et al., 2015) may impact this relationship when it comes to EMFs. Interestingly, Wu et al. (2021) find a positive relationship between innovation (as measured via patents) and exports in the Chinese context, and business group membership (allowing for greater sharing of resources, capabilities and processes) weakens the relationship.

The path to innovation of any kind, product, process or business model related, is fraught with uncertainties and sustained effort on part of the organizations involved. The question that naturally arises is, to what extent does this effort contribute towards providing a competitive edge in international markets, especially so when there is a systemic scarcity of complementary resources (Esteve-Pérez and Rodríguez, 2013; Golovko and Valentini, 2011; Leonidou et al., 2007; Love and Roper, 2015). While some level of exploration of contextual factors have been carried out (ownership, size etc.), our contention is that heterogeneity among EMFs essentially boils down to accessibility to these complementary resources.

While both RBV and KBV essentially put resource configurations at the core of a firm's competitive ability, they consider resources, including knowledge, as given to the firm. In particular, the KBV focuses on a firm's knowledge assets as the key drivers behind long term competitiveness and performance (Foss et al., 2014), including in foreign sales (Denicolai et al., 2014) and global strategy (Grant and Phene, 2022; Stoian et al., 2024). Yet, the path towards attaining this critical knowledge is itself a resource intensive exercise, and theoretical exploration of the value of knowledge resources within resource constrained environments, has ignored this aspect. While the well-known Dynamic Capabilities framework (Teece et al., 2010) incorporate the temporal evolution of resource configurations, it is more relevant for "higher order processes", and less so for operationalization of changes to current resource levels, or the effort put in towards this change, which is where our theorizing is aimed at. We argue that this effort put into innovation has limited impact when it comes to gaining a competitive edge in international markets for resource constrained EMFs, and the limits on the returns are determined by the degree of slack in complementary resources. We develop our primary hypotheses around this idea, below.

2.3 Hypotheses

Innovation effort adds to key intangible resources of the firm in the form of new knowledge – thus enhancing its ability to add value through new offerings and improved processes, which in turn increases its competitive advantage. However, knowledge-based intangibles alone are not sufficient to enable this transformation (Chen et al., 2016). Firms, irrespective of the life-cycle stage they are in, need to assimilate, orchestrate, and manage a portfolio of complementary resources to facilitate

innovation (Carnes et al., 2017; Cuervo-Cazurra et al., 2007). These complementary resources enhance the overall capabilities of a firm, and may be sourced internally (Fuentelsaz et al., 2015) or externally, through collaborations and/or acquisitions (Harrison et al., 2001; King et al., 2003).

Constraints on complementary *generic* resources are a feature in many EMFs (Kaufmann and Roesch, 2012). These often appear in the form of scale, collateral, input, and productivity related constraints, often more so for younger and less mature firms (Child, 2019; Greenaway et al., 2007; Singh, 2009; Manova, 2008). Constraints on access to financial resources, such as credit, banking services, institutional investors etc., and availability of sufficient collateral, are a feature of many emerging markets, and can limit and be limited by the scale of EMF's operations within the domestic market (Bose et al., 2019; Hoskisson et al., 2013). At the same time, EMFs are often restricted by their access to high quality intermediate inputs from international suppliers (Bhaduri and Ray, 2004, Torres Mazzi and Foster-McGregor, 2021), even as they invest in innovation to enhance their overall knowledge stock. Importing these from foreign suppliers implies additional layers of complexity, costs and organizational burden. These generic constraints impact all functions of EMFs adversely, by reducing the efficiency of the marginal unit of effort invested, including innovation.

At the same time, restricted access to complementary *knowledge* resources also affects innovation effort in EMFs more directly. Underdeveloped factor markets within their domestic economies, such as access to research expertise and latest technologies (Hoskisson et al., 2013; Wright et al., 2012), implies more effort is required on part of EMFs to catch up with the knowledge frontier. Institutional weaknesses resulting in underdeveloped or suboptimal innovation ecosystems, with corresponding lack of connectivity with research intermediaries, universities, and other research organizations, compound this problem even further, as a result of low connectivity or low absorptive capacity (Anand et al., 2021; Meyer et al., 2009; Meyer and Grosse, 2019). A suboptimal innovation ecosystem often implies duplication of knowledge generation effort and barriers to commercialization of newly created knowledge, leading to all round inefficiency in knowledge production and utilization (Adner and Kapoor, 2010).

Market-seeking internationalization steps such as exports, while being less risky, usually require radical redesign of products, processes, and standards, different from what is acceptable in the domestic market. Thus, it is likely that when faced with severe constraints in complementary resources, the innovation effort – export linkage will exhibit suboptimality, and that exports from these firms are driven by other contextual factors unrelated to their innovation effort itself.

This is primarily because translation of innovation effort into exports encompasses business activities such as understanding of new markets and consumers, adaptation of existing or discovery of new products, services and processes to new standards, establishing new partnerships in foreign locales, among others. All of these require coordination of various business functions of an EMF with its

innovation arm, along with capital and financial support, and appropriate expertise at multiple points in the value chain, as these need to be combined for translating new knowledge into success in foreign markets. Thus, it is not just newly created knowledge stock or new knowledge creation activities that are key to exports for resource constrained firms, but how existing resources and capabilities are combined and used at various points on the value chain, that determines their export potential. It is here that EMFs are likely to fall behind their developed country counterparts – due to scarcities in generic resources, which are key to efficiency and coordination within the value chain.

Constraints on knowledge resources imply that innovation effort may not translate into appropriate innovation outcomes within the right timeframe and/or within the right specification, resulting in delays, wastage and quality issues in the outcome. Commercialization barriers due to poor ecosystems can hamper the process of getting the innovation ready for the market. Poor quality of innovation ecosystems implies that the necessary externally sourced knowledge is either not available or cannot be absorbed as required. Hence, we expect that for a highly resource constrained EMF, internationalization outcomes such as exports are unresponsive to its effort put into innovating. In the limit, that is, in the case where the constraints are very severe, we expect this relationship to disappear. This leads us to our first hypothesis:

Hypothesis 1. *EMFs which are highly constrained in complementary resources will not exhibit a direct relationship between innovation effort and export outcomes.*

However, we conjecture that this relationship (or the lack of it) changes to a significant degree as slacks appear in an EMF's complementary resources. The extant literature, largely based on the developed economy firms who face relatively higher abundance of tangible and intangible resources, indicates a positive linkage between the two (Esteve-Pérez and Rodríguez, 2013; Golovko and Valentini, 2011; Leonidou et al., 2007; Love and Roper, 2015). However, we argue that within emerging economy contexts, where such resources are less abundant, this relationship is likely to be of a very different nature, even for firms who are relatively resource rich.

First, we argue that the positive relationship is more likely to be present *in the initial stages* of innovation effort when the technological and knowledge base of the EMF is significantly lower than international standards while relative resource richness imply that constraints of complementary resources are less binding. Thus, when an EMF focuses on innovation, the resulting new knowledge is likely to have a significant positive impact on exports in the beginning. New knowledge at this stage can more readily be incorporated into new processes, new products, and services, which cater to international markets better. This is particularly so, as investments in innovation help EMFs to *move up* the value chain through improved products and processes (Singh, 2009), for instance, by moving away from being vendors to own brand businesses (Wang and Wu, 2012). Better, higher quality products also open up newer export markets as these now become more acceptable to a wider international customer

base. This enables EMFs to not only tap into developed markets more effectively, but also establish themselves in emerging and less developed markets, where competitive pressures from the developed market MNEs might be comparatively less.

However, value extraction from even larger investments in innovation effort subsequently is likely to be more difficult even for relatively resource-rich EMFs, as complementary resource constraints start to bind within an institutionally difficult environment. As the scale of innovation effort goes up, the strain on these complementary resources goes up as well, and without additional investments in new infrastructure, new processes around coordinating knowledge production and absorption, the EMF will face an upper bound to the otherwise positive impact of innovation efforts on exports. Given that EMFs are likely to be located in institutionally resource constrained environments, there is a likely dampening effect on how innovation activities stimulate internationalization (Child, 2019; Hoskisson et al., 2013).

Hence, for an EMF with relatively higher levels of resources and *starting* out on innovation activities, the limiting impact of difficult internal and external environments is likely to be minimal. Given the existing levels of complementary resources available to the firm, innovation activities on a relatively smaller scale can be supported and the outcome of innovation can be incorporated into newer products and processes with relative ease. However, as innovation efforts become more resource intensive – for instance, through higher levels of R&D – the resource constraints on the EMF start to bind as the innovation and commercialization functions compete for the finite resources of the firm and the environment, and hence the impact on export success will tend to plateau.

This leads us to hypothesize that a relatively resource-rich EMF's own innovation effort can indeed have a positive impact on exports in the initial stages, this relationship is subject to *decreasing returns*. In fact, the returns are likely to peak at an "optimum" level of innovation activities and subsequently decline as the EMF expands its innovative activities beyond the optimum. This leads us to hypothesize that the relationship between innovation and exports by relatively resource rich EMFs exhibit an inverted U-shape, as expressed in the following hypothesis:

Hypothesis 2. *EMFs which are relatively richer in complementary resources will exhibit an inverted U-shape in their relationship between innovation effort and exports, that is, for low levels of innovation effort, its marginal impact on its exports is positive whereas for relatively higher levels it is negative*.

3. RESEARCH METHODS

3.1 Data

The emerging market context examined here is that of Indian firms over the 2009-2017 period, and provides an interesting case study for the empirical analysis for two main reasons. Firstly, while India is among the fastest-growing economies in the world today, the post 2007-08 global financial crisis era

was marked by a severe slowdown of the economy, along with all round resource crunch faced by domestic firms, leading to a severe fall in private investment and capital formation (Anand and Tulin, 2014). This led to a massive slowdown of private investments and capital formation, along with a decade of policy paralysis within the economy, which is only seeing a reversal now in the post-Covid era. Yet, India's export market continued to be a major contributor to its economy, making it one of the leading exporters worldwide during the same period. Secondly, while India is a world leading exporter, and overall R&D investment in the country has been relatively low, there exists wide variations across sectors and firms (Reddy & Sasidharan, 2023), making the Indian context appropriate for our study.

Data is obtained from the Prowess database provided by the Centre for Monitoring Indian Economy (CMIE), a private research organization in India. The Prowess database covers large and medium-size Indian firms with detailed financial data. Following normal selection criteria, we exclude firm-years with missing values for export sales and other control variables, and observations in the upper and lower 1% tails of the distribution to control for outliers. Finally, we allow for the entry and exit of firms, as the use of an unbalanced panel partially mitigates potential selection and survivorship bias. To deal with potential simultaneity bias, we apply a one-year lag to all independent and control variables and the final panel dataset contains 84,764 firm-year observations for 19,057 Indian firms over the period of 2009-2017.

