Unpacking the impact of innovation ambidexterity on export performance: Microfoundations and infrastructure investment

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Abstract

When designing and managing routines for their innovation activities firms often face a challenge. Either they can concentrate their efforts on one approach i.e. exploring new ideas or exploiting its existing capabilities, or they can try to do both, i.e. becoming ambidextrous. In this paper, we aim to explore first the effect of exploration, exploitation and ambidexterity on export performance and second the moderating role of investment in infrastructure. Using firm-level data from the UK's innovation survey (CIS) we find that both exploration and exploitation improve export performance. We also find that investment in infrastructure weakens this relationship. Counterintuitively, we find that ambidexterity has a negative effect on export performance, and that it is negatively moderated by investment in infrastructure. We use microfoundations arguments (the routines firms employ and the actions taken by individuals and groups within them to shape their exporting capabilities) to explain how efforts to achieve ambidexterity can improve export performance.

Keywords

Exploration, exploitation, ambidexterity, export performance, infrastructure investment, microfoundations

1. Introduction

Recent political developments and global disputes, such as the UK's exit from the European Union, have once again brought to the forefront of public and academic attention the debate about the strategies, routines and investments firms can use to boost their export performance. Research that has been dealing with such questions has been receiving significant attention in both the IB (e.g., Lederman 2010; Robertson and Chetty 2000) and the innovation (e.g. Calantone, Tamer Cavusgil et al. 2004, Castellani and Fassio 2019) bodies of literature. Such work often calls for a greater focus on the microfoundations (Liu and Huang 2018) as they can help explain in greater detail how a firm's routines can shape its capabilities and, thus, its export performance. In line with previous work (Felin, Foss et al. 2012), we define microfoundations as the routines firms employ and the actions taken by individuals and groups within them to shape their exporting capabilities.

One dominant and popular argument in the IB literature is that export performance depends on the ability of firms to implement routines for exploring new opportunities in the context within which they operate (Robertson and Chetty 2000), e.g. by identifying new ideas and developing them into new products for the export markets. When this is the case, rules and regulations, aimed at standardising and controlling products and services across countries, may restrict their ability to explore and hence reduce their export performance (Lederman 2010). Another popular, and often complementary, argument in the IB literature is that export performance is more reliant on the ability to exploit existing resources and convert them into capabilities (e.g. Gnizy, Cadogan et al. 2017). This would include the development of routines for streamlining the movement of goods and the sharing of information between countries. When this is the case, standardisation and common regulatory frameworks can reduce waste, increase efficiency and reduce the risk of innovation (Benito, Grøgaard et al. 2003). A more balanced approach

would suggest that export performance is more reliant on the ability of a firm to become ambidextrous, either by balancing or by switching between exploration and exploitation. When this is the case, firms would be able to identify the strategy which better suits the context at hand (Robertson and Chetty 2000) and then either explore new opportunities or exploit existing resources. Understanding in more detail the impact of firms' microfoundations on the management of exploration and exploitation, therefore, can advance our understanding of the factors that affect export performance.

Previous work has explored aspects of exploration and exploitation (March 1991), e.g. by investigating the effects of standardisation and adaptation on exporting behaviour (Cavusgil, Zou et al. 1993, Theodosiou and Leonidou 2003, Schmid and Kotulla 2011). As a result, the routines that determine the strategies for either adapting products to the local market or standardising them are reasonably well understood (Tan and Sousa 2013). At one level, firms strengthen their capabilities in exporting by investing in products which are new to both themselves and potentially the world (Azar and Ciabuschi 2017). This is because they need to adapt their products to the needs of the new market and to develop appropriate marketing strategies (Li, Liu et al. 2019). At another level, firms invest in the marketing and supply chain processes. This is because they need to ensure access to the new market in an efficient and effective manner (Hausman, Lee et al. 2010).

Yet, famous examples of big exporters, such as Dyson from the UK and Huawei from China, regularly demonstrate how sustained investment in new equipment and processes has profoundly affected how they manage their routines and build capabilities in ways that affect their export performance. Therefore, firms may become better able at managing their exploration or exploitation routines and at developing exporting capabilities by investing in their infrastructure, i.e. in their organisational facilities and structures, such as machinery

equipment and software (e.g. Ramirez, Melville et al. 2010). When they do so, they are better positioned to deal with requirements that may be different across different markets.

Changes in infrastructure require changes in the formal and informal organizational routines, i.e. changes in the microfoundations. For instance, a new piece of equipment that enables automation would lead to the retirement of some older routines (repetitive patterns of action) and skills and the adoption of new ones. These would lead to a new set of capabilities, which would affect how firms are able to deploy their resources and, thus, how they engage with exploration and exploitation strategies. When pursuing an exploration strategy, investment in infrastructure is likely to focus on building the capabilities needed to develop new products for the export market (Dow 2006). When this is the case, the focus is more on developing and strengthening a firm's own capabilities by understanding the customer needs in the export market and then by developing products and services in ways that address them (Morris, Hammond et al. 2014). When pursuing an exploitation strategy, investment is more likely to focus on process efficiencies, e.g. the improvement of supply chain communication and synergies (Jean, Sinkovics et al. 2010). Firms that are able to do both would be able to develop products that appeal to the export market and to develop processes that ensure that products reach the customers in a cost-efficient manner.

In this paper, we contribute to the international business literature by using arguments from microfoundations research (March 1991, Felin, Foss et al. 2012, Morris, Hammond et al. 2014, Liu, Sarala et al. 2017). Our aim is to address the following two questions:

1. *How do strategies that pursue exploration, exploitation or ambidexterity affect export performance?*
2. *How can investment in infrastructure affect the relationships between the different forms of strategy (exploration, exploitation or ambidexterity) and export performance?*

We aim to address these questions, by employing the resource-based view as our theoretical lenses and by focusing on microfoundations. We use firm-level data from the UK's innovation survey (CIS). Addressing these two research questions at the microfoundations level helps provide guidance to managers who are looking to invest in infrastructure at one end and make choices about their firm's focus on exploration or exploitation at the other.

The paper is structured as follows. In the next section, we develop a set of hypotheses, which explain how we expect exploration, exploitation and ambidexterity to affect export performance. We follow this by explaining how investment in infrastructure will moderate this relationship. We then present our analysis and conclude with a discussion of our results and implications for theory and practice.

2. Development of Hypotheses

A firm is pursuing an exploration strategy when it is proactively pursuing new opportunities through an iterative process whereby it continuously learns their customers' problems and needs to develop and introduce new product ideas (March, 1991). Within the context of exporting, this iterative process would also involve customers in the export market. Therefore, the deployment of an exploration strategy would suggest that firms develop new ideas for the export market, and learn from it in ways that support its innovation process (Love and Ganotakis 2013). This view is also consistent with the global engagement hypothesis, which argues that when firms engage with global business activities their propensity to innovate increases (Lederman 2010). Therefore, when pursuing an exploration strategy, the microfoundations that affect export performance, are the routines and actions taken by individuals and groups that help to both understand how the export market operates and how to solve problems of customers in that market.

A firm that is pursuing an exploitation strategy, on the other hand, would seek to improve its existing processes through refinement, production and execution (March, 1991). In the exporting context, the deployment of this strategy would suggest that a firm improves its capabilities by focusing on the management of tasks that facilitate access the new market, such as integration and cooperation with local suppliers (Jean, Sinkovics et al. 2010). Therefore, when pursuing an exploitation strategy, the microfoundations that affect export performance are the routines and actions taken by individuals and groups that enable access to the export market.

A more balanced or ambidextrous strategy would require the firm to be able to explore new ideas by solving customers' problems and exploit its existing capabilities (Gupta, Smith et al. 2006). If exploration is traded off against exploitation, and if there is a cost of switching between the two strategies (Swift 2016), then an ambidextrous strategy would be the result of a fine balance between the two. Their managers would be able to undertake, or at least oversee, different types of routines and actions, and reap their benefits by identifying new possibilities in the export market and refining existing processes in ways that improve its capabilities (Judge and Blocker 2008).

