ESSAYS ON INTERMEDIATION AND TRADE

A thesis submitted in partial fulfilment of the requirements for the Degree

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ABSTRACT

This thesis focuses on determinants of firms' export performance. Chapter One introduces the literature on firm export behaviour. Chapter Two replicates the work of Ahn, Khandelwal, and Wei (2011). It examines the role of intermediaries in facilitating trade. Using Chinese data mostly sourced independently from the authors, I am able to reproduce the key evidence reported by AKW in favour of their intermediated trade model. However, when I extend their analysis to include additional data, I find that their results are not generally robust. My findings indicate that further research needs to be done to better understand the role of intermediaries in international trade markets.

Chapter Three uses meta-analysis to analyse the empirical literature on spillovers and exports. It collects 3,025 estimated spillover effects from 98 studies. The estimated spillover effects in the literature span a large number of types and measures of both exports and spillovers. As a result, I transform estimates to partial correlation coefficients (PCCs). I analyse these transformed effects using a variety of estimators. My analysis produces three main findings. First, while I estimate a mean overall effect of spillovers on exports that is statistically significant, the size of the effect is economically negligible. Second, I find evidence of positive publication bias. However, the size of the estimated publication bias is small, and disappears in some regressions when other explanatory variables are included in the analysis. Third, while some data, estimation and study characteristics are significantly related to estimated spillover effects, only a few are robust, and none are large in size.

Chapter Four investigates spillover effects from other exporters on incumbent, exporting manufacturers. Specifically, I examine the following spillover effects on firm's export performance: spillovers from geographic proximity to other exporters, national agglomeration of exporters exporting the same products, regional agglomeration of exporters exporting the same product, regional concentration of exporters with the same destination market, and regional concentration of exporters exporting the same product to the same destination market. I use export volume as an indicator of the intensive margin and compare spillovers specifically from both direct exporters and intermediary firms. I find that spillovers have a positive and statistically significant relationship with a firm's intensive margin of export. My results indicate little difference between spillover effects from direct exporters and spillover effects from intermediary firms. I interpret my results to indicate that the primary transmission mechanism among incumbent exporting firms is information spillovers.

Chapter Five brings my thesis to a close. It provides an overall summary of the main findings of my research, along with a final set of conclusions.

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Chapter 1. Introduction

According to the theory of export-led growth, exports have played an important role in contributing to economic growth in both developed and developing countries. Many reasons have been put forward to support the export-led growth proposition. These include increased demand for a country's output, reallocation of resources from the non-traded sector to the relatively more efficient export sector, exposure to better production and management practices, acquisition of knowledge about advanced technologies, and access to additional sources of financing. Trade expansion also allows firms to gain from specialization and increasing returns to scale (Giles & Williams, 2000). As a result, there is much interest in understanding the determinants of exports.

Classic trade theories have contributed to our understanding of the causes and consequences of international trade using the concept of comparative advantage (Dornbusch, Fischer, & Samuelson, 1977; 1980). Countries that differ in their efficiency of production technologies or in their endowments of factors of production find it mutually beneficial to trade. Sector-specific technological gaps have been highly successful in explaining the pattern of international trade. In classic trade models, trade is always inter-industry trade as countries have a clear incentive to export the good that it has a comparative advantage in and import the other good. As the importance of intra-industry trade in world trade started to rise, however, it became apparent that we needed models that could explain such trade. This led to the development of a new branch of trade theory, now called new trade theories, where the motivation for international trade comes from scale economies and product differentiation and where countries can both

import and export a good in the same industry, consistent with the empirical observation of intra-industry trade patterns (Krugman, 1980).