The primary *dependent variable* in our analysis is firm-level export outcome and is operationalized through annual export intensity (ratio of exports to total sales), which in our sample varies from zero (no exports) to one (fully exporting, no domestic sales). The key *independent variable* of interest is the level of innovation effort and is operationalized through R&D intensity calculated as annual R&D expenditure over total sales. Several measures of complementary resource constraints (both scale and process related) are used, and these are: firm size and total collateral for scale, and levels of domestically available inputs used, total factor productivity, total intangible assets for process related constraints.

Use of domestic inputs is operationalized as (1 – share of *imported inputs*), where the share of *imported inputs* is the percentage share of imported raw materials consumed in total raw materials consumed during the year, as reported in the Prowess data. Firm size is operationalized as the natural logarithm of *total assets*, also reported in the data. Productivity of a firm is operationalized as the *Total Factor Productivity* (TFP), which is estimated using the established Levinsohn and Petrin (2003) methodology. Finally, collateral and intangible assets are operationalized as the natural logarithm of *net fixed assets* and *net intangible assets* respectively, as reported in the data. In general, all else held constant, a *higher value* of any of these indicates a *lower level of constraints* on complementary resources faced by the firm.

The following firm-specific controls are also included to account for inter-firm heterogeneity: *Wage* (natural logarithm of total wage bill), *Debt* (ratio of total debt to total assets), and *age* (natural logarithm

of total number of years since incorporation). Apart from these firm specific factors, we also control for year and year-industry fixed effects to account for business cycles and time-varying sectoral variations.

3.2 Estimation Strategy

Given the nature of the research questions and available data, we adopt panel estimation approach while using the Heckman two-step correction (Heckman, 1979) model to control for selection bias. The first step is estimation of the *selection regression* based on a probit model to estimate the probability of firms' participation in exporting and control for factors that influence firm's decision to export as follows:

$$\text{Prob}\,(EXP\ dummy_{i,m,t}) = f\left(x_{i,m,t}.\alpha + \tau_t + \delta_{m,t} + \nu_{i,m,t}\right) \tag{1}$$

where Prob $\left(EXP\ dummy_{i,m,t} = 1|x_{i,m,t}\right) = \Phi\left(x_{i,m,t}.\alpha\right)$ provides the *probit* specification required for the Heckman correction, with $x_{i,m,t}$ is the vector of exogenous variables for firm i in sector m at time t. Export participation ($EXP\ dummy$) is measured as a binary variable, which takes the value of one for those firms that have export activity, and zero otherwise. τ_t are year fixed effects to account for possible business cycle effects, $\delta_{m,t}$ are *year-sector* fixed effects to control for time-varying industry-specific shocks. Finally, $\nu_{i,m,t}$ are normally distributed idiosyncratic errors (clustered at firm-level), and $\Phi(.)$ is the standard normal cumulative distribution function. Once Equation (1) is estimated for parameters α, and given $\psi(\cdot)$ as the standard normal density function, the Inverse Mills Ratio (IMR) is computed as:

$$\hat{\lambda}_{i,m,t} = \frac{\psi\left(x_{i,m,t}.\hat{\alpha}\right)}{\Phi\left(x_{i,m,t}.\hat{\alpha}\right)} \tag{2}$$

which is then included as an additional regressor in equation (3) to control for selection in *outcome equation* as the second step that tests the relationship between innovation effort and export performance (export intensity) conditional on the export participation decision of firms conducted from the first step. For identification, the Heckman approach requires an exclusion restriction (see Heckman, 1979; Wolfolds and Siegel, 2019; Bendig and Hoke, 2022) in terms of a variable that is highly correlated with the decision to export in the first step but has no (or a very weak) relationship with the export performance in the second step. We use two exclusion variables, namely foreign ownership and sectoral share of exports[1]. Foreign ownership is a dummy variable that captures whether a firm is owned by a

[1] Besides checking the significance level of the selected set of instruments in the first stage to test the strength of a set of instruments statistically, we also carry out additional tests outlined by Certo et al. (2016) and Bendig and Hoke (2022). The correlation between the IMR and the independent variable is a helpful indicator for whether a chosen variable qualifies as an instrument. Furthermore, we find that the pseudo-R-squared values of the first stage is larger after including suitable instruments compared to a first-stage estimation without any instruments (Certo et al., 2016; Papies et al., 2017).

foreign entity and can be used as a proxy for information sunk costs. The literature highlights that information costs can be a major element of exporting sunk costs, and firms can overcome these information barriers by creating linkages with entities that have more overseas experience (Alessandria and Choi, 2007; Roberts and Tybout, 1997), which can help them to continue exporting by getting better access to resources, information and technical expertise, but may not necessarily impact how much they are exporting. Similarly, some studies (Zhao and Zou, 2002; Bleaney and Wakelin, 2008) highlight the effect of industry concentration on export behaviour and find evidence that exporting firms mostly operate in sectors that have significantly higher intra-industry trade, and thus sectoral share of exports can also be used as an exclusion variable that directly affects the decision of firms to export.

Thus, the *outcome equation* is as follows:

$$EXP_{i,m,t} = \beta_0 + \beta_1 RD_{i,m,t} + \beta_2 RD_{i,m,t}^2 + \beta_3 \hat{\lambda}_{i,m,t} + \sum_j \gamma_j y_{i,m,t-1} + \tau_t + \delta_{m,t} + \varepsilon_{i,m,t} \quad (3)$$

where $EXP_{i,m,t}$ represents export intensity of firms measured as the proportion of exports out of the firm's total sales during the year, and given that $0 \leqslant exp_{i,m,t} \leqslant 1$, we use tobit regression estimation. $RD_{i,m,t}$ represents firm specific R&D intensity, $y_{i,m,t-1}$ represents the vector of lagged firm specific controls, τ_t are year fixed effects, $\delta_{m,t}$ are *year-sector* fixed effects, and $\epsilon_{i,m,t}$ are the idiosyncratic errors (clustered at firm-level). Additionally, we also use OLS regressions with similar specifications and fixed effects for robustness.

Finally, the impact of complementary resources on the R&D – export link is tested by carrying out independent estimations of Equations (1) and (3) on sub-samples, where the sub-samples are based on a cut-off point for the size of the moderator in question. For all five measures of scale and process related complementary resources, use of domestic inputs, size, TFP, collateral and intangible assets, where the threshold point is the 75th percentile of the respective distribution of all the firms in that particular year, above which the value is considered "high" enough so that the constraint does not bind, and below which, it is considered "low" (constrained). The test of whether there exists a statistically significant difference in the mean values of the coefficient between the sub-samples is carried out using the appropriate t-statistic. Aside from estimation on the sub-samples, we also present the results of the same on the whole sample as a baseline measure of the impact of R&D intensity on export intensity.

We carry out a series of estimations to test the robustness of our results such as controlling for endogeneity concerns and alternative estimation strategy for moderation analysis. We carry out Heckman-2SLS estimations to address the endogeneity concerns related to sample selection bias, reverse causality and unobserved heterogeneity that may influence the relationship between R&D intensity and export intensity. The Heckman-2SLS approach combines the two-stage Heckman sample

selection model with a two-stage least squares estimator that can solve the sample selection bias in the selection model while simultaneously correcting for reverse causality and unobserved variables (Wooldridge, 2010; Certo et al., 2016). We use sectoral R&D expenditures as an instrument for firm-level R&D intensity based on the literature of applied industrial organisation (Benfratello et al., 2022) as studies show that R&D activity of firms are strongly related to their industry characteristics (technology, product differentiation, etc.) and that's why innovating firms are more concentrated in sectors with significantly higher R&D intensity (Bleaney and Wakelin, 2008). The validity and relevance of these instruments are verified using a number of diagnostic tests, including the Kleibergen-Paap and Hansen tests for under and over identification respectively, and Anderson-Rubin and Stock-Wright tests for weak instruments. These tests confirm that the estimates do not suffer from weak instrument or over-identification problems. Further, we also test the robustness of our moderation results using classic interaction effects in the regressions instead of various cut-off points. The results of these additional robustness tests align with our main results fully and are not included as part of the main manuscript due to brevity reasons but are provided as supplementary material. Overall, the robustness results confirm the findings in our main regression models.

4. FINDINGS

Table 1 reports descriptive statistics of the main variables of interest, reporting means and standard deviations for the whole sample in column 1, and of relevant sub-samples in the following columns. We also report *p*-values for the test of equality of means between different groups (columns 4, 7,10, 13 and 16, respectively). Cross correlations between the variables are reported in Table 2.

[Insert Table 1 here]

[Insert Table 2 here]

We now present the main results of our paper. The estimates of the baseline models, based on the whole sample are presented first (Table 3, Figure 1), followed by results based on the sub-samples (Tables 4-8 and Figures 2-6), with the latter constituting the core of the tests of Hypotheses 1 and 2. The Tobit and OLS results report the marginal effect of each covariate on export intensity, along with standard errors (in parenthesis). The figures show the marginal impact of R&D intensity on export intensity from the OLS estimates, which are fully in agreement with the Tobit estimates. The solid lines in Figures 2-6 represent the marginal impact of R&D intensity on export intensity when *only significant* terms are included (i.e., including coefficients with associated p-values < 0.05 only), whereas the dotted graph represents the same with the inclusion of non-significant terms.

4.1 Baseline results

Table 3 reports the marginal effect of each covariate along with standard errors (in parenthesis) for the baseline estimation model. The estimates of Equation (1) are reported in column 1, followed by the Tobit and OLS estimates of Equation (3) in columns 2 and 3, respectively. The baseline indicates that the effect of R&D intensity (3.47 and 2.28) is positive and significant. Also, the effect of the squared R&D intensity term (-14.74 and -9.46) is negative and significant, implying an inverted U-shape. The marginal impact of R&D intensity on export intensity in the baseline model for the OLS estimates is presented in Figure 1.

[Insert Table 3 here]

[Insert Figure 1 here]

4.2 Impact of resource constraints

Five sources of resource constraints are considered – the use of domestic inputs, firm size, productivity, collateral, and intangible assets. The corresponding results are presented in Tables 4-8, respectively, with first-stage Probit results in columns 1 and 2, followed by second stage Tobit/OLS estimates in columns 3-6, for sub-sample of firms with relatively higher resource availability (firms above 75^{th} percentile for the given resource in question) in columns 3 and 5, and relatively more resource scarcity in columns 4 and 6 (rest of the firms).

[Insert Tables 4-8 here]

First, we consider the availability of domestic inputs (Table 4). In columns 3 (Tobit) and 5 (OLS), representing firms with high use of domestic inputs, the marginal effect of R&D intensity (5.39 and 3.75) is positive, while that of squared R&D intensity (-27.64 and -18.55, respectively) is negative. Thus, the relationship has an inverted U-shape. However, columns 4 (Tobit) and 6 (OLS), representing firms with low use of domestic inputs, show that the effect of the first order R&D term (2.90 and 1.76) is positive and lower in value, and the second order terms are also negative and statistically significant (-11.40 and –6.63). The difference between the two sub-samples, in terms of the R&D intensity – export intensity relationship is significant at 5% level of significance and can be seen in Figure 2.