Therefore, and depending on the context, deploying any of the three strategies, exploration, exploitation or ambidexterity, will help a firm to build capabilities, which ultimately affect its performance. As a result, the resource based view, which argues that a firm's resources are key to superior performance (Grant 1991) becomes an appropriate framework for exploring the effect of these strategies on competitiveness. Our key premise is that firms pursuing any of the three strategies, will shape their microfoundations in a way that helps build their capabilities and thus improve their performance. We also argue that this ability will be contingent upon

the investment in infrastructure. We explain the effect of each in turn and develop six hypotheses predicting how performance will change.

Exploration, usually depends on the ability of a firm to explore opportunities outside its normal learning environment (Gupta, Smith et al. 2006). In a typical exporting context such an environment would include employees of a subsidiary (Fang, Wade et al. 2013), suppliers, customers and, even, competitors (Xia and Liu 2017). Employees could provide ideas for improvement based largely on their existing understanding of a product's performance and use in the exporting market (Minbaeva, Pedersen et al. 2014). They could also use their skills to solve problems associated with the products and services the firm is offering (Sheremata 2000) which could result in ideas for new products. Customers, suppliers and competitors of the export market can provide new ideas (Salomon and Shaver 2005), which can lead to increased know-how of the operation and use of a product (Baldwin and von Hippel 2011). When the levels of exploration are low, then firms' microfoundations will be focusing on internal operations. When this is the case the routines they employ to develop products will be focusing more on extracting knowledge from existing sources (Minbaeva, Pedersen et al. 2014). As a result, firms would be less likely to benefit from any knowledge spillovers from the exporting market. For instance, existing employees may be focusing on routines and tasks that lead to incremental performance improvements of a product. Over time, there would be relatively little radical improvement in what they offer in both the home and the export markets.

As the level of exploration increases, however, firms start exploring opportunities outside their normal learning environment (Gupta, Smith et al. 2006). In such cases, their managers will be increasingly looking to merge ideas, which have originated outside the immediate network of their operations into the existing knowledge bases. In an exporting context, this would suggest that firms are implementing routines that help them engage with resources outside their

immediate network of operations, e.g. with their subsidiaries (Minbaeva, Pedersen et al. 2014). Therefore, in such contexts, higher levels of exploration will indicate higher levels of experimentation and learning both in the home and the export markets.

In summary, higher levels of exploration will encourage a better understanding of the export market and hence improve the ability to develop new products with stronger export performance.

Therefore, our first hypothesis is:

H1: Exploration is positively associated with a firm's export performance.

Exploitation usually depends on a firm's ability to improve its processes in ways that maximise the utilisation of its existing resources (Gupta, Smith et al. 2006). As a result, higher levels of exploitation have been linked with higher levels of operational and supply chain efficiencies (Huang, Yen et al. 2014) and at times contrasted against the effects of exploration (Piao and Zajac 2016). At the microfoundation level, when exploitation is low, the routines firms employ will not be focusing on the improvement of existing processes (Uotila, Maula et al. 2009). This could support some flexibility (Bonner, Ruekert et al. 2002), e.g. on the timing of the decision making, but it is likely to reduce the firm's ability to achieve economies of scale and subsequently hinder its ability to develop new routines that allow access to the new market in a cost-efficient manner.

At higher levels of exploitation though, there will be higher levels of improvement of existing routines and tasks through refinement, production and execution (March, 1991). Therefore, managers will be focusing more on improving existing processes and products. This will result to improvements in their exporting performance for two connected reasons. First is the inevitable improvement of the processes which emerges from experience (Letmathe and Zielinski 2016). As managers know more about the performance of their products in the export

market they will be better able to optimise its performance, and, as a result, its export performance will gradually improve (Tsinopoulos, Lages et al. 2014, Cieślik, Kaciak et al. 2015).

Second is the improvement of production processes responsible for developing and delivering products in the export market. As managers understand their routines better and become better able at improving them, the relevant production cost is reduced (Jean, Sinkovics et al. 2010). For instance, when operating in an export market the continuous refinement of the production processes will result in better management of its operations and thus improve the availability of its products to that market (Levy 1995). Therefore, higher levels of exploitation will lead to higher levels of access to the firm's product to the export market.

Therefore, our second hypothesis is:

H2: Exploitation is positively associated with a firm's export performance.

Previous work on ambidexterity has explored its antecedents (Gibson and Birkinshaw 2004, Cao, Gedajlovic et al. 2009, Junni, Sarala et al. 2015) and consequences (Hughes, Martin et al. 2010, Tamayo-Torres, Roehrich et al. 2017) and its effect organizational performance. This work indicates that the structure, location and management of innovation activities can act as significant enablers to firms efforts to become ambidextrous (Hughes, Martin et al. 2010, Burgess, Strauss et al. 2015, Junni, Sarala et al. 2015, Tamayo-Torres, Roehrich et al. 2017) and subsequently their ability to improve performance. A key argument underlying these studies is that ambidexterity enables firms to manage multiple situations (Gibson and Birkinshaw 2004). At the microfoundation level, therefore, ambidexterity would require routines and actions that proactively balance contradictory demands brought about by the pursuit of exploration and exploitation.

Developing products for the export market brings about several demands which, at times, can be contradictory (Schmid and Kotulla 2011). Managing those demands leads to problems which arise from internal conflicts and inevitable trade-offs. Although such problems are likely to always be present, the routines of ambidextrous firms are better able at solving them by either resolving the associated trade-off, e.g. between developing new products for the export market and adapting the existing ones (Schmid and Kotulla 2011), or by identifying which is the better decision (Gibson and Birkinshaw 2004).

Therefore, our third hypothesis is:

H3: Ambidexterity is positively associated with a firm's export performance.

For the rest of our theoretical development we focus on firm investment in infrastructure. We expect investment in infrastructure to moderate the hypothesised relationships for two connected reasons. The first is that it can help firms expand their operations so as to reach new markets. This could mean the streamlining of production processes and the increase of capacity in certain regions. The second is that, such investment could support a firm's efforts to develop entirely new products. This could mean the development of capabilities through the implementation of systems for becoming more effective in assimilating knowledge from the new market and even learning from failure (Edmondson 2011). Put differently, there are intuitive reasons to expect that investment in infrastructure can affect the relationship between a firm's exploration and exploitation efforts, and its export performance. Yet, such arguments assume that firms can do both at the same time, i.e. that they need to have developed routines that support ambidexterity to benefit from such investments.

We argue that the effect of investment in infrastructure is contingent on whether a firm is focusing on either exploration or exploitation, or ambidexterity. Activities associated with any

of these strategies absorb resources and require significant problem solving ability and managerial attention to complete comprehensively. Furthermore, the decision to invest requires a strategic evaluation of the firm's current capabilities and has consequences for its innovation performance (Henard and McFadyen 2012). Such decisions encourage the evaluation of internal strengths and external opportunities (Rumelt 1986). It would thus be reasonable to conclude that given the profound impact on a firm's routines, investment in infrastructure will affect the trade-off between exploration/exploitation and thus its ability to improve its export performance.

We start with exploration and exploitation and then focus on ambidexterity.

Investment in infrastructure is directly associated with firms' capabilities, requires significant organisational and managerial effort, and results in changes in routines and tasks. On the one hand this could have a positive effect on the relationship between exploration and export performance. When embedded within firm routines and tasks, increased infrastructure could increase capacity and automation, which could allow development and experimentation. This is especially so when there is a clear structure for decision making (Khazanchi, Lewis et al. 2007). On the other hand the situations within which problem solving is undertaken becomes, at least in the short term, more complex and, as a result, managers would have to restrict their efforts, resources and attention to only a few elements, potentially ignoring others (Ocasio 1997, Ocasio 2011).

When the level of infrastructure investment is low, higher levels of exploration may allow firms to learn from the export market and develop new products for it. As the level of infrastructure investment increases new routines and tasks will need to be implemented and existing ones changed (Galeazzo, Furlan et al. 2017). For instance, when a firm installs a new business intelligence system, routines associated with understanding and analysing data from customers

would need to be changed. Therefore, and despite the potential longer-term benefits, in the short term, such changes are likely to generate implementation problems and absorb resources and managerial attention.