The next wave in the development of trade theory came about when firm-level empirical evidence revealed the heterogeneity across exporters and non-exporters while trade models to that date had treated firms as homogenous producers. For example, Bernard, Jensen, and Lawrence (1995) and Bernard, Jensen, Redding, and Schott (2007) find that exporting firms are larger, more productive, and more capital- and skill-intensive compared to non-exporting firms. Exporters tend to pay higher wages to employees, and exhibit greater short-term growth. These findings contributed to the development of new trade models that incorporate firm heterogeneity to explain how firms become exporters. For example, Melitz (2003) and Bernard, Eaton, Jensen, and Kortum (2003) use firm heterogeneity in productivity to display that only producers achieving the "productivity threshold" can engage in the international trade market. Following these trade models, a large number of empirical studies have focused on the relationship between firm productivity and export decision, demonstrating that the more productive producers export while less productive producers only serve the domestic market (Aw, Chung, & Roberts, 2000; Castellani, 2002; Head & Ries, 2003).

Although productivity is a key factor that affects a firm's entry into the export market, export activity involves much more than just the production process. An exporting firm needs to gain knowledge about foreign destination markets and consumer tastes, which helps it make decisions about foreign market access, whether

or not to develop new products catering to the preferences of foreign consumers, how to distribute the products, and whether or not to establish own distribution networks. According to Ahn, Khandelwal, and Wei (2011), the existence of intermediaries in trade, to some extent, can help producers to overcome the productivity and information barriers. They show that intermediaries establish their own distribution networks and help domestic manufacturers distribute products to foreign markets. By saving on search costs and distribution-related costs, less productive manufacturers can indirectly participate in the export market through the intermediary sector. Empirical literature shows that intermediation has been widely pervasive in developed and developing economies, such as Japan (Rossman, 1984), the U.S. (Bernard, Jensen, Redding, & Schott, 2010), Italy (Bernard, Grazzi, & Tomasi, 2015), China (Feenstra & Hanson, 2004), Chile and Colombia (Blum, Claro, & Horstmann, 2009). The existence of intermediaries clearly provides a choice of indirectly participating in the export market for less productive producers, and this choice of export mode is something that I am interested in studying.

The aim of this thesis is to investigate factors that affect a firm's export performance. The first question I want to study is how intermediaries affect a firm's export decision, which I do in Chapter two by replicating the work of Ahn, Khandelwal, and Wei [AKW] (2011) titled "The role of intermediaries in facilitating trade". Following Melitz (2003), AKW develop a theoretical model to explain how intermediary firms affect the export mode of heterogeneous firms. Whereas in Melitz

(2003) firms decide whether or not to export, AKW allow for a third option, exporting through intermediaries. Exporting firms can either export their products directly overseas, incurring bilateral fixed and variable costs, or they can sell to domestic intermediaries that rebrand and market their products to overseas consumers, incurring a lower fixed cost without any additional variable costs. Based on different compositions of trade cost, AKW derive three testable predictions on the pattern of intermediated trade:

(i) For a specific market, firms of intermediate levels of productivity use intermediation, while the most productive firms choose to export directly;

(ii) The export price of intermediaries should be higher than that of direct exporters;

(iii) The export share of intermediaries is associated with the destination country's characteristics.

The replication begins by reproducing the above three predictions using data mostly sourced independently from the authors and their code. The replication results show supportive evidence for all of the three predictions. As a part of my robustness checks, I re-estimate AKW's first hypothesis on the relationship between firm productivity and export mode choices with more recent data. However, I find supportive evidence for the first hypothesis with only one of the three productivity proxies used in AKW. I also examine subsamples of firms by geographic regions and use data from earlier years to re-analyse the other two hypotheses and find that their

results are not all robust to these variations. My final robustness check uses all three different publicly available versions of one of the key variables - the number of required importing procedures – which in the study is used as the proxy for the fixed cost of entering into a specific market. Whether or not I get results that support the AKW hypothesis depends on which version of this variable I use.