[Insert Figure 2 here]

Next, we consider the impact of firm size on the R&D - export relationship, as presented in Table 5. The difference between firms which are relatively large versus small is, once again, quite stark. While the larger firms exhibit an inverted U-shaped R&D – export relationship, for relatively smaller firms, no relationship, not even a linear one is evident. This can be seen in the positive effect of R&D intensity (4.58 and 3.22) followed negative effect of R&D intensity squared (-18.24 and -12.43) for the sub-sample of larger firms, whereas for smaller firms, neither coefficient is significant (although they are of

the right sign). The difference between the two sub-samples, in terms of the R&D intensity – export intensity relationship is significant at 1% level of significance and can be seen in Figure 3.

[Insert Figure 3 here]

The impact of total factor productivity (TFP) is presented in Table 6. The nature of the impact of TFP is very similar to that of reliance on domestic inputs discussed earlier. For the sub-sample of firms whose TFP is high, the relationship is an inverted U-shaped one (marginal effects for R&D intensity and R&D intensity squared are 6.39 and -45.22 respectively in case of Tobit, and 3.39 and -17.03 for OLS). For firms with lower TFP, the marginal effect of R&D intensity (2.90 and 1.85 for Tobit and OLS, respectively) is positive and significant, and the squared terms are also negative and statistically significant. The difference between the two sub-samples, in terms of the R&D intensity – export intensity relationship is significant at 1% level of significance and can be seen in Figure 4.

[Insert Figure 4 here]

Next, we examine the impact of collateral on the same relationship between R&D and exports, presented in Table 7. The nature of the impact of collateral is very similar to that of firm size discussed earlier. For the sub-sample of more collateralized firms, the relationship is an inverted U-shaped one (marginal effects for R&D intensity and R&D intensity squared are 5.25 and -25.33 respectively in case of Tobit, and 3.51 and -17.65 for OLS). For less collateralized firms, the marginal effect of R&D intensity is positive and significant, and the squared terms are negative and statistically significant. The difference between the two sub-samples, in terms of the R&D intensity – export intensity relationship is significant at 1% level of significance and can be seen in Figure 5.

[Insert Figure 5 here]

Finally, we examine the impact of intangible assets on the relationship between R&D and exports, presented in Table 8. For the sub-sample of firms with more intangibles, the relationship is an inverted U-shaped one (marginal effects for R&D intensity and R&D intensity squared are 3.40 and -15.99 respectively in case of Tobit, and 2.35 and -11.24 for OLS). For firms with lower intangibles, the relationship becomes linear as the marginal effect of R&D intensity (3.03 and 1.84) is positive, while the squared terms are insignificant. The difference between the two sub-samples, in terms of the R&D intensity – export intensity relationship is significant at 10% level of significance and can be seen in Figure 6.

[Insert Figure 6 here]

Overall, the pattern is quite clear from Tables 4-8 and Figures 2-6. When resource constraints are less binding (more domestically available inputs, large firm size, high productivity, more collateral and

intangible assets), the relationship is inverted U-shaped. For these firms, starting from a low level, increase in R&D intensity is associated with increased export intensity, and effect reverses beyond an optimal threshold of R&D. For resource scarce EMFs, R&D intensity is able to influence exports, either not at all (as in the case of small firms) or to a far lesser extent compared to relatively resource rich firms. Even if the non-significant terms are considered (represented in the dotted line graphs in Figures 2-6), we can see that the curvatures of the graphs are different, with that of the resource rich firms being greater than the resource constrained ones. The exports are relatively more responsive to R&D in case of the former than the latter (except in the region of optimality, where the non-linear graph plateaus).

Thus, the evidence in favour of Hypothesis 1 is slightly weak, but are in the right direction (i.e., the relationship does not disappear altogether, but weakens significantly). And we find firm evidence for Hypothesis 2. All the above results pass the additional robustness tests.

5. DISCUSSION

EMFs generally face a wide array of constraints around the availability of key tangible and intangible resources due to widespread institutional and environmental weaknesses (Meyer et al., 2009; Yiu and Lau, 2008). However, EMFs are also increasingly investing in innovation-related activities such as R&D as a means of enhancing their competitive advantage in international markets (Mudambi, 2011). Innovative EMFs are expected to enjoy competitive advantages in new markets, as new knowledge and technological capabilities developed on their own enable them to move up the value chain as well as offer better products and services in line with international standards (Wang and Wu, 2012; Singh, 2009).

The KBV highlights the role of knowledge as the key resource a firm, in this case an EMF, and which can enhance its competitive advantage in international markets. The KBV perspective has been instrumental in examining the internationalization phenomenon from various perspectives (Stoian et al., 2024). This paper sheds light on this conceptual linkage from the perspective of an EMF's knowledge creation *effort* and its attempt to access international markets through exports. Results show that the linkage is complex, non-linear, and conditioned on the slack in complementary resources. We find that when complementary resource levels are low for an EMF, the focal linkage is weak and even sometimes non-existent, thus making innovation effort inefficient. On the other hand, when the levels of these complementary resources are *relatively* high, a stronger link between innovation effort and exports exist, but bound from above. In the latter case innovation effort is more efficient in terms of boosting exports than the former, that is, same marginal increase in innovation effort can bring about relatively better export outcomes, but up to a threshold in effort, and any further effort is met with a detrimental effect on exports. Our analysis thus implies that for EMFs in general, the effectiveness of new knowledge generation activities is limited by the levels of complementary resource constraints,

thus bringing into question the supremacy of knowledge assets, as suggested on the basis of the KBV. Thus, EMFs can under- or over-invest in their attempt to be innovative, in both cases preventing export outcomes from reaching their optimal levels.

As seen earlier, intermediate inputs, productivity and intangibles are mostly related to the process of production, while firm size and collateral are related to the scale of production. The results indicate that when EMFs face more severe scale-related constraints, the relationship between innovation effort and exports disappear completely, implying that a firm's own innovation effort becomes redundant as far as access to foreign markets are concerned. Given that firm size represents overall scale, which is difficult for EMFs to change in the short run, investments in longer term scale economies (reducing per unit cost of production) ought to be a strategic priority for EMFs over focusing on costly R&D or related effort to boost innovation. This is not the case when resource constraints are binding via collateral/fixed assets or on the production process, and innovation effort can still improve export outcomes, but the incremental effect is significantly smaller.

Our findings have crucial theoretical implications for the linkage between innovation and internationalization, particularly when examined through the lens of the KBV. Both these put resource bundling and configurations at their core to explain the competitive advantage of firms (Barney, 1991; Grant 1996a; 2006). However, in both, a firm's current competitive scope is explained through current configurations of key resources. This paper extends their theoretical scope and contributes to a greater understanding of the innovation – internationalization linkage in two ways.

Firstly, our analysis anchors the heterogeneity in the innovation effort – exports linkage firmly with the underlying heterogeneity in complementary resources, which emerges as a key boundary condition on the applicability of the KBV for internationalization of EMFs. Second, it goes to the foundations of the KBV, which claims knowledge is the most important strategic resource a firm possesses (Bergh et al., 2023; Grant, 1996a; 2006). Previous studies set in developed contexts have indicated mixed findings, (Carboni and Medda, 2018; D'Angelo, 2012; Falk and de Lemos, 2019; Gashi et al., 2014; Love and Roper, 2015; Máñez et al., 2015; Saridakis et al., 2019), as have those recent ones set in emerging contexts (Dong et al., 2022; Edeh et al., 2020; Reddy and Sasidharan, 2023).

Whereas previous studies were generally silent on the root cause of this variance in the relationship or did so with a limited examination of firm-level factors, we identify variation in complementary resources to be the driver of this heterogeneity. Wu et al.'s (2021) findings for firms in business groups point towards the role of resource sharing, scale economies and potential institutional effects on the relationship. This points towards limitations of the KBV within emerging market contexts, in its prioritizing knowledge above all other resources. Denicolai et al. (2014) in fact a find an inverted U-shaped relationship between intangible knowledge assets and exports, along with a key role played by complementary tangible assets in this relationship. Our paper takes this further and shows that even the

effort to build knowledge assets is fraught with barriers in a resource constrained environment and suggests a re-thinking of knowledge alone as the key strategic asset along the lines of the KBV. In particular, the use of the KBV within emerging market contexts for studying internationalization may not be suitable, without due consideration to unique extenuating factors that EMFs face, as suggested by Ray et al. (2023).

A direct theoretical implication of presenting knowledge resources as somehow being superior to other resources, or as a key factor in augmenting other resources (Bergh et al., 2023), is that the *search* for knowledge-based resources ought to be the strategic priority of all firms, and that this is likely to result in unambiguous improvement in performance, all else held equal. In contrast, our findings suggest otherwise, at least as far as export performance is concerned, the search for knowledge is largely ineffective when complementary resources are hard to access. Thus, contrary to what the KBV implies, the search for knowledge cannot always be a strategic priority for EMFs seeking international success, in the presence of resource constraints. As echoed in Ray et al., (2023), our paper also suggests that EMFs will have to strategize their investments differently, in keeping with the environmental limitations they face, and not rely purely on activities such as R&D in boosting their internationalization potential and performance. Future research needs to focus on the path taken by EMFs towards acquiring knowledge and complementary resource bundling, and not just on the impact of the stock of knowledge (Bergh et al., 2024; Pereira and Bamel, 2021).

The managerial implications of our study for EMFs, are quite clear. There is a definite shift in the locus of global R&D (Awate et al., 2015; Govindarajan and Ramamurti, 2011; Mudambi, 2011), with increasing emphasis on new knowledge creation in emerging markets. This new knowledge is used to address domestic challenges as well as to address global markets, as EMFs also internationalize at the same time. EMFs operate within resource constrained environments, and both addressing the *current* needs of the international market while investing in costly innovation activities to address *future* needs can be a heavy drain on resources. Thus, while investing in innovation effort may potentially help access international markets, their impact will remain bounded without holistic approach towards enhancing overall resource endowments.

5.2 Limitations and conclusion

This paper makes an important theoretical contribution to the understanding of EMFs' export competitiveness through effort in innovation, by examining the role of underlying resource endowments. At the same time, it is not without its limitations. First, the focus of this paper has been on exports as the means of reaching international markets. While exports are the most widely used mode of entry by EMFs into international markets (Gaur et al., 2014), there is growing adoption of others such as joint ventures, M&As, direct investments, etc. However, such moves are generally made by larger and more well-established firms with better access to resources domestically and globally. Hence,

examining export-led internationalization may be limiting, but it does help to capture the inter-firm variation in resource constraints better. Second, while we examine R&D activity only, generally innovation spans a wider range of activities. R&D does capture a firm's innovation effort to a large extent, but not fully, as the nature of the data available restricted us to the use of R&D investments only. Our definition of R&D is broad, and includes *any* form of R&D investments made – internally, externally, through collaborations etc.