Therefore, investment in infrastructure would, at least in the short term, divert attention to the development of new routines and this will affect export performance. At low levels of infrastructure investment, an exploitation strategy would support the identification of opportunities for improvements and will lead to increased levels of export performance. However, higher levels of infrastructure investment increase the likelihood that relevant routines and tasks will also need to change. These changes will require the reconfiguration of the way resources and knowledge are combined (Grigoriou and Rothaermel 2014). For instance, investing in a system that improves supply chain visibility will improve performance, but only if the routines firms follow to integrate customers and suppliers have also been changed (Barratt and Oke 2007, Dubey 2018). Therefore, the diversion of attention and resources to the management of the new infrastructure will, at least in the short term, reduce its ability to respond because it will reduce the speed through which knowledge is diffused (Chandler and Hwang 2015). As a result, when firms pursue either an exploration or an exploitation strategy, this lack of flexibility will make it both less able to adapt to the needs of the export market and to learn from it.

Therefore, our fourth and fifth hypotheses are:

H4: Investment in infrastructure negatively moderates the relationship between exploration and export performance so that when investment is high, the positive effect of exploration on export performance is weakened.

H5: Investment in infrastructure negatively moderates the relationship between exploitation and export performance so that when investment is high, the positive effect of exploitation on export performance is weakened.

In the development of the third hypothesis, we argued that higher levels of ambidexterity would improve its export performance. When the levels of ambidexterity increase, a firm has implemented routines that increase its capability to resolve different types of problems (Gibson and Birkinshaw 2004). Therefore, the routines of ambidextrous firms make it better able at sharing its resources and attention to different types of challenges. It therefore makes firms better at dealing with competing and potentially conflicting demands.

As we explained in the development of the fourth and fifth hypotheses, we expect that, in the short term, increased levels of investment in infrastructure will weaken the relationship between the pursuit of an exploration or an exploitation strategy and export performance. We argued that this would be so because of the challenge of dealing with multiple demands when routines and tasks have been developed for either of those strategies. Yet, routines and tasks of ambidextrous firms enable them to work on multiple tasks (Cao, Gedajlovic et al. 2009). Therefore, it would be reasonable to expect that such routines would help with the faster integration of infrastructure investments and bring about the relevant benefits faster.

Thus, our sixth and final hypothesis is:

H6: Investment in infrastructure positively moderates the relationship between ambidexterity and export performance so that when investment is high, the positive effect of ambidexterity on export performance is strengthened.

Our hypotheses are summarised in Figure 1.

---Insert Figure 1 about here---

3. Methodology

3.1 Sample

To test our hypotheses and address the two research questions we used a panel of exporting firms reporting information relating to production and process innovation during the period 2004-2016. The data consists of five waves of UK Community Innovation Survey (CIS), which provides a rich source of firm-level innovation information. This data was collected by the UK's Office of National Statistics (ONS), and employs a rigorous sampling procedure to ensure the representativeness of the population of UK establishments (see Robson and Achur (2013) for more details). The final exporting firm panel includes information about 5,278 manufacturing firms and 6,789 service firms with an average response rate of about 50%. The survey has been conducted every other year and covers a three-year time period. The respondents were typically R&D and senior level managers.

3.2 Measures

Table 1 lists the definition of variables we used. Export Product Sales (EXPORT) is the dependent variable and measures export performance. It is the natural logarithms of export sales for exporting firms, EXPORT=ln(1+export sales). This measure has frequently been used in international business studies (Ito and Pucik 1993, Bertrand 2011). It provides a monetary indicator of export output and as such it assesses performance objectively (Peng, Hill et al. 2000).

Exploration, exploitation, and ambidexterity are our independent variables. We assess the level of explorative and exploitative ability based on whether a firm has a certain type of innovation output. Therefore, we focus on the difference of learning and innovation to distinguish exploration and exploitation rather than focus on different types, which is consistent with the prior studies (Cao, Gedajlovic et al. 2009, Jansen, Tempelaar et al. 2009, Floortje and Jan 2014). Exploration (*EXPLOR*) refers to the ability of the firm to develop new products and services by pursuing new opportunities departing from existing knowledge (Danneels 2002, Benner and Tushman 2003, Jansen, Tempelaar et al. 2009). Exploration innovations can offer new generations of products resulting from experimentation and entering new technological fields (March, 1991). A stronger exploration ability is associated with a more radical innovation output (Benner and Tushman 2003). Therefore, we consider the exploration to be at the lowest level when no new products or services were developed. It is at a higher level when products or services have been developed that were new to the firm. Exploration is at the highest level when a firm has developed products or services that were new to the market. *EXPLOR* is coded as 0 when a firm has developed no new products or services; 1 when a firm has developed products or services that were new to the firm; and 2 when a firm has developed products or services that were new to the world. The measurement is consistent with our definition of exploration and with that of prior studies (Faems, Van Looy et al. 2005, Vega-Jurado, Gutierrez-Gracia et al. 2008, Floortje and Jan 2014).

Exploitation (*EXPLOIT*) refers to the ability of the firm to improve existing products and refine existing processes by pursuing efficiencies within existing technological trajectory. It results from those activities that aim at modifying products or developing new or significantly improved methods for the production or supply of goods or services (Benner and Tushman 2003, Floortje and Jan 2014). Exploitation often builds on the existing activities and the capabilities a firm has (Gupta, Smith et al. 2006, Floortje and Jan 2014). Exploitation is

associated with incremental innovation output and process improvement activities. Therefore, we consider that a firm has the lowest level of exploitation if it is involved in no incremental product innovation or process innovation activities. Exploitation is at a higher level when a firm is involved in one of these activities. It is at the highest level when a firm is involved in both activities. *EXPLOIT* is coded as 0 when a firm has developed no process innovation; 1 when a firm has developed process innovations that were new to the firm; 2 when a firm has developed process innovations that were new to its industry.

Ambidexterity (*AMBIDT*) refers to the ability of the firm to develop innovation from ambidextrous activities, which combine exploration and exploitation (Cao et al., 2009). Because we theorize that there are synergistic benefits arising from high level of exploration and exploitation, we measure *AMBIDT* as a combined magnitude of exploration and exploitation (Jansen, Tempelaar et al. 2009). Therefore, we consider that the higher the level of exploration and exploitation, the higher the level of ambidexterity. We multiply exploration and exploitation to form the measurement of *AMBIDT*. Before this operation we mean-centered exploration and exploitation to minimize the potential for multicollinearity. This multiplied measurement is a relative measure between exploration and exploitation and has been adopted previously by Cao, Gedajlovic et al. (2009) and Gibson and Birkinshaw (2004), which accounts for the ability a firm to address multiple, inconsistent innovation pursuits simultaneously.

The moderating variable (INFRAST) measures the extent to which a firm invests in infrastructure. It is measured as the natural logarithms transformed value of the total spending in infrastructure such as advanced machinery equipment and software.

---Insert Table 1 about here---

3.3 Controls

Previous studies in the international business and innovation bodies of literature have indicated many factors that could affect export performance (e.g. Stoian, Rialp et al. 2011, Leonidou, Fotiadis et al. 2015). Therefore, we included several firm, industry and regional-level control variables in the estimate models.

The firm-level variables include R&D spending activities, labor productivity and firm size. Higher levels of R&D expenditure is associated with better export performance and higher propensity to export (Ito and Pucik 1993, Roper and Love 2002). We measured this activity with two variables— internal knowledge (INTKNOW) and external knowledge (EXTKNOW). INTKNOW is the natural logarithm of internal R&D investment. Internal R&D is an innovation source and closely relates to a firm's capability of exporting (Roper and Love, 2002). EXTKNOW captures the extent to which a firm engages in acquiring knowledge from external parties. It is measured as the natural logarithms of external R&D expenditure. One additional variable that could have an impact on export performance is labor productivity (LABOR) (Guan and Ma 2003). We measured labor productivity as the ratio of total annual turnover to the number of employees. Finally, we controlled for firm size, as small firms are more likely to adapt changes (Damanpour 2010, Snihur and Wiklund 2019) and larger firms have more resources to improve their export performance (Ito and Pucik 1993). We measured firm size by the variable BAND, which includes five size bands[1] (see details in Table 1).