Together with AKW (2011), Akerman (2010) and Felbermayr & Jung (2008) focus on the impact of intermediaries on non-exporting firm's participation decision in a situation where the intermediary is employed by the firm to assist its entry into the export market. However, because of external economies, firms can benefit from other firms through indirect channels as well, which can affect their exports. In the literature of international trade, these external effects are often referred to as spillover effects. Spillovers can affect export performance directly or they can affect the firm's productivity which in turn affects its export performance. Many different channels though which spillovers affect exports have been hypothesised in the literature. First, firms could adopt, through demonstration and imitation, new technologies and management techniques (Greenaway, Sousa, & Wakelin, 2004). This learning from other firms can help the firms become more efficient and achieve the productivity threshold of exporting. This type of learning effect is likely to occur among producers in the same industry or via buyer-supplier linkages (Kneller & Pisu, 2007). Another channel is through information externalities that reduce costs (Aitken, Hanson, & Harrison, 1997). Exporting involves sunk costs, which might include the establishment

of distribution networks, specifying the product compliance and regulations and acquiring knowledge about foreign market demand and foreign consumer tastes. Knowledge transfers from other exporting firms could help lower these sunk costs, helping firms find it profitable to start exporting or easier to export to more countries. A third channel is through agglomeration economies that lower costs. For example, locational concentration of exporters can make it feasible to build specialised transportation infrastructure, such as roads, railways, ports, airports, and storage facilities (Duranton & Puga, 2004). Reducing the transportation and transaction costs makes it possible for more producers to participate in the export market.

Generally, a firm's export growth can be classified as either affecting its extensive margin or its intensive margin. Extensive margin refers to participation decisions. More specifically, extensive export margin refers to decision to start exporting, extensive country margin refers to the decision to start exporting to a specific country and extensive country-product margin refers to the decision to start exporting a specific product to a specific country. Intensive margin, on the other hand, refers to a decision to grow the value of exports. This can be further decomposed into a price decision and a volume decision. Many empirical studies focus only on whether a firm decides to participate in the export market or on how much it exports after becoming an exporter, but others examine both the external and internal margins of trade.

While theoretical models are clearly able to distinguish the links between different spillover types and different effects on a firm's export performance, it is challenging to

distinguish the types and the performance effects in empirical papers. Furthermore, while positive spillover effects dominate the theoretical predictions, overall empirical evidence is mixed. For example, Aitken et al. (1997) estimate a positive relationship between FDI spillovers and the export decision of Mexican manufacturing firms, but find no spillover effects from the general presence of exporters. Becchetti and Rossi (2000) estimate positive externalities of geographical agglomeration on the export intensity of Italian firms but find little effect on the probability of starting to export. Bernard and Jensen (2004) study different spillovers from exporters – state-specific but outside the industry, industry-specific but outside the state, and state and industry-specific – but find no evidence of spillover effects on the decision to export for U.S. manufacturing plants.

Given the mixed evidence of spillovers and trade, my second objective for the thesis is to understand why the empirical results are so mixed and to gain a clearer picture of impact of spillovers on exports. I do this in Chapter Three with a meta-regression analysis. The objective of this study is to answer the following questions:

(Q1) Do spillovers have an overall positive impact on exports, and, if so, how large?;

(Q2) Is there a publication bias, and, if so, after correcting the bias, what is the overall mean spillover effect?;

(Q3) What are the primary transmission mechanisms of spillovers?

(Q4) What are the factors causing heterogeneity in the estimates across studies?

I collect 3,025 estimated spillover effects from 98 studies for my meta-regression analysis. The estimated spillover effects in the literature span a large number of types and measures of export decisions and spillovers. As a result, I transform estimates to partial correlation coefficients (PCCs). I then analyse these transformed effects using four different versions of Weighted Least Squares estimators, incorporating both meta-analytic "Fixed Effects" and "Random Effects" models. The main findings from this chapter are as follows: First, I find a statistically significant and positive mean overall effect of spillovers on exports, but this effect is economically negligible. Second, by using conventional Funnel Asymmetry Tests, I find evidence of a positive publication bias. However, generally, the impact of publication bias is small. Third, by using both Bayesian Model Averaging and frequentist WLS estimation, I find that some data, estimation and study characteristics have a significant effect on the size of the spillover estimates. However, only a few of these characteristics are robust to all regressions, and their influence is always small.