In summary, our paper explores the role of tangible and intangible resources in determining the nature of the innovation effort – exports relationship in EMFs, where the former is measured through R&D intensity. This relationship is non-linear, with an upper bound, and is also contextualized by the availability of specific tangible resources. Alternative scenarios and strategies can then be devised for EMFs with varying levels of resource endowments, regarding how important innovation effort is exports, if at all. The paper makes a novel contribution to the growing field of internationalization by innovative firms from emerging market economies, by drawing up key boundary conditions on internationalization via exports.

REFERENCES

Acemoglu, D., & Johnson, S. (2005) 'Unbundling Institutions', *Journal of Political Economy* 113(5), 949–995.

Adner, R., and Kapoor, R. (2010) 'Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations', *Strategic Management Journal* 31(3), 306–333.

Alessandria, G., and Choi, H. (2007). Do sunk costs of exporting matter for net export dynamics? *The Quarterly Journal of Economics*, *122*(1), 289–336.

Anand, R., and Tulin, M. V. (2014) 'Disentangling India's investment slowdown'. International Monetary Fund, 2014(47).

Anand, J., McDermott, G., Mudambi, R., & Narula, R. (2021) 'Innovation in and from emerging economies: New insights and lessons for international business research', *Journal of International Business Studies* 52(4), 545–559.

Awate, S., Larsen, M. M., and Mudambi, R. (2015) 'Accessing vs sourcing knowledge: A comparative study of R&D internationalization between emerging and advanced economy firms', *Journal of International Business Studies* 46(1), 63–86.

Barney, J. (1991). 'Firm Resources and Sustained Competitive Advantage', Journal of Management, 17(1), 99–120.

Barney, J., Wright, M., and Ketchen, D. J. (2001) 'The resource-based view of the firm: Ten years after 1991' *Journal of Management* 27(6), 625–641.

Bergh, D. D., D'Oria, L., Crook, T. R., & Roccapriore, A. (2024). 'Is knowledge really the most important strategic resource? A meta-analytic review', *Strategic Management Journal*.

Bendig, D. and Hoke, J. (2022) Correcting Selection Bias in Innovation and Entrepreneurship Research: A Practical Guide to Applying the Heckman Two-Stage Estimation. Available at SSRN 4105207

Beneito, P. (2006) 'The innovative performance of in-house and contracted R&D in terms of patents and utility models', *Research Policy* 35(4), 502–517.

Benfratello, L., Bottasso, A. and Piccardo, C., (2022). 'R&D and export performance: exploring heterogeneity along the export intensity distribution', *Journal of Industrial and Business Economics* 49, 189–232.

Bhaduri, S. and Ray, A. S. (2004) 'Exporting through technological capability: Econometric evidence from India's pharmaceutical and electrical/electronics firms', *Oxford Development Studies* 32(1), 87–100.

Bleaney, M., and Wakelin, K., (2008). 'Efficiency, innovation and exports, Oxford Bulletin of Economics and Statistics' 64(1), 3-15.

Bose, U., MacDonald, R. and Tsoukas, S. (2019) 'Policy Initiatives and Firms' Access to External Finance: Evidence from a Panel of Emerging Asian Economies?' *Journal of Corporate Finance* 59, 162–84.

Cantwell, J., and Mudambi, R. (2005) 'MNE competence-creating subsidiary mandates', *Strategic Management Journal* 26(12), 1109–1128.

Cao, C., Li, N., Li, X., and Liu L. (2013) 'Reforming China's S&T system' *Science* 341: 460– 462.

Carboni, O. A. and Medda, G. (2018) 'R&D, export and investment decision: evidence from European firms', *Applied Economics* 50(2), 187–201.

Carnes, C.M., Chirico, F., Hitt, M.A., Huh, D.W. and Pisano, V. (2017) 'Resource Orchestration for Innovation: Structuring and Bundling Resources in Growth- and Maturity-Stage Firms', *Long Range Planning* 50(4), 472–486.

Cassiman, B. and Golovko, E. (2011) 'Innovation and internationalization through exports', *Journal of International Business Studies* 42(1), 56–75.

Cassiman, B. and Veugelers, R. (2006) 'In Search of Complementarity in Innovation Strategy: Internal R&D and External Knowledge Acquisition', *Management Science* 52(1), 68–82.

Certo, S. T., Busenbark, J. R., Woo, H.-S., and Semadeni, M. (2016). 'Sample selection bias and Heckman models in strategic management research', *Strategic Management Journal*, 37(13), 2639-2657.

Chen, Y., Vanhaverbeke, W., & Du, J. (2016) 'The interaction between internal R&D and different types of external knowledge sourcing: An empirical study of Chinese innovative firms', *R&D Management* 46(S3), 1006–1023.

Child, J. (2016) Building the innovation capacity of SMEs in China. In A. Y. Lewin, M. Kenney, and J. P. Murmann (Eds.), *China's innovation challenge*: 189–218. Cambridge: Cambridge University Press.

Child, J. (2019) Innovation and Internationalization of SMEs in Emerging Markets. In R. Grosse and K. E. Meyer (Eds.), *The Oxford Handbook of Management in Emerging Markets*, Oxford University Press.

Cieślik, A., Qu, Y., and Qu, T. (2018) 'Innovations and Export Performance: Firm Level Evidence from China'. *Entrepreneurial Business and Economics Review*, 6(4), Article 4.

Cirera, X., Marin, A. and Markwald, R. (2015) 'Explaining export diversification through firm innovation decisions: The case of Brazil', *Research Policy* 44(10), 1962–1973.

Clerides, S. K., Lach, S. and Tybout, J. R. (1998) 'Is learning by exporting important? Micro-dynamic evidence from Colombia, Mexico, and Morocco', *Quarterly Journal of Economics* 113(3), 903–947.

Cuervo-Cazurra, A. (2012) 'Extending theory by analyzing developing country multinational companies: Solving the Goldilocks debate', *Global Strategy Journal* 2(3), 153–167.

Cuervo-Cazurra, A., Carneiro, J., Finchelstein, D., Duran, P., Gonzalez-Perez, M. J., Montoya, M. A., Reyes, A. B., Fleury, T. L., Newburry, W., (2019) 'Uncommoditizing strategies by emerging market firms', *Multinational Business Review* 27(2), 141-177.

Cuervo-Cazurra, A., Maloney, M. M. and Manrakhan, S. (2007) 'Causes of the difficulties in internationalization', *Journal of International Business Studies* 38(5), 709–725.

D'Angelo, A. (2012) 'Innovation and export performance: a study of Italian high-tech SMEs', *Journal of Management & Governance* 16(3), 393–423.

Demirbag, M. and Glaister, K. W. (2010) 'Factors Determining Offshore Location Choice for R&D Projects: A Comparative Study of Developed and Emerging Regions', *Journal of Management Studies* 47(8), 1534–1560.

Denicolai, S., Zucchella, A. and Strange, R. (2014) 'Knowledge assets and firm international performance', *International Business Review* 23(1), 55–62.

Dong, G., Kokko, A., and Zhou, H. (2022) 'Innovation and export performance of emerging market enterprises: The roles of state and foreign ownership in China' *International Business Review* 31(6), 102025.

Edeh, J. N., Obodoechi, D. N., and Ramos-Hidalgo, E. (2020) 'Effects of innovation strategies on export performance: New empirical evidence from developing market firms', *Technological Forecasting and Social Change* 158, 120167.

Esteve-Pérez, S. and Rodríguez, D. (2013) 'The dynamics of exports and R&D in SMEs', *Small Business Economics* 41(1), 219–240.

Filippetti, A., Frenz, M. and Ietto-Gillie, G. (2011) 'Are innovation and internationalization related? An analysis of European countries', *Industry and Innovation*, 18(5), 437–459.

Falk, M. and de Lemos, F. F. (2019) 'Complementarity of R&D and productivity in SME export behavior', *Journal of Business Research* 96, 157–168.

Filatotchev, I., Liu, X., Buck, T. and Wright, M. (2009) 'The export orientation and export performance of high-technology SMEs in emerging markets: The effects of knowledge transfer by returnee entrepreneurs', *Journal of International Business Studies* 40(6), 1005–1021.

Foss, N.J., Lyngsie, J. and Zahra, S.A. (2013) 'The role of external knowledge sources and organizational design in the process of opportunity exploitation', *Strategic Management Journal* 34(12), 1453–1471.

Freixanet, J. and Rialp, J. (2021) 'Disentangling the relationship between internationalization, incremental and radical innovation, and firm performance', *Global Strategy Journal*, In Press.

Fuentelsaz, L., Garrido, E. and Maicas, J. P. (2015) 'Incumbents, technological change and institutions: How the value of complementary resources varies across markets', *Strategic Management Journal* 36(12), 1778–1801.

Gashi, P., Hashi, I. and Pugh, G. (2014) 'Export behaviour of SMEs in transition countries', *Small Business Economics* 42(2), 407–435.

Gaur, A. S., Kumar, V. and Singh, D. (2014) 'Institutions, resources, and internationalization of emerging economy firms', *Journal of World Business* 49(1), 12–20.

Golovko, E., and Valentini, G. (2011) 'Exploring the complementarity between innovation and export for SMEs' growth' *Journal of International Business Studies* 42(3): 362–380.

González, X., Miles-Touya, D. and Pazó, C. (2016) 'R&D, worker training and innovation: firm-level evidence', *Industry and Innovation* 23(8), 694–712.

Govindarajan, V., and Ramamurti, R. (2011) 'Reverse innovation, emerging markets, and global strategy', *Global Strategy Journal* 1(3–4), 191–205.

Grant, R. M. (1996a) 'Toward a knowledge-based theory of the firm', *Strategic Management Journal* 17(S2), 109–122.

Grant, R. M. (1996b). 'Prospering in Dynamically-Competitive Environments: Organizational Capability as Knowledge Integration', *Organization Science*, 7(4), 375–387.

Grant, R. M. (2006). The Knowledge-Based View of the Firm. In A. Campbell & D. O. Faulkner (Eds.), *The Oxford Handbook of Strategy: A Strategy Overview and Competitive Strategy*. Oxford University Press.

Grant, R. and Phene, A. (2022) 'The knowledge based view and global strategy: Past impact and future potential', *Global Strategy Journal* 12(1), 3–30.

Greenaway, D., Guariglia, A., and Kneller, R. (2007) 'Financial factors and exporting decisions', *Journal of International Economics* 73, pp. 377-395.

Harrison, J.S., Hitt, M.A., Hoskisson, R.E. and Ireland, R.D. (2001) 'Resource complementarity in business combinations: Extending the logic to organizational alliances', *Journal of Management* 27(6), 679–690.

Heckman, J. (1979) 'Sample Specification Bias as a Selection Error', *Econometrica* 47(1), 153–162.