[1] We exclude SALES (the natural logarithms of the annual turnover) into the variable lists, because it is highly correlated with BAND ($r=0.79$, $p<0.05$). We use BAND instead of SALES, because the correlation between BAND and LABOR ($r=0.01$, $p>0.05$) is insignificant, which is weaker than that between SALES and LABOR ($r=0.12$, $p<0.05$). The estimate results using BAND are very similar to those using SALES.

We used three-digit SIC code to control for industry variance, as the propensity of some sectors to export is likely to be different (Filatotchev, Liu et al. 2009). We included seven industry dummies comprising: manufacturing, mining, electricity and water supply, construction, hotel and hospitalities, transportation, and other industries. We also accounted for measurement errors resulted from the different coding systems of SIC code across the survey periods. We recoded all SIC code based on the report of Standard Industrial Classification from UK Office of National Statistics (Statistics 2007). Furthermore, we included time dummies to take unobserved over-time differences across the survey periods into account.

Finally, export performance may vary across different geographical locations (Freeman, Styles et al. 2012). For instance, the location of a firm may affect the degree to which it has access to networks and infrastructure for export service and export performance. To account for any such regional differences, we used twelve UK regional dummies using the regional classification code from ONS (see Table 1).

4. Analysis

4.1 Model selection and descriptive analysis

Our analysis is based on an unbalanced panel[2], which has 21,484 observation numbers. We aimed to assess the effect of ambidextrous innovation activities on the export performance and the moderating role of investment in infrastructure. The analysis is based on a firm-year unit. The dependent variable EXPORT captures the export product sales from all exporting firms. Not all exporting firms had export sales in every survey period, because some exported intermittently. This resulted in zero values in their export sales in certain survey periods. More

[2] This unbalanced panel includes 6,611 firms that were observed once and 176 firms that were observed five times.

specifically, 20.76% of the dependent variable was zero. EXPORT is thus a left-censored variable. Following other studies with censored dependent variables (Laursen and Salter 2006, Grimpe and Kaiser 2010, Leiponen and Helfat 2010, Klingebiel and Rammer 2014), we used random Tobit model to form the analysis. Several alternative estimate techniques have also been adopted for the robustness checks, e.g., generalized linear model with gamma distribution (Gamma GLM; (McCullagh and Nelder 1989)) and generalized estimating equations (GEE; (Hardin and Hilbe 2013).

In order to examine the relationship between ambidextrous innovation activities and export performance, we followed the prior uses of CIS (van Beers and Zand 2014) and adopted the time lag embedded in the data. The EXPORT item asked the firms to report the export product performance at the time of completion of the survey (e.g. 2014 in CIS9). The EXPLOR items asked the respondents to report sales that were new to the market and sales that were new to the business from goods and services during the previous three years (e.g. 2012-2014 in CIS9). The EXPLOIT items asked the respondents whether they had any new or significantly improved processes and whether they had such processes that were new to the firm's industry during the previous three years (e.g. 2012-2014 in CIS9). This built-in time lag between the independent and dependent variables has been employed in previous studies that have used similar data (e.g. Laursen and Salter 2006, Klingebiel and Rammer 2014).

Table 2 shows the descriptive statistics and correlations of the variables. We tested for multicollinearity by using variance inflation factors (VIFs). When VIFs are larger than 10**,** there is a concern for multicollinearity (Kutner, Nachtsheim et al. 2004). Table 2 shows that the VIF values of the independent variables vary from 1.00 to 3.29. As they are less than 10, we conclude that there are no issues of multicollinearity.

---Insert Table 2 about here---

We estimated five models, which are presented in Table 1. Models 1-3 include control variables and add the independent (EXPLOR, EXPLOIT and AMBIDT) variables subsequently; Model 4 adds the moderator (INFRAST); and Model 5 adds the interaction terms between EXPLOR and INFRAST, EXPLOIT and INFRAST, and AMBIDT and INFRAST to account for all the moderation effect of investment in infrastructure on export performance. Model 5 is our final model on which the hypotheses testing is based. Following Aiken and West (1991), the independent and moderating variables were standardized before calculating the two-way interaction terms. The hypotheses testing and robustness checks are based on Model 5. For models 1-5, the Wald Chi squares indicate that the effect of the independent and control variables on export performance were all at the 0.001 level. Table 3 shows the results of models 1-5.

---Insert Table 3 about here---

4.2 Hypotheses testing

The results for the hypothesis testing are in Table 3. Hypothesis 1 predicted that exploration is positively associated with export performance. The coefficient *EXPLOR* of Model 5 indicates a positive and significant relationship ($\beta_{EXPLOR\text{-}Model3}$=0.197, p<0.01). This result suggests that one standard deviation increase in *EXPLOR* is associated with 0.197 unit increase in export performance, which is in line with H_1. Therefore, H_1 is supported. Hypothesis 2 predicted that exploitation is positively associated with the export performance. The coefficient *EXPLOIT* of Model 5 indicates a positive and significant relationship ($\beta_{EXPLOIT\text{-}Model3}$=0.333, p<0.01). It indicates that one standard deviation increase in *EXPLOIT* is associated with 0.333 unit increase in export performance. Therefore, H_2 is supported. Hypothesis 3 predicted that the ambidexterity is positively associated with export performance. However, the coefficient *AMBIDT* of Model 5 indicates a negative and significant relationship ($\beta_{AMBIDT\text{-}Model3}$= -0.175,

p<0.01). It suggests that one standard deviation increase in *AMBIDT* is associated with 0.175 unit decrease in export performance. Therefore, H_3 is not supported.

Hypothesis 4 predicted that the positive effect of exploration on export performance is weaker with high levels of investment in infrastructure and stronger with low levels of such investment. The results of Model 5 show that the interaction term of *EXPLOR* and *INFRAST* is negative and significant at the 0.01 level ($\beta_{EXPLOR*INFRAST\text{-}Model3}$= -0.202, p<0.01). In order to visualize the moderation patterns, we followed the procedure introduced by Aiken and West (1991) and drew Figure 2 based on the regression results of Model 5. In predicting export performance based on Model 5 (shown in Figure 2), the slope for low *INFRAST* is positive and significant (γ=0.399, p<0.01), and the slope for high *INFRAST* is zero (γ=-0.005, p>0.1). It indicates that when *INFRAST* is high, one standard deviation increase in *EXPLOR* is associated with 0.399 unit increase in export performance; while, when *INFRAST* is low, one standard deviation increase in *EXPLOR* is not associated with changes in export performance. Therefore, the pattern of lines in Figure 2 shows that the slope of the square line (indicating high level of investment in infrastructure) is flatter than the slope of the diamond line (indicating low level of investment in infrastructure). It indicates that as investment in infrastructure increases, the positive impact of exploration on export product sales weakens. Investment in infrastructure thus negatively moderates the relationship between exploration and export product sales. Therefore, H_4 is supported.

---Insert Figure 2 about here---

Hypothesis 5 predicted that the positive effect of exploitation on export performance is stronger when investment in infrastructure is low and weaker such investment is higher. Model 5 shows that the linear interaction term of *EXPLOIT* and *INFRAST* is negative and significant at the 0.01 level ($\beta_{EXPLOIT*INFRAST\text{-}Model3}$= -0.158, p<0.01). Shown in Figure 3, the slope for the low

INFRAST is positive and significant (γ=0.491, p<0.01), and the slope for the high *INFRAST* is positive and significant (γ=0.175, p<0.05). It indicates that when *INFRAST* is high, one standard deviation increase in *EXPLOIT* is associated with 0.491 unit increase in export performance; while, when *INFRAST* is low, one standard deviation increase in *EXPLOIT* is associated with 0.175 unit increase in export performance. Therefore, in Figure 3, the pattern of lines suggests that the slope of the square line indicating high level of investment in infrastructure, is flatter than that of the diamond line, indicating a low level of investment in infrastructure. It indicates that as the investment in infrastructure increases, the positive impact of exploitation on export product sales weakens. Investment in infrastructure thus negatively moderates the relationship between exploitation and export product sales. Therefore, H_5 is supported.