My meta-analysis chapter reveals that the most effective spillover channel is from other exporters instead of region-specific spillovers, industry-specific spillovers or spillovers associated with FDI. The aim of Chapter Four is to understand this relationship more carefully to find out if the size of the spillover depends on whether the exporter of concern is an intermediary firm or an exporting manufacturer. The chapter also studies different types of agglomeration to understand where

agglomeration has the largest potential to create spillovers. Specifically, I examine spillovers from

1) geographic proximity to other exporters
2) national agglomeration of exporters exporting the same products
3) regional agglomeration of exporters exporting the same product
4) regional concentration of exporters with same destination market and
5) regional concentration of exporters exporting same product to same destination market.

I use export volume as an indicator of the intensive margin and investigate, using various measures, whether spillovers from direct exporters and intermediary firms affect a firm's export margin. I find that spillovers have a positive and statistically significant relationship with a firm's intensive margin of export. This finding is robust to all my different spillover measures. Previous literature has suggested that direct exporters possess specific technical information on production and technology as well as knowledge about foreign markets and consumers and that intermediary firms have informational advantage and specialize in matching manufacturers and customers across markets. Therefore, I can expect that firms can benefit from technology spillovers and information spillover from direct exporters, while information transfers dominate the spillover effects from intermediaries. My results show that the spillover effects from these two groups are very similar in size. I interpret this to mean that the

primary transmission mechanism among incumbent exporting firms is information spillovers. Knowledge about the demand of specific destination market and the foreign consumers' tastes on specific product plays important role in promoting producers exporting more products or exporting to more markets.

To conclude, my replication study in Chapter Two generally finds supportive evidence of intermediaries facilitating trade. However, when I do further tests, the results are not robust. Chapter Three looks at the overall spillover effects on exports in the literature. Combining different channels of spillovers, I find that the mean overall spillover effect on exports is economically negligible. In my final chapter, Chapter Four, I focus on the relationship between spillovers from intermediaries and direct exporters and the existing exporters' intensive margin. I find that information transfers dominate the spillovers among incumbent exporters and that intermediaries can generate information spillovers to promote other exporters' performance in the export market. Overall, I find support that intermediaries can be beneficial for both non-exporters, in helping them to begin exporting, and exporters, in increasing the productivity of their exports through spillovers, and therefore that intermediaries play an important role in trade.

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Chapter 2. A Replication Study of the Role of Intermediaries in Facilitating Trade: Evidence from China

2.1 Introduction

Japanese trading companies, as intermediaries, have been successfully contributing to accessing foreign markets for Japan's domestic manufacturers (Sarathy, 1985). These intermediaries have been able to reduce domestic producers' search, negotiation and transaction costs by providing low-cost export services. The success of the Japanese trading-company model has resulted in imitation of other countries. For example, the U.S. passed the Exporting Trading Company Act of 1982 to promote exports by encouraging the formation and development of export-trade-service companies (Bello & Williamson, 1985). However, the role of intermediary firms has largely been ignored by theoretical and empirical studies of international trade. Ahn, Khandelwal, and Wei [AKW] (2011) develop a theoretical model to explain how intermediary firms affect the export mode of heterogenous firms and derive three predictions on the pattern of intermediated trade. They use Chinese trade transaction data to provide empirical evidence for the model. This chapter replicates AKW and provides robustness checks to gain further insights into how intermediary firms facilitate exporting.

The theoretical model of AKW (2011) modifies the seminal Melitz (2003)model to allow for the existence of an intermediary sector. It explains how intermediary firms help manufacturers participate in the export market. In the model, the revenue and costs faced by indirect and direct exporters differ. While using an intermediary leads to lower revenue per unit, the costs are also lower because using an intermediary incurs a one-off fixed cost that avoids the need for bilateral fixed and variable costs that direct

exporters must incur. The model predicts that the most productive firms choose to export directly, firms of intermediate levels of productivity use intermediation and the firms with the lowest productivity sell on the domestic market only. Considering the different cost components of direct and indirect exporters, the second prediction of the model is that the consumer prices of the intermediated exports are higher than those of direct exports. The authors also show how the proportion of indirect exports varies with trade costs and market size, leading to the third prediction that higher intermediary export share is related to countries with higher