Hoskisson, R. E. et al. (2000) 'Strategy in Emerging Economies', *Academy of Management Journal* 43(3), 249–267.

Hoskisson, R.E., Wright, M., Filatotchev, I. and Peng, M.W. (2013) 'Emerging Multinationals from Mid-Range Economies: The Influence of Institutions and Factor Markets', *Journal of Management Studies* 50(7), 1295–1321.

Hwang, Y.-S., Hwang, M.-H., and Dong, X. (2015) 'The Relationships Among Firm Size, Innovation Type, and Export Performance with Regard to Time Spans', *Emerging Markets Finance and Trade* 51(5), 947–962.

Kaufmann, L. and Roesch, J.-F. (2012) 'Constraints to Building and Deploying Marketing Capabilities by Emerging Market Firms in Advanced Markets', *Journal of International Marketing* 20(4), 1–24.

King, D. R., Covin, J. G. and Hegarty, W. H. (2003) 'Complementary Resources and the Exploitation of Technological Innovations', *Journal of Management* 29(4), 589–606.

Kolbe, D., Frasquet, M., Calderon, H. (2022) 'The role of market orientation and innovation capability in export performance of small- and medium-sized enterprises: a Latin American perspective', *Multinational Business Review* 30(2), 289-312.

Lakitan, B. (2013) 'Connecting all the dots: Identifying the "actor level" challenges in establishing effective innovation system in Indonesia', *Technology in Society* 35(1), 41–54.

Landau, C., Karna, A., Richter, A., and Uhlenbruck, K. (2016) 'Institutional leverage capability: creating and using institutional advantages for internationalization' *Global Strategy Journal* 6(1): 50–68.

Leonidou, L.C., Katsikeas, C.S., Palihawadana, D. and Spyropoulou, S. (2007) 'An analytical review of the factors stimulating smaller firms to export: Implications for policy-makers', *International Marketing Review* 24(6), 735–770.

Levinsohn, J. and Petrin, A. (2003) 'Estimating Production Functions Using Inputs to Control for Unobservables', *Review of Economic Studies* 70(2), 317–341.

Li, F., Ding, D. (2017) 'The dual effects of home country institutions on the internationalization of private firms in emerging markets: Evidence from China', *Multinational Business Review* 25(2), 128-149.

LiPuma, J. A., Newbert, S. L., and Doh, J. P. (2013) 'The effect of institutional quality on firm export performance in emerging economies: A contingency model of firm age and size' *Small Business Economics* 40(4): 817–841.

Lopez-Vega, H., and Lakemond, N. (2022) 'Tapping into emerging markets: EMNEs' strategies for innovation capability building', *Global Strategy Journal* 12(2), 394–417.

Love, J. H. and Roper, S. (2015) 'SME innovation, exporting and growth: A review of existing evidence', *International Small Business Journal: Researching Entrepreneurship* 33(1), 28–48.

Luo, Y. and Tung, R. L. (2007) 'International expansion of emerging market enterprises: A springboard perspective', *Journal of International Business Studies* 38(4), 481–498.

Máñez, J. A., Rochina-Barrachina, M. E. and Sanchis-Llopis, J. A. (2015) 'The dynamic linkages among exports, R&D and productivity', *World Economy* 38(4), 583-612.

Manova, K. (2008) 'Credit constraints, equity market liberalizations and international trade', *Journal of International Economics* 76(1), 33-47.

Martín-de Castro, G., Delgado-Verde, M., Navas-López, J. E., & Cruz-González, J. (2013) 'The moderating role of innovation culture in the relationship between knowledge assets and product innovation', *Technological Forecasting and Social Change* 80(2), 351–363.

Meyer, K.E., Estrin, S., Bhaumik, S. and Peng, M (2009) 'Institutions, resources, and entry strategies in emerging economies', *Strategic Management Journal* 30(1), 61–80.

Meyer, K. E. and Grosse, R. (2019) 'Introduction to Managing in Emerging Markets', in Grosse, R. and Meyer, K. E. (eds) *The Oxford Handbook of Management in Emerging Market*s. Oxford University Press, 1–56.

Meyer, K. E., and Peng, M. W. (2016) 'Theoretical foundations of emerging economy business research' *Journal of International Business Studies* 47(1), 3–22.

Mudambi, R. (2011) 'Hierarchy, coordination, and innovation in the multinational enterprise', *Global Strategy Journal* 1(3–4), 317–323.

Nelson, R. R. and Nelson, K. (2002) 'Technology, institutions, and innovation systems', *Research Policy* 31(2), 265–272.

Papies, D., Ebbes, P., and Van Heerde, H. J. (2017). Addressing endogeneity in marketing models. In P. S. H. Leeflang, J. E. Wieringa, T. H. A. Bijmolt, and K. H. Pauwels (Eds.), *Advanced methods for modeling markets* (pp. 581-627). Springer.

Ortigueira-Sánchez, L. C., Welsh, D. H. B., and Stein, W. C. (2022) 'Innovation drivers for export performance' *Sustainable Technology and Entrepreneurship* 1(2), 100013.

Pereira, V., & Bamel, U. (2021) 'Extending the resource and knowledge based view: A critical analysis into its theoretical evolution and future research directions', *Journal of Business Research*, 132, 557–570.

Ramamurti, R. (2012) 'What is really different about emerging market multinationals?' *Global Strategy Journal* 2(1), 41–47.

Ray, P., Ray, S. and Kumar, V. (2023) 'A knowledge-based view of emerging market firm internationalization: the case of the Indian IT industry', *Journal of Knowledge Management* 27(4), 1086–1108.

Reddy, K., and Sasidharan, S. (2023) 'Innovative efforts and export market survival: Evidence from an emerging economy', *Technological Forecasting and Social Change* 186, 122109.

Roberts, M. J., & Tybout, J. R. (1997). 'The decision to export in Colombia: An empirical model of entry with sunk costs.' *The American Economic Review, 87,* 545–564.

Roper, S., Du, J. and Love, J. H. (2008) 'Modeling the innovation value chain', *Research Policy* 37, 961–977.

Roper, S. and Love, J. H. (2002) 'Innovation and export performance: Evidence from the UK and German manufacturing plants', *Research Policy* 31(7), 1087-1102.

Saridakis, G., Idris, B., Hansen, J.M. and Dana, L.P. (2019) 'SMEs' internationalisation: When does innovation matter?', *Journal of Business Research* 96, 250–263.

Scheela, W., Isidro, E., Jittrapanun, T., and Trang, N. T. T. (2015) 'Formal and informal venture capital investing in emerging economies in Southeast Asia' *Asia Pacific Journal of Management* 32(3): 597–617.

Singh, D. A. (2009) 'Export performance of emerging market firms', *International Business Review* 18(4), 321–330.

Stoian, M.-C., Tardios, J.A. and Samdanis, M. (2024) 'The knowledge-based view in international business: A systematic review of the literature and future research directions', *International Business Review* 33(2), 102239.

Teece, D. J. (2010) 'Technological innovation and the theory of the firm: The role of enterprise-level knowledge, complementarities, and (dynamic) capabilities', in Hall, B. H. and Rosenberg, N. (eds) *Handbook of the Economics of Innovation*. North-Holland, 679–730.

Torres Mazzi, C. and Foster-McGregor, N. (2021) 'Imported intermediates, technological capabilities and exports: Evidence from Brazilian firm-level data', *Research Policy* 50(1), 104141.

Vega-Jurado, J., Gutiérrez-Gracia, A., Fernández-de-Lucio, I. and Manjarrés-Henríquez, L. (2008) 'The effect of external and internal factors on firms' product innovation', *Research Policy* 37(4), 616–632.

Wang, W. and Ma, H. (2018) 'Export strategy, export intensity and learning: Integrating the resource perspective and institutional perspective', *Journal of World Business* 53(4), 581–592.

Wang, H.-W. and Wu, M.-C. (2012) 'Business type, industry value chain, and R&D performance: Evidence from high-tech firms in an emerging market', *Technological Forecasting and Social Change* 79(2), 326–340.

Wolfolds, S. E. and Siegel, J. (2019) 'Misaccounting for endogeneity: The peril of relying on the

Heckman two-step method without a valid instrument', *Strategic Management Journal*, 40(3), 432-462.

Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel Data*. MIT press, Cambridge, MA.

Wright, M., Liu, X. and Filatotchev, I. (2012) 'Returnee Entrepreneurs: Resource Orchestration, Context and Knowledge Spillovers', in. Emerald Group Publishing Limited, 243–263.

Wu, L., Wei, Y. and Wang, C. (2021) 'Disentangling the effects of business groups in the innovation-export relationship', *Research Policy* 50(1), 104093.

Yiu, D. W. and Lau, C. M. (2008) 'Corporate entrepreneurship as resource capital configuration in emerging market firms', *Entrepreneurship: Theory and Practice* 32(1), 37–57.

Zhang, Y., Li, H., Hitt, M. and Cui, G. (2007) 'R&D intensity and international joint venture performance in an emerging market: moderating effects of market focus and ownership structure', *Journal of International Business Studies* 38(6), 944–960.

Zhao, H. and Zou, S., (2002). 'The Impact of Industry Concentration and Firm Location on Export Propensity and Intensity: An Empirical Analysis of Chinese Manufacturing Firms. Journal of International Marketing', 10(1), 52-71.