---Insert Figure 3 about here---

Hypothesis 6 predicted that a positive moderating effect of investment in infrastructure on the relationship between ambidexterity and export performance so that when investment is high, the positive effect of ambidexterity on export performance will strengthen. The interaction term of *AMBIDT* and *INFRAST* is positive and significant at the 0.01 level ($\beta_{AMBIDT*INFRAST\text{-}Model3}$= 0.151, p<0.01). Shown in Figure 4, the slope for the low *INFRAST* is negative and significant (γ=-0.326, p<0.05), and the slope for the high *INFRAST* is zero (γ=-0.024, p>0.1). It indicates that when *INFRAST* is high, one standard deviation increase in *AMBIDT* is associated with 0.326 unit decrease in export performance; while, when *INFRAST* is low, one standard deviation increase in *AMBIDT* is associated with no change in export performance. Therefore, Figure 4 shows that the downward slope of the square line, indicating high level of investment in infrastructure, is flatter than that of the diamond line, indicating low level of investment in infrastructure. The increases in investment in infrastructure are thus associated with decreases

in the negative effect between ambidextrous innovation activities and export product sales. This pattern indicates that as a firm invests more in infrastructure, the negative effect of ambidexterity on export product sales weakens. Therefore, contrary to what we hypothesized, investment in infrastructure negatively moderates the relationship between ambidexterity and export product sales. Therefore, H_6 is not supported.

---Insert Figure 4 about here---

Moreover, we would like to note the effects of some control variables. We controlled for the regional influence by taking 10 regions dummies into Model 5 and found that Scotland has the strongest positive regional impact on export performance. In addition, as we expected, the survey period that includes 2008 financial crisis has shown the strongest negative impact on export performance comparing to other time dummies.

4.2.1 Robustness and Sensitivity

In order to test the sensitivity of the results across alternative estimate strategy, we used: (1) alternative estimate methods Ordinary Least Squares (OLS, Model 6), (2) a Tobit model (Model 7), (3) a generalized linear model with gamma distribution (Gamma GLM, Model 8), (4) generalized estimating equations (GEE, Model 9), (5) a multilevel mixed linear model (Model 10) to account for the potential unobserved heterogeneity due to the cross-region and cross-industry nature of the data, and (6) the matching method (Model 11) to account for the endogeneity of the choice of ambidexterity strategy. We report the results of the robustness checks in Table 4, which are consistent with the results of Model 5.

---Insert Table 4 about here---

We conducted the matching method to account for any endogeneity caused by any confound effects of ambidexterity and other firm-level characteristics. For example, a firm that is more

active in R&D acquisition may be more likely to implement ambidexterity and thus more likely to do well in the export market. If that is the case, R&D acquisition may account for observed association between AMBIDT and EXPORT. The matching method can be used to help alleviate such concerns. Using nearest-neighbour matching, we show that our results are not biased by a confound effect of ambidextrous innovation activities and other firm-level characteristics[3].

5. Discussion and Conclusions

5.1 Theoretical implications

In this paper, we set out to address the following two research questions:

1. *How do strategies that pursue exploration, exploitation or ambidexterity affect export performance?*
2. *How can investment in infrastructure affect the relationships between the different forms of strategy (exploration, exploitation or ambidexterity) and export performance?*

Following our theoretical development and empirical analysis, we now revisit these two questions and explain what the contribution of this work is on the international business literature.

Our theoretical development suggested that firms that pursue any of the three strategies would shape their microfoundations (the routines firms employ and the actions taken by individuals and groups within them to shape their exporting capabilities) in a way that helps build their

[3] Nevertheless, we acknowledged our interpretation on results of Model 5 must be contingent on the potential for endogeneity.

capabilities and thus improve their performance and that this will be contingent upon the investment in infrastructure. By developing this argument, our results, answer the first research question and support the notion that in all cases the effect is positive. These findings advance the debate on the effect of exploration, exploitation and ambidexterity on export performance and help explain the role of microfoundations. First, when export performance is at stake, our findings explain that exploitation does not impel exploration (Piao and Zajac 2016) and thus a firm would not have to focus on developing routines on one of the two at one time and at one level (Floortje and Jan 2014). We explain, using the resource-based view, that routines improve their firms' ability to solve different types of problems.

More specifically, when a firm is pursuing an exploration strategy, export performance's differences lie in the way learning takes place when exporting. Routines associated with increased levels of exploration encourage greater levels of learning from the export market (Tse, Yu et al. 2017) because firms will be operating outside their normal environment (Gupta, Smith et al. 2006). Our work therefore contributes to this literature by adding to the findings of these studies. We explain that by extracting knowledge from existing internal and external resources, firms become better able at solving customers' problems at the foreign market and hence improve their overall export performance.

When a firm is pursuing an exploitation strategy, it is focusing more on the management of routines that improve its access to the export market. Therefore, the difference to that of exploration lies in how the firm manages routines associated with production and distribution. Different rules and regulations could make accessing the export market more uncertain (Tushman and O'Reilly 1996). Higher levels of exploitation would suggest that any learning associated with exporting is likely to be more sustained, or at least to have a longer-term impact. Therefore, our results confirm the arguments of previous studies that routines that support

exploitation will lead to operational and supply chain efficiencies (Huang, Yen et al. 2014) and will improve access to the export market.

Finally, and contrary to our hypothesized relationship, our results indicate that firms with higher levels of ambidexterity become relatively less likely to improve their export performance. One possible explanation for this result may relate to the time it takes for ambidextrous routines to affect export performance. We argued that the degree to which a firm is able to become ambidextrous and improve its performance would depend on how it manages two core activities. The first relates to the management of the routines and the second to how it is able to integrate the knowledge it gains from external sources (Jansen, Tempelaar et al. 2009). When these two activities follow each other (Lin, McDonough et al. 2013), e.g. a firm improves routines, which it then uses to integrate external knowledge into its products, it would also need to complete a learning cycle (exploration-exploitation) before improvements in its export performance become noticeable. Similarly, when this done by focusing on different research or product units (Floortje and Jan 2014), e.g. a firm asks one unit to focus on routines for exploration and another to focus on exploitation, it may take time and additional effort to integrate knowledge in a way that improves export performance. Even when exploration and exploitation are pursued concurrently, resolving conflicts that may arise would require the establishing of complex routines that emphasise resolution and integration (Simsek, Heavey et al. 2009). Therefore, one explanation for our counterintuitive result is that the management of the routines that generate ambidexterity slow down the process of improving export performance. This may be something, which is not captured by our data. We do acknowledge, however, that this is an argument, which would require some further investigation.

In answering our second research question, our results show that infrastructural investment weakens the positive effect of exploration and exploitation on export performance. They also

show that it weakens the negative effect of ambidexterity on export product sales. Although investment in infrastructure is usually a positive development, it is also likely to absorb managers' time and attention (Ocasio 1997, Ocasio 2011). The implementation of such investments require process changes, consume resources, and may divert attention from the development of appropriate exporting strategies. When firms combine such investments with routines to either explore new ideas or exploit existing capabilities the overall effect on export performance weakens.

One significant implication of this finding is the relative effect of infrastructure investment and where attention should be paid to improve export performance. The direct effect (Table 4) of our infrastructure variable is, as expected, positive. That is, investing in infrastructure has a positive effect on export performance. Yet, its moderating effect on the firm's ability to convert exploration or exploitation strategy to exporting is negative. Consistent with the principle of situated attention, managers will vary their focus depending on the consistency and variance of the situation they find themselves in (Ocasio 1997). Both the investment in infrastructure (Anand, Ward et al. 2009) and the efforts to export (Cavusgil 1984) are activities that require resources and specific capabilities to be developed. As such, our findings suggest that managers will divert their attention on building this capability that ensure that the investment works. Therefore, the attention and effort required to convert the investment into processes that will then improve export performance acts as a barrier to the firm's ability to convert its exploration and exploitation strategy into exports.