TABLE 1: Summary statistics (Mean and Standard Deviation)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	Whole sample	*More domestic inputs*	*Less domestic inputs*	*p-value*	*Larger firms*	*Smaller firms*	*p-value*	*High TFP*	*Low TFP*	*p-value*	*More collateral*	*Less collateral*	*p-value*	*More intangibles*	*Less intangibles*	*p-value*
EXP	0.103	0.161	0.094	0.000	0.128	0.089	0.000	0.112	0.078	0.000	0.110	0.081	0.000	0.126	0.092	0.000
	(0.230)	(0.240)	(0.227)		(0.239)	(0.223)		(0.240)	(0.198)		(0.239)	(0.196)		(0.243)	(0.222)	
RD intensity	0.011	0.012	0.009	0.000	0.012	0.010	0.000	0.012	0.008	0.000	0.010	0.010	0.105	0.012	0.010	0.000
	(0.023)	(0.025)	(0.018)		(0.026)	(0.021)		(0.024)	(0.019)		(0.022)	(0.023)		(0.024)	(0.022)	
Squared RD	0.001	0.001	0.000	0.000	0.001	0.001	0.000	0.001	0.000	0.001	0.001	0.001	0.268	0.001	0.001	0.096
	(0.004)	(0.004)	(0.002)		(0.003)	(0.004)		(0.004)	(0.003)		(0.004)	(0.003)		(0.003)	(0.004)	
Size	6.553	7.322	6.433	0.000	8.471	5.502	0.000	6.944	6.407	0.000	6.674	6.511	0.000	6.989	6.343	0.000
	(1.871)	(1.505)	(1.893)		(0.925)	(1.352)		(1.816)	(1.870)		(1.931)	(1.848)		(1.599)	(1.953)	
Wages	3.439	4.453	3.267	0.000	4.929	2.601	0.000	3.367	3.451	0.000	3.400	3.438	0.015	3.088	4.132	0.000
	(1.981)	(1.524)	(1.996)		(1.533)	(1.693)		(1.970)	(1.985)		(1.977)	(1.982)		(2.083)	(1.527)	
TFP	3.402	2.865	2.678	0.000	3.001	2.539	0.000	3.633	2.376	0.000	2.889	2.163	0.000	2.706	2.699	0.415
	(3.148)	(0.762)	(1.202)		(0.973)	(1.211)		(0.825)	(1.071)		(1.149)	(0.981)		(1.213)	(1.019)	
Debt	0.482	0.390	0.496	0.000	0.408	0.523	0.007	0.482	0.482	0.956	0.595	0.442	0.000	0.507	0.430	0.000
	(2.075)	(0.661)	(2.216)		(0.380)	(2.571)		(3.482)	(1.172)		(1.228)	(2.297)		(2.105)	(2.012)	
Age	2.902	3.250	2.847	0.000	2.993	2.857	0.000	2.829	2.928	0.000	2.787	2.941	0.000	2.907	2.889	0.001
	(0.765)	(0.625)	(0.771)		(0.732)	(0.779)		(0.768)	(0.762)		(0.817)	(0.742)		(0.757)	(0.783)	
Foreign ownership	0.028	0.043	0.026	0.000	0.045	0.019	0.000	0.027	0.029	0.206	0.030	0.023	0.000	0.038	0.024	0.000
	(0.166)	(0.202)	(0.159)		(0.207)	(0.137)		(0.162)	(0.167)		(0.170)	(0.151)		(0.190)	(0.152)	
Sectoral exports	0.285	0.365	0.273	0.000	0.291	0.283	0.000	0.294	0.263	0.000	0.290	0.284	0.000	0.294	0.281	0.000
	(0.132)	(0.131)	(0.127)		(0.135)	(0.130)		(0.131)	(0.131)		(0.129)	(0.133)		(0.138)	(0.128)	
Observations	84,764	11,438	73,326		30,045	54,719		23,126	61,638		21,776	62,988		57,216	27,548	

TABLE 2: Correlation matrix

	RD intensity	Squared RD	Size	Wage	TFP	Debt	Age	Foreign ownership	Sectoral exports	Imported inputs	Collateral	Intangibles
RD intensity	1.000											
Squared RD	0.892	1.000										
Size	-0.010	-0.013	1.000									
Wage	0.016	-0.002	0.823	1.000								
TFP	0.034	0.057	0.215	0.112	1.000							
Debt	0.075	0.118	-0.068	-0.101	-0.091	1.000						
Age	-0.167	-0.131	0.193	0.245	-0.096	-0.099	1.000					
Foreign ownership	0.061	0.069	-0.008	0.042	0.006	-0.127	0.045	1.000				
Sectoral exports	-0.028	-0.065	-0.021	0.009	-0.085	-0.102	0.017	0.033	1.000			
Imported inputs	0.050	0.025	-0.021	-0.057	-0.046	0.003	-0.005	0.013	0.027	1.000		
Collateral	-0.002	0.006	0.030	0.041	-0.177	0.164	-0.053	-0.054	0.096	-0.004	1.000	
Intangibles	0.114	0.054	0.266	0.229	0.014	-0.014	-0.073	-0.001	0.008	-0.013	0.092	1.000

TABLE 3: Baseline model

	(1)	(2)	(3)
	Probit	**Tobit**	**OLS**
	First-stage	*Second -stage*	*Second -stage*
Dependent variable:	EXP dummy	EXP	EXP
RD intensity	-	3.467***	2.281***
		(0.715)	(0.484)
Squared RD	-	-14.743***	-9.460***
		(4.903)	(3.327)
Size	0.019***	0.066***	0.041***
	(0.003)	(0.011)	(0.008)
Wages	0.107***	-0.163***	-0.092***
	(0.002)	(0.027)	(0.018)
TFP	0.012***	0.040***	0.027***
	(0.003)	(0.013)	(0.008)
Debt	-0.007	-0.042**	0.001
	(0.005)	(0.019)	(0.003)
Age	0.037***	-0.066***	-0.041***
	(0.004)	(0.013)	(0.009)
Foreign ownership	0.104***	-	-
	(0.017)		
Sectoral exports	0.716***	-	-
	(0.056)		
Inverse mills ratio	-	-0.837***	-0.396***
		(0.122)	(0.080)
Constant	0.380***	0.651***	0.766***
	(0.003)	(0.007)	(0.133)
Observations	84,764	9,803	9,803
R-squared	0.189	0.126	0.072
Year FE	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes
Sector* Year FE	Yes	Yes	Yes

TABLE 4: Impact of domestic inputs

	(1)	(2)	(3)	(4)	(5)	(6)
	Probit		**Tobit**		**OLS**	
	First-stage		*Second -stage*		*Second -stage*	
Dependent variable:	EXP dummy		EXP		EXP	
	More domestic inputs	*Less domestic inputs*	*More domestic inputs*	*Less domestic inputs*	*More domestic inputs*	*Less domestic inputs*
RD intensity	-	-	5.394***	2.903***	3.750***	1.763***
			(1.111)	(0.812)	(0.763)	(0.571)
Squared RD	-	-	-27.642***	-11.401**	-18.551***	-6.630*
			(7.755)	(5.241)	(4.882)	(3.861)
Size	-0.001	0.020***	0.046***	0.069***	0.032***	0.044***
	(0.008)	(0.003)	(0.015)	(0.015)	(0.010)	(0.010)
Wages	0.085***	0.098***	-0.115***	-0.182***	-0.059***	-0.102***
	(0.008)	(0.002)	(0.027)	(0.037)	(0.017)	(0.026)
TFP	-0.005	0.012***	-0.016	0.037**	-0.015	0.026***
	(0.009)	(0.003)	(0.022)	(0.015)	(0.014)	(0.009)
Debt	-0.056***	-0.005	0.014	-0.037	0.026	0.003
	(0.017)	(0.005)	(0.036)	(0.023)	(0.021)	(0.003)
Age	0.036***	0.031***	-0.063***	-0.061***	-0.033***	-0.038***
	(0.011)	(0.004)	(0.017)	(0.016)	(0.011)	(0.010)
Foreign ownership	0.048	0.110***	-	-	-	-
	(0.035)	(0.017)				
Sectoral exports	0.689***	0.713***	-	-	-	-
	(0.108)	(0.054)				
Inverse mills ratio	-	-	-0.705***	-0.973***	-0.221*	-0.473***
			(0.214)	(0.166)	(0.128)	(0.115)
Constant	0.745***	0.323***	0.744***	0.596***	0.431***	0.811***
	(0.007)	(0.003)	(0.008)	(0.009)	(0.118)	(0.168)
Observations	11,438	73,326	3,469	6,334	3,469	6,334
R-squared	0.122	0.162	0.566	0.102	0.12	0.069
Test of equality (p-value): RD intensity	-	-	0.046		0.004	
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector* Year FE	Yes	Yes	Yes	Yes	Yes	Yes

TABLE 5: Impact of firm size

	(1)	(2)	(3)	(4)	(5)	(6)
	Probit		**Tobit**		**OLS**	
	First-stage		*Second -stage*		*Second -stage*	
Dependent variable:	EXP dummy		EXP		EXP	
	Larger firms	*Smaller firms*	*Larger firms*	*Smaller firms*	*Larger firms*	*Smaller firms*
RD intensity	-	-	4.579***	1.526	3.216***	0.549
			(0.958)	(0.965)	(0.683)	(0.595)
Squared RD	-	-	-18.236**	-6.948	-12.431**	-2.793
			(7.350)	(5.699)	(5.230)	(3.436)
Size	0.062***	0.006*	0.094***	0.052**	0.063***	0.033***
	(0.006)	(0.003)	(0.022)	(0.021)	(0.016)	(0.012)
Wages	0.113***	0.095***	-0.139***	-0.168***	-0.091***	-0.116***
	(0.004)	(0.003)	(0.030)	(0.057)	(0.022)	(0.041)
TFP	0.011**	0.003	0.050***	-0.008	0.038***	-0.010
	(0.005)	(0.003)	(0.017)	(0.019)	(0.011)	(0.010)
Debt	-0.048***	-0.005	0.022	-0.070**	0.019	0.004
	(0.013)	(0.004)	(0.028)	(0.032)	(0.015)	(0.004)
Age	0.058***	0.028***	-0.066***	-0.066***	-0.045***	-0.047***
	(0.007)	(0.005)	(0.018)	(0.023)	(0.013)	(0.015)
Foreign ownership	0.086***	0.124***	-	-	-	-
	(0.023)	(0.022)				
Sectoral exports	0.867***	0.598***	-	-	-	-
	(0.102)	(0.063)				
Inverse mills ratio	-	-	-0.702***	-0.953***	-0.392***	-0.531***
			(0.150)	(0.258)	(0.101)	(0.183)
Constant	0.530***	0.298***	0.692***	0.578***	0.608***	0.912***
	(0.005)	(0.004)	(0.008)	(0.012)	(0.122)	(0.313)
Observations	30,045	54,719	6,249	3,554	6,249	3,554
R-squared	0.188	0.154	0.176	0.124	0.108	0.067
Test of equality (p-value): RD intensity	-	-	0.009		0.000	
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector* Year FE	Yes	Yes	Yes	Yes	Yes	Yes

TABLE 6: Impact of total factor productivity

	(1)	(2)	(3)	(4)	(5)	(6)
	Probit		**Tobit**		**OLS**	
	First-stage		*Second -stage*		*Second -stage*	
Dependent variable:	EXP dummy		EXP		EXP	
	High TFP	*Low TFP*	*High TFP*	*Low TFP*	*High TFP*	*Low TFP*
RD intensity	-	-	6.394***	2.895***	3.386***	1.853***
			(0.373)	(0.766)	(0.771)	(0.538)
Squared RD	-	-	-45.221***	-11.561**	-17.027***	-7.085*
			(4.842)	(4.988)	(3.889)	(3.732)
Size	0.025***	0.015***	0.104***	0.052***	0.056***	0.036***
	(0.004)	(0.003)	(0.007)	(0.013)	(0.011)	(0.009)
Wages	0.098***	0.108***	-0.152***	-0.177***	-0.075***	-0.106***
	(0.004)	(0.003)	(0.014)	(0.030)	(0.022)	(0.022)
TFP	0.028***	0.014***	0.074***	0.029**	0.031**	0.022**
	(0.005)	(0.004)	(0.008)	(0.015)	(0.015)	(0.009)
Debt	-0.001	-0.015	-0.036**	-0.025	-0.001	0.007
	(0.002)	(0.012)	(0.018)	(0.021)	(0.003)	(0.005)
Age	0.060***	0.031***	-0.064***	-0.065***	-0.041***	-0.040***
	(0.007)	(0.005)	(0.007)	(0.014)	(0.014)	(0.009)
Foreign ownership	0.092***	0.110***	-	-	-	-
	(0.024)	(0.020)				
Sectoral exports	1.226**	0.544***	-	-	-	-
	(0.495)	(0.067)				
Inverse mills ratio	-	-	-0.608***	-0.963***	-0.223**	-0.495***
			(0.060)	(0.140)	(0.091)	(0.096)
Constant	0.346***	0.393***	0.663***	0.647***	0.276*	0.912***
	(0.004)	(0.004)	(0.065)	(0.008)	(0.145)	(0.159)
Observations	23,030	61,638	2,545	7,256	2,545	7,256
R-squared	0.232	0.178	0.328	0.105	0.128	0.068
Test of equality (p-value): RD intensity	-	-	0.000		0.000	
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector* Year FE	Yes	Yes	Yes	Yes	Yes	Yes

TABLE 7: Impact of collateral/net fixed assets

	(1)	(2)	(3)	(4)	(5)	(6)
	Probit		**Tobit**		**OLS**	
	First-stage		*Second -stage*		*Second -stage*	
Dependent variable:	EXP dummy		EXP		EXP	
	More collateral	*Less collateral*	*More collateral*	*Less collateral*	*More collateral*	*Less collateral*
RD intensity	-	-	5.249***	2.708***	3.511***	1.748***
			(1.688)	(0.742)	(1.088)	(0.507)
Squared RD	-	-	-25.334***	-11.189**	-17.647***	-6.653*
			(9.464)	(5.217)	(6.007)	(3.556)
Size	0.009*	0.016***	0.017	0.079***	0.014	0.051***
	(0.005)	(0.003)	(0.021)	(0.013)	(0.012)	(0.009)
Wages	0.102***	0.105***	-0.118*	-0.163***	-0.064*	-0.095***
	(0.005)	(0.003)	(0.069)	(0.026)	(0.036)	(0.019)
TFP	0.001	0.007**	-0.015	0.052***	-0.017	0.035***
	(0.006)	(0.003)	(0.029)	(0.015)	(0.015)	(0.009)
Debt	-0.035***	-0.005	0.092*	-0.055**	0.052*	-0.002
	(0.013)	(0.005)	(0.055)	(0.022)	(0.028)	(0.003)
Age	0.029***	0.036***	-0.049*	-0.065***	-0.025	-0.043***
	(0.007)	(0.005)	(0.029)	(0.014)	(0.015)	(0.009)
Foreign ownership	0.049	0.124***	-	-	-	-
	(0.032)	(0.019)				
Sectoral exports	0.727***	0.737***	-	-	-	-
	(0.103)	(0.067)				
Inverse mills ratio	-	-	-0.797**	-0.780***	-0.324**	-0.377***
			(0.351)	(0.121)	(0.163)	(0.083)
Constant	0.340***	0.394***	0.620***	0.660***	0.618***	0.729***
	(0.005)	(0.004)	(0.014)	(0.007)	(0.234)	(0.130)
Observations	21,776	62,988	2,027	7,776	2,027	7,776
R-squared	0.209	0.186	0.182	0.135	0.109	0.079
Test of equality (p-value): RD intensity	-	-	0.000		0.000	
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector* Year FE	Yes	Yes	Yes	Yes	Yes	Yes

TABLE 8: Impact of intangibles

	(1)	(2)	(3)	(4)	(5)	(6)
	Probit		**Tobit**		**OLS**	
	First-stage		*Second-stage*		*Second-stage*	
Dependent variable:	EXP dummy		EXP		EXP	
	More intangibles	*Less intangibles*	*More intangibles*	*Less intangibles*	*More intangibles*	*Less intangibles*
RD intensity	-	-	3.404***	3.028***	2.348***	1.838***
			(0.836)	(1.104)	(0.595)	(0.700)
Squared RD	-	-	-15.998***	-10.697	-11.242***	-5.759
			(5.378)	(6.933)	(3.818)	(4.343)
Size	0.011***	0.034***	0.048***	0.101***	0.029***	0.066***
	(0.003)	(0.005)	(0.015)	(0.019)	(0.010)	(0.013)
Wages	0.095***	0.110***	-0.133***	-0.211***	-0.069***	-0.133***
	(0.003)	(0.005)	(0.031)	(0.041)	(0.021)	(0.028)
TFP	0.013***	0.010*	0.041**	0.039**	-0.026**	-0.030***
	(0.003)	(0.005)	(0.017)	(0.019)	(0.010)	(0.011)
Debt	-0.012	-0.002	-0.026	-0.060*	0.006	-0.020
	(0.011)	(0.004)	(0.021)	(0.034)	(0.004)	(0.014)
Age	0.037***	0.049***	-0.070***	-0.076***	-0.043***	-0.048***
	(0.005)	(0.007)	(0.016)	(0.023)	(0.011)	(0.014)
Foreign ownership	0.094***	0.117***	-	-	-	-
	(0.020)	(0.026)				
Sectoral exports	0.595***	0.931***	-	-	-	-
	(0.072)	(0.093)				
Inverse mills ratio	-	-	-0.769***	-1.035***	-0.334***	-0.559***
			(0.142)	(0.216)	(0.093)	(0.140)
Constant	0.323***	0.499***	0.642***	0.664***	0.714***	0.768***
	(0.004)	(0.005)	(0.009)	(0.010)	(0.174)	(0.150)
Observations	57,216	27,548	5,657	4,146	5,657	4,146
R-squared	0.202	0.137	0.133	0.144	0.078	0.085
Test of equality (p-value): RD intensity	-	-	0.089		0.055	
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector* Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Figure 1