Furthermore, infrastructure investment weakens the relationship between ambidexterity and export performance. We argued that the negative relationship between ambidexterity and export performance is likely to be the result of the time and the additional effort needed to integrate knowledge in a way that affects export performance. Yet routines and tasks of

ambidextrous firms enable them to overcome the trade-off between exploration and exploitation (Cao, Gedajlovic et al. 2009). Therefore, when higher levels of infrastructure investment are combined with higher levels of ambidexterity the firm's routines may change in a way that reduces the time it takes to integrate knowledge and hence result in higher levels of export performance. Arguments from learning theory do support this proposition as they explain how increased investment will increase an organisation's ability to recognize the value of information, assimilate it, and apply it to commercial ends (Tortoriello 2015) i.e. its absorptive capacity (Cohen and Levinthal 1990). Therefore, it would be reasonable to deduce that when a firm becomes better able at assimilating external knowledge it will also become faster at doing so (Zobel 2017). Thus, if infrastructure investment has an effect on speed, then routines that help overcome the trade-off between exploration and exploitation will become faster, improving export performance.

Our work therefore advances the literature in the international business literature by explaining how a key contextual factor, investment in infrastructure affects how a firm manages its activities to achieve export performance (Robertson and Chetty 2000, Gnizy, Cadogan et al. 2017). It also advances previous work that explores aspects of exploration and exploitation, and its effects on exporting behaviour (Cavusgil, Zou et al. 1993, Theodosiou and Leonidou 2003, Schmid and Kotulla 2011). We find that a strategy that focuses either on exploration or on exploitation is likely to have positive effect on export performance. Yet, this is not case when it is trying to do both, i.e. to be ambidextrous. Furthermore, the investment in infrastructure will affect the relationship between these strategies and export performance. It benefits the ambidextrous firm but has a negative moderating effect on export performance when the focus is either on exploration or on exploitation.

5.2 Managerial Implications

Firms that look at improving their export performance can benefit from our results. We provide empirical support to the notion that, within the context of export performance, there is a limit to the benefits of ambidexterity. Firms should be prepared to examine multiple dimensions when they are considering exploration or exploitation activities for the export market. Our suggestion would, therefore, be to develop, when possible, routines associated with both exploration, such as R&D, and exploitation, such as production, in the export market and to combine the two in ways that can help address customers' requirement. For instance, they could start by developing the systems and routines that would need to be followed when conflicts arise for the pursuit of exploration and exploitation.

This suggestion, however, is conditional on the availability of resources for investing in infrastructure. Our arguments and empirical evidence suggest that this will reduce the negative effect of ambidexterity on export performance. We would therefore recommend to managers aiming at improving their export performance that they start by evaluating their capability to invest in infrastructure. Then, they either develop routines that enhance simultaneously exploration and exploitation, or they focus solely on one of the two. Although there may be several additional factors that could influence this relationship, the likelihood of improving export performance increases when infrastructure investment takes place at the same time.

6. Limitations and guidance for future work

There are some limitations within the context of which our findings need to be interpreted. The first relates to the geographical scope of our findings. Although CIS provides us with a rich and nationally representative sample, it was collected from one developed economy—UK. Future research could therefore expand the geographical scope into developing economies that

have distinct institutional environment, which plays a key role in innovation and export behaviour.

A second limitation relates to the potential for endogeneity. We conducted several robustness tests to ensure that this does not bias our results. However, there was no good instrument variable in CIS to apply instrumental variable estimation (IV). This may be due to the interrelations between available variables and export performance. We acknowledge that the interpretation of our findings may be subject to the potential for endogeneity; however, the consistent results of all robustness tests indicate that this risk is minimal.

Apart from addressing the limitations of our work, future work could benefit from further exploring the impact of the attention-based view on exporting and innovation strategies. We believe that this offers a promising avenue for future research as it can help explain much of managers' behavior. One possible study would be to explore how the decision to pursue an exploration, exploitation, or ambidextrous strategy is taken. Our starting point in our study was after the decision had been taken and implemented. Yet, the context within which this decision is considered may be critical. A future study, therefore, could investigate some antecedent factors that lead to this decision.

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Table 1: Variable Definitions using CIS dataset for 2004-2016

Equation 1: $EXPORT_{it}=\beta_{10} + \beta_{11}EXPLOR_{it}+ \beta_{12}EXPLOIT_{it} + \beta_{13}AMBIDT_{it} + \beta_{14}Control\ Variables + \varepsilon_{it}$

Equation 2: $EXPORT_{it}=\beta_{20} + \beta_{21}EXPLOR_{it} + \beta_{22}EXPLOIT_{it} + \beta_{23}AMBIDT_{it} + \beta_{24}INFRAST_{it} + \beta_{25}Control\ Variables + \varepsilon_{it}$

Equation 3: $EXPORT_{it}=\beta_{30} + \beta_{31}EXPLOR_{it} + \beta_{32}EXPLOIT_{it} + \beta_{33}AMBIDT_{it} + \beta_{34}INFRAST_{it} + \beta_{35}EXPLOR_{it} \times INFRAST_{it} + \beta_{36}Control\ Variables + \varepsilon_{it}$

Equation 4: $EXPORT_{it}=\beta_{40} + \beta_{41}EXPLOR_{it} + \beta_{42}EXPLOIT_{it} + \beta_{43}AMBIDT_{it} + \beta_{44}INFRAST_{it} + \beta_{45}EXPLOR_{it} \times INFRAST_{it} + \beta_{46}EXPLOIT_{it} \times INFRAST_{it} + \beta_{47}Control\ Variables + \varepsilon_{it}$

Equation 5: $EXPORT_{it}=\beta_{50} + \beta_{51}EXPLOR_{it} + \beta_{52}EXPLOIT_{it} + \beta_{53}AMBIDT_{it} + \beta_{54}INFRAST_{it}+ \beta_{55}EXPLOR_{it} \times INFRAST_{it} + \beta_{56}EXPLOIT_{it} \times INFRAST_{it} + \beta_{57}AMBID_{it} \times INFRAST_{it}+ \beta_{58}Control\ Variables + \varepsilon_{it}$

Definitions

EXPORT	Export product sales. The natural logarithms of total firm export sales revenue.
EXPLOR	Exploration. A categorical variable: 0 when a firm has no new products or services; 1 when a firm has products or services innovation that were new to the firm; 2 when a firm has products or services innovation that were new to the world.
EXPLOIT	Exploitation. A categorical variable: 0 when a firm has no incremental product innovation or process innovation for the production or supply of products or services; 1 when a firm has incremental product innovation or process innovation; 2 when a firm has both incremental product innovation and process innovation.
AMBIDT	Ambidexterity. A ratio variable from the multiplication between EXPLOR and EXPLOIT
INFRAST	Infrastructure. The natural logarithms of investment in infrastructure.
EXPLOR * INFRAST	Interaction term of EXPLOR and INFRAST
EXPLOIT * INFRAST	Interaction term of EXPLOIT and INFRAST
AMBIDT * INFRAST	Interaction term of AMBIDT and INFRAST
Control variables	
INTKNOW	Internal knowledge investment. The natural logarithm transformed value of in-house R&D investment/ turnover
EXTKNOW	External knowledge investment. The natural logarithm transformed value of external R&D investment/ turnover
LABOR	Firms' turnover per employee
BAND	Employment size band. Band 1 is less than 20 employees. Band 2 is no less than 20 employees and less than 50. Band 3 is no less than 50 employees and less than 100. Band 4 is no less than 100 employees and less than 250. Band 5 is no less than 250.
REGION	Regional dummy variable represents the following 12 UK regions: East Midlands, Eastern England, London, Northeast England, Northwest England, Northern Ireland, Scotland, Southeast England, Southwest England, Wales, West Midlands, Yorkshire and Humber

INDUSTRY	Industry dummy variable representative of 7 standardized industry code, including manufacture, mining, electricity & water supply, construction, hotel &accommodation, transportation and other. As for manufacture industry, there are 23 four-digit SIC codes.
YEAR	Time dummy variable represents 4 survey periods
ε_{it}	Random error term
$\beta_0 ... \beta_5$	Model coefficients, where β_0 measures the constants; β_1 measures the relationship between exploration and export; β_2 measures the relationship between exploitation and export; β_3 measures the relationship between ambidexterity and export; β_4, β_5 and β_6 measure the moderating effects of investment in infrastructure.

Table 2: Descriptive Statistics and Correlation Coefficients

	Variable	1	2	3	4	5	6	7	8	9	10	Mean	SD	VIF
1	EXPORT											5.26	3.53	
2	EXPLOR	0.18*										0.47	0.78	3.19
3	EXPLOIT	0.20*	0.70*									0.58	0.75	2.10
4	AMBIDT	0.10*	0.71*	0.50*								0.41	0.61	2.04
5	INFRAST	0.20*	0.27*	0.33*	0.18*							1.60	2.34	1.25
6	INTKW	0.33*	0.46*	0.43*	0.27*	0.33*						1.53	2.46	1.57
7	EXTKW	0.16*	0.26*	0.24*	0.17*	0.25*	0.42*					0.42	1.36	1.25
8	LABOR	0.02*	-0.01*	-0.01	-0.01	0.01	-0.01	0.00				309	4029	1.00
9	BAND	0.22*	-0.02*	-0.02*	0.01	0.15*	0.15*	0.11*	0.00			3.10	1.48	1.07
10	INDUSTRY	-0.16*	-0.11*	-0.10*	-0.06*	-0.11*	-0.13*	-0.05*	0.02*	-0.10*		4.98	3.76	1.06
11	REGION	0.00	-0.01*	-0.02*	-0.02*	-0.01	0.00	0.00	0.00	-0.05*	0.01*	6.53	3.18	1.00

*Correlation is significant at 0.05 levels. N=21,484

Table 3: Ambidexterity Effect on Logarithms of Export Product Sales

Dependent variable:	**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
EXPORT					**XTTOBIT**[†]					
	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
EXPLOR	0.190***	(0.05)	0.189***	(0.05)	0.209***	(0.05)	0.168***	(0.05)	0.197***	(0.05)
EXPLOIT	0.392***	(0.04)	0.324***	(0.04)	0.304***	(0.04)	0.344***	(0.04)	0.333***	(0.04)
AMBIDT	-0.189***	(0.04)	-0.183***	(0.04)	-0.132***	(0.04)	-0.117**	(0.04)	-0.175***	(0.04)
INFRAST			0.316***	(0.03)	0.348***	(0.03)	0.370***	(0.03)	0.279***	(0.04)
EXPLOR * INFRAST					-0.184***	(0.03)	-0.091**	(0.03)	-0.202***	(0.04)
EXPLOIT* INFRAST							-0.151***	(0.04)	-0.158***	(0.04)
AMBIDT * INFRAST									0.151***	(0.04)
Controls										
INTKNOW	0.382***	(0.01)	0.360***	(0.01)	0.361***	(0.01)	0.359***	(0.01)	0.357***	(0.01)
EXTKNOW	0.068**	(0.02)	0.044*	(0.02)	0.055*	(0.02)	0.055*	(0.02)	0.056*	(0.02)
LABOR	0.000*	(0.00)	0.000*	(0.00)	0.000*	(0.00)	0.000*	(0.00)	0.000*	(0.00)
BAND (band 1 as base)										
Size Band 2	0.453***	(0.09)	0.410***	(0.09)	0.411***	(0.09)	0.408***	(0.09)	0.409***	(0.09)
Size Band 3	1.155***	(0.09)	1.089***	(0.09)	1.090***	(0.09)	1.086***	(0.09)	1.088***	(0.09)
Size Band 4	1.386***	(0.09)	1.312***	(0.09)	1.327***	(0.09)	1.326***	(0.09)	1.327***	(0.09)
Size Band 5	1.458***	(0.09)	1.353***	(0.09)	1.365***	(0.09)	1.363***	(0.09)	1.362***	(0.09)
sigma_u	1.465***	(0.04)	1.478***	(0.04)	1.482***	(0.04)	1.482***	(0.04)	1.482***	(0.04)
sigma_e	3.577***	(0.02)	3.561***	(0.02)	3.556***	(0.02)	3.555***	(0.02)	3.553***	(0.02)
Industry dummies	Included		Included		Included		Included		Included	
Regional dummies	Included		Included		Included		Included		Included	
Year dummies	Included		Included		Included		Included		Included	
No. of Observation	21484		21484		21484		21484		21484	
AIC	103804.890		103695.945		103648.511		103632.706		103616.015	
BIC	104107.942		104006.973		103967.514		103959.684		103950.968	
Log likelihood	-51864.445		-51808.973		-51784.255		-51775.353		-51766.008	
Wald Chi Square	3985.444		4103.769		4155.341		4174.206		4194.385	
Prob>chi2	0.000		0.000		0.000		0.000		0.000	

[†] Panel effect tobit model; * p<0.05 ** p<0.01 *** p<0.001

Table 4: Robustness Check for Ambidexterity Effect on Logarithms of Export Product Sales: Alternative Estimates

Dependent variable:	**Model 6**		**Model 6a**		**Model 6b**		**Model 7**		**Model 7a**		**Model 7b**	
EXPORT	**OLS**		**Tobit**		**GLM**		**GEE**[†]		**Mixed-effect**[†]		**Matching**	
	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
EXPLOR	0.114**	(0.03)	0.178***	(0.05)	0.028***	(0.01)	0.035***	(0.01)	0.117**	(0.04)	0.021***	(0.01)
EXPLOIT	0.231***	(0.03)	0.331***	(0.04)	0.056***	(0.01)	0.059***	(0.01)	0.232***	(0.03)	0.023***	(0.01)
AMBIDT	-0.129***	(0.03)	-0.175***	(0.04)	-0.029***	(0.01)	-0.030***	(0.01)	-0.131***	(0.03)	-0.011*	(0.01)
INFRAST	0.191***	(0.03)	0.257***	(0.04)	0.042***	(0.01)	0.050***	(0.01)	0.194***	(0.03)	0.015**	(0.00)
EXPLOR * INFRAST	-0.135***	(0.03)	-0.194***	(0.04)	-0.032***	(0.01)	-0.034***	(0.01)	-0.132***	(0.04)	-0.011*	(0.01)
EXPLOIT * INFRAST	-0.111***	(0.03)	-0.160***	(0.04)	-0.028***	(0.01)	-0.028***	(0.00)	-0.111***	(0.03)	-0.015**	(0.00)
AMBIDT * INFRAST	0.111***	(0.03)	0.151***	(0.04)	0.024***	(0.00)	0.025***	(0.00)	0.110***	(0.03)	0.012**	(0.00)
Controls												
INTKNOW	0.322***	(0.01)	0.369***	(0.01)	0.052***	(0.00)	0.050***	(0.00)	0.324***	(0.01)	0.043***	(0.00)
EXTKNOW	0.051**	(0.02)	0.054*	(0.02)	0.008**	(0.00)	0.008**	(0.00)	0.051**	(0.02)	-0.001	(0.00)
LABOR	0.000	(0.00)	0.000*	(0.00)	0.000	(0.00)	0.000**	(0.00)	0.000**	(0.00)	0.000	(0.00)
BAND (as base)												
Size Band 2	0.433***	(0.06)	0.420***	(0.09)	0.109***	(0.02)	0.105***	(0.02)	0.433***	(0.07)	0.103***	(0.02)
Size Band 3	1.072***	(0.06)	1.087***	(0.09)	0.232***	(0.02)	0.227***	(0.02)	1.077***	(0.07)	0.243***	(0.02)
Size Band 4	1.397***	(0.07)	1.323***	(0.09)	0.283***	(0.02)	0.278***	(0.02)	1.395***	(0.07)	0.325***	(0.02)
Size Band 5	1.527***	(0.07)	1.316***	(0.08)	0.277***	(0.02)	0.284***	(0.02)	1.516***	(0.07)	0.384***	(0.02)
Random effect parameters (variance)												
Industry									0.629***	(0.15)		
Province									0.338***	(0.05)		
Industry dummies	Included		Included		Included		Included		Included		Included	
Regional dummies	Included		Included		Included		Included		Included		Included	
Year dummies	Included		Included		Included		Included		Included		Included	
No. of observation	21484		21484		21484		21484		21484		1962	
AIC	110712.126		104069.242		112536.129		N/A		110717.710		76444.149	
BIC	111031.128		104396.220		112855.132		N/A		110893.161		76745.231	
Log likelihood	-55316.063		-51993.621		-56228.065		N/A		-55336.855		-38182.074	
Wald Chi Square	F-statistic=161.298		4217.295		4271.279		3986.682		4081.665		3665.730	
Prob>chi2	0.000		0.000		0.000		0.000		0.000		0.000	

[†] Panel effect model; * p<0.05 ** p<0.01 *** p<0.001

Figure 1 Conceptual Framework

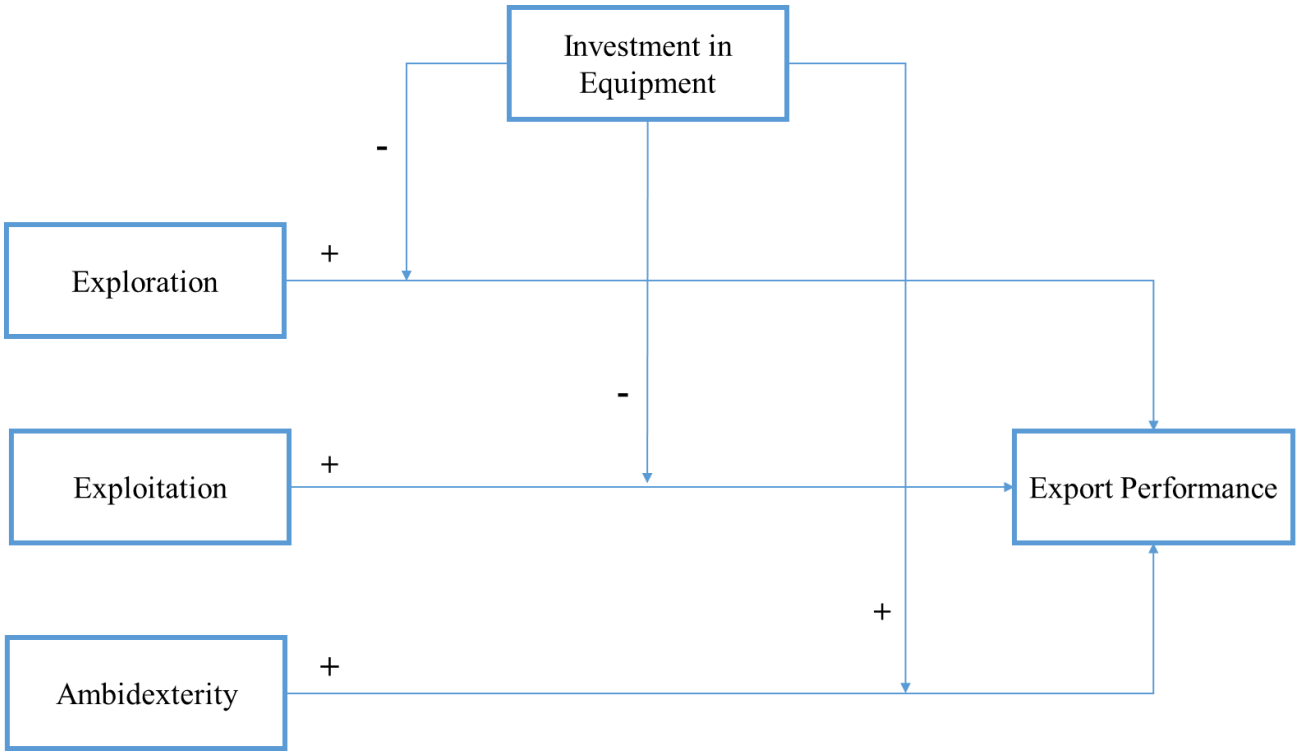

Figure 2 The Moderation Effect of Infrastructure Investment on the Relationship between Exploration and Export Performance

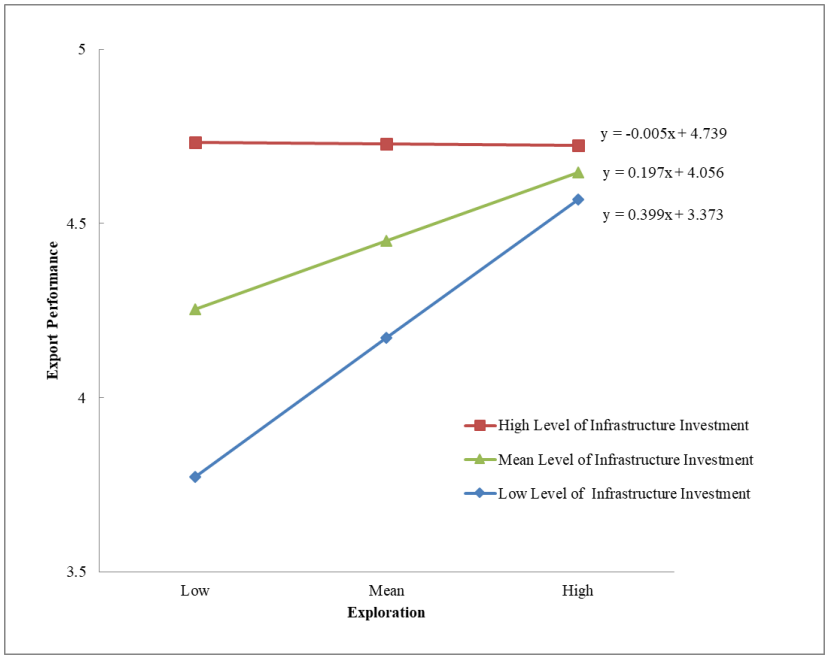

Figure 3 The Moderation Effect of Infrastructure Investment on the Relationship between Exploitation and Export Performance

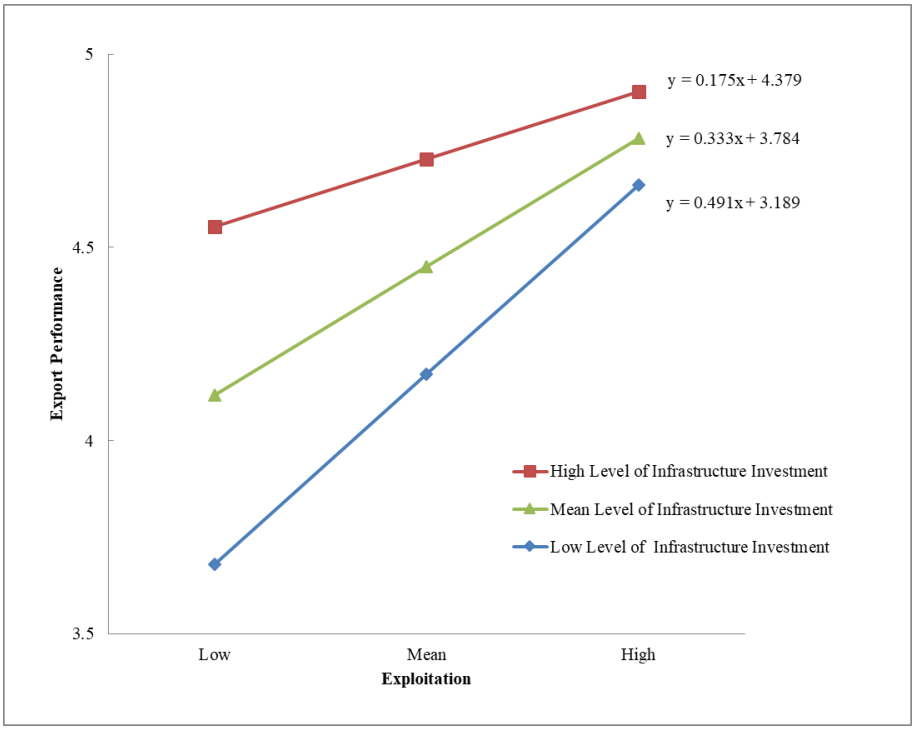

Figure 4 The Moderation Effect of Infrastructure Investment on the Relationship between Ambidexterity and Export Performance