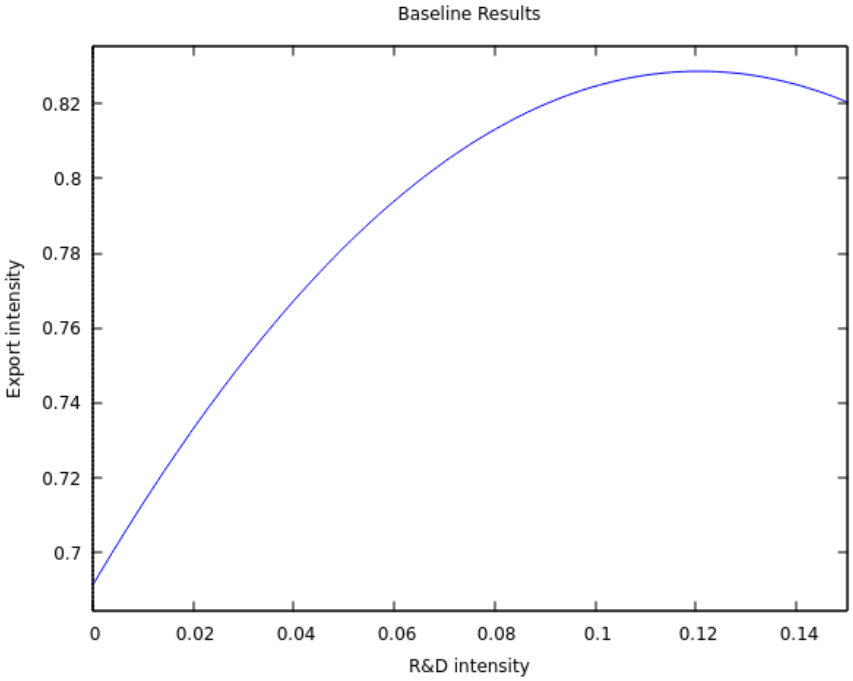


Figure 2

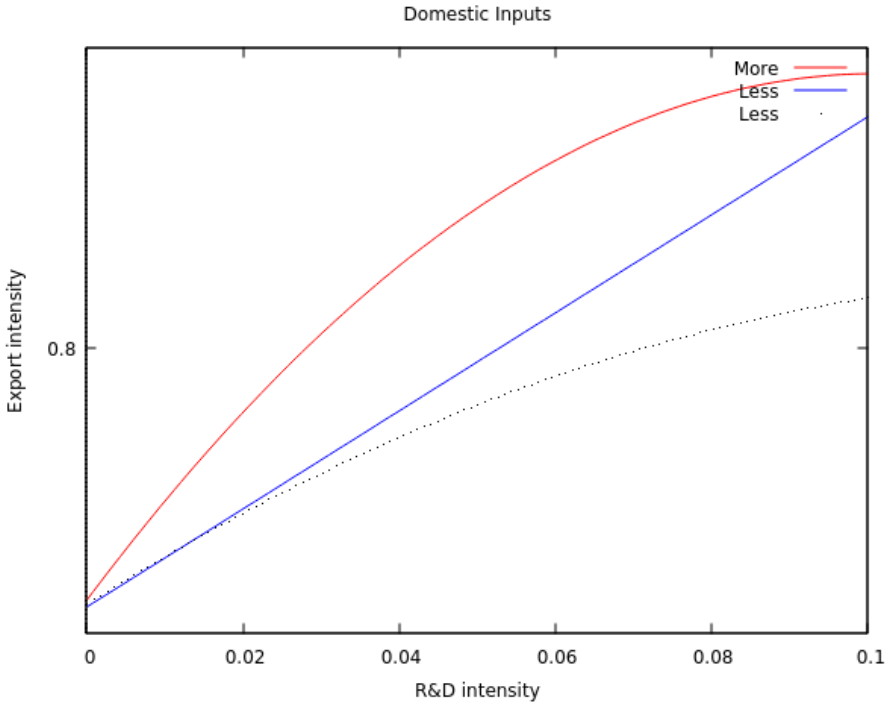


Figure 3

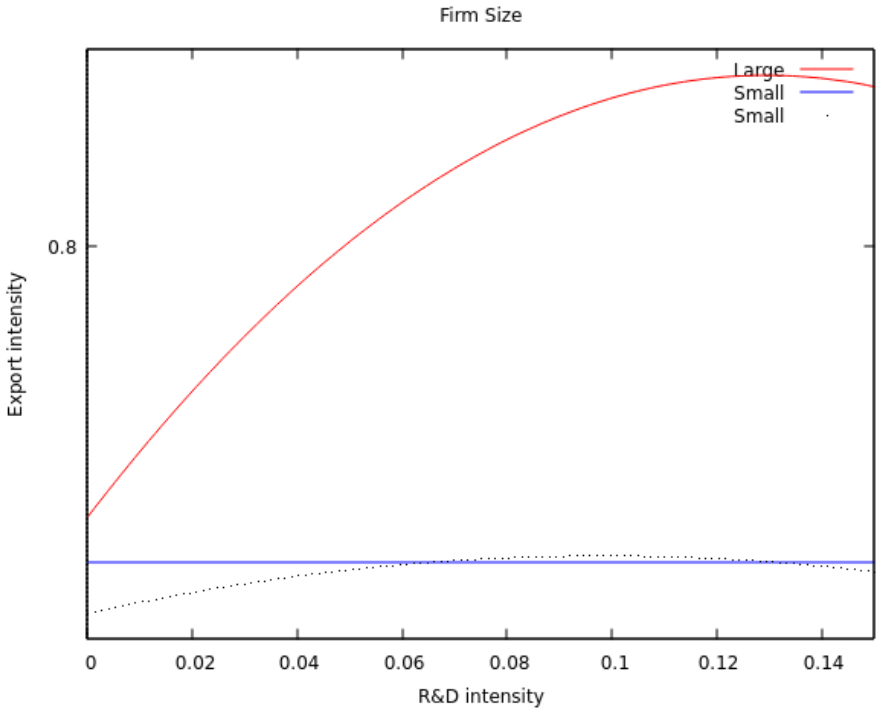


Figure 4

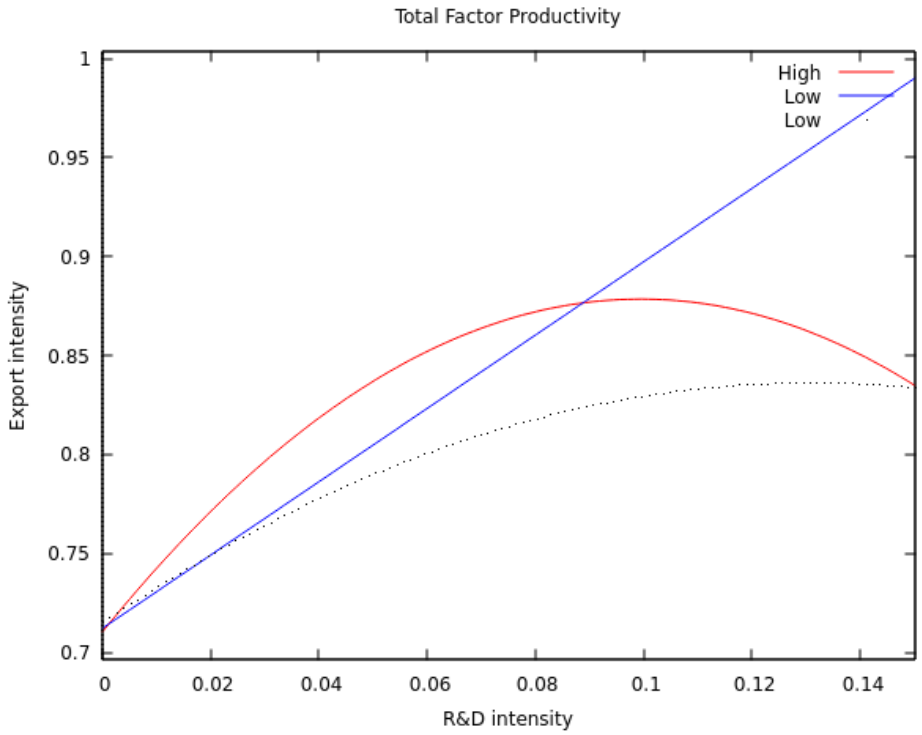


Figure 5

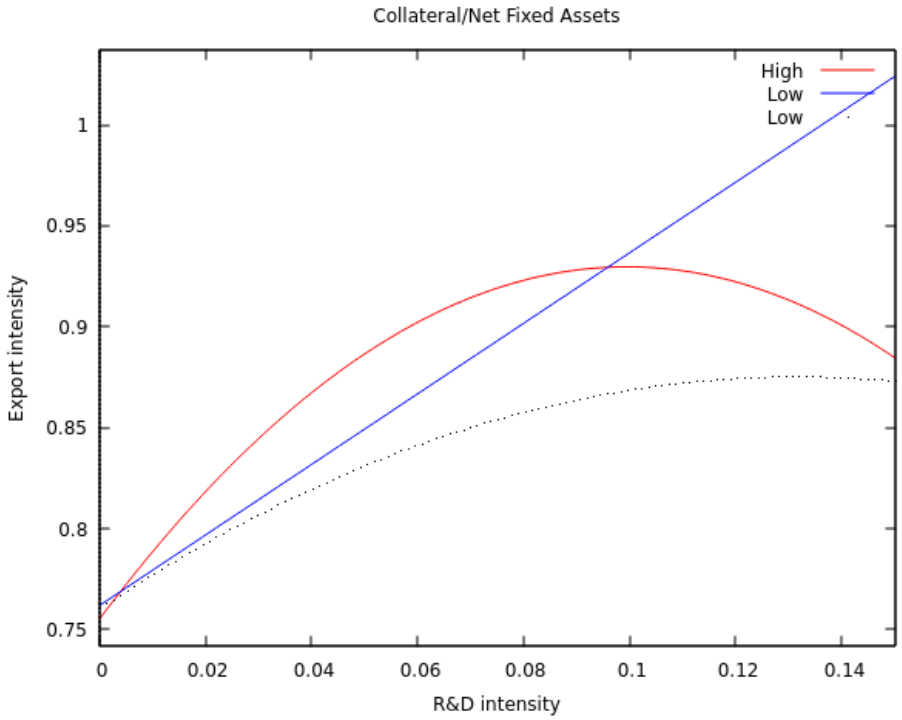
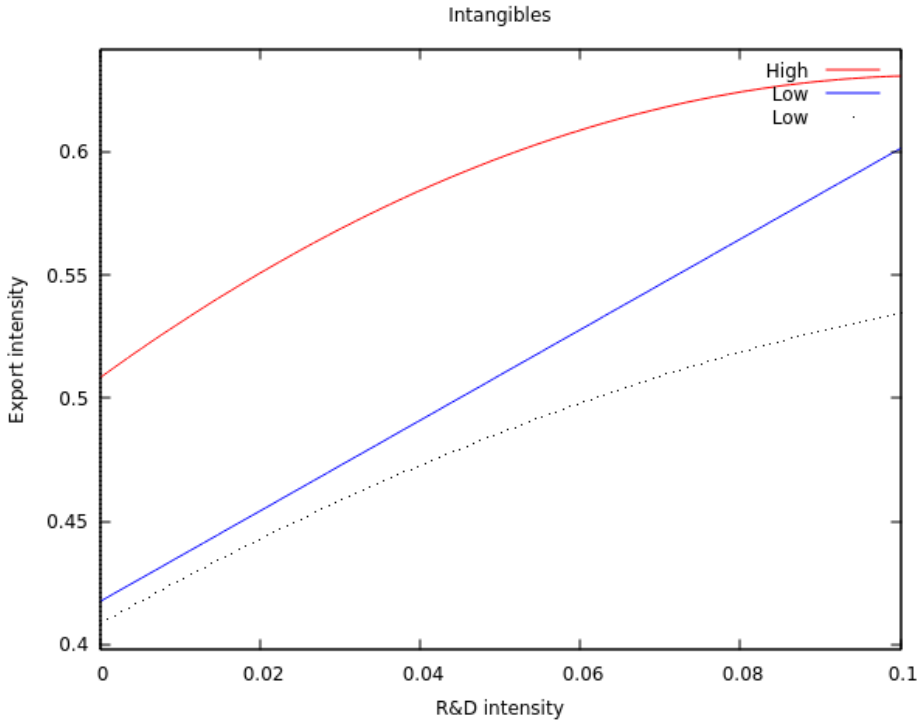


Figure 6



Supplementary Materials

TABLE S.1: Robustness tests – Interaction effects

Dependent variable:	**EXP**									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Resources (Res):	***Domestic inputs***		***Firm size***		***Total Factor Productivity***		***Collateral***		***Intangibles***	
	Tobit	***OLS***	***Tobit***	***OLS***	***Tobit***	***OLS***	***Tobit***	***OLS***	***Tobit***	***OLS***
RD intensity*Res	8.771***	6.161***	1.129***	0.991***	1.799**	1.426***	6.699**	4.561***	0.002*	0.001*
	(1.856)	(1.410)	(0.374)	(0.236)	(0.735)	(0.464)	(2.611)	(1.742)	(0.001)	(0.001)
Squared RD*Res	-36.539***	-23.905***	-3.512	-3.275*	-11.432***	-7.599***	-37.930***	-25.856***	-0.009	-0.006
	(14.140)	(10.829)	(2.702)	(1.806)	(4.472)	(2.644)	(13.221)	(9.319)	(0.005)	(0.004)
Inverse mills ratio	-0.488***	-0.275***	-0.839***	-0.394***	-0.849***	-0.405***	-0.801***	-0.384***	-0.622***	-0.348***
	(0.128)	(0.091)	(0.120)	(0.078)	(0.122)	(0.080)	(0.129)	(0.085)	(0.154)	(0.105)
Observations	7,112	7,112	9,803	9,803	9,803	9,803	8,920	8,920	6,096	6,096
R-squared	0.244	0.119	0.132	0.080	0.128	0.075	0.132	0.079	0.151	0.089
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector* Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

TABLE S.2: Robustness tests – Heckman-2SLS estimations

Dependent variable:	**EXP**										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Baseline Model	***More domestic inputs***	***Less domestic inputs***	***Larger firms***	***Smaller firms***	***High TFP***	***Low TFP***	***More collateral***	***Less collateral***	***More intangibles***	***Less intangibles***
RD intensity	2.705***	3.624***	2.265***	3.480***	0.733	3.252***	2.460***	4.383***	2.019***	2.978***	2.087**
	(0.702)	(1.01)	(0.871)	(0.908)	(0.986)	(1.038)	(0.775)	(1.402)	(0.755)	(0.848)	(1.008)
Squared RD	-12.399**	-17.109***	-10.065	-14.808*	-3.490	-20.240***	-10.510*	-22.100***	-8.426	-16.534***	-6.793
	(5.440)	(5.526)	(6.123)	(8.116)	(5.885)	(6.906)	(5.792)	(7.468)	(6.191)	(5.754)	(6.563)
Inverse mills ratio	-0.448***	-0.314**	-0.476***	-0.330***	-0.682***	-0.151	-0.576***	-0.237	-0.488***	-0.405***	-0.568***
	(0.091)	(0.138)	(0.110)	(0.127)	(0.214)	(0.131)	(0.103)	(0.223)	(0.091)	(0.108)	(0.152)
Observations	7,355	2,527	4,828	4,790	2,565	1,666	5,689	1,554	5,801	4,179	3,176
Test of equality (p-value): RD intensity	-	0.045		0.007		0.087		0.000		0.090	
Kleibergen-Paap LM statistic	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000
Anderson-Rubin Wald test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Stock-Wright LM statistic	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hansen J statistic	0.512	0.332	0.670	0.349	0.470	0.291	0.852	0.453	0.135	0.181	0.714
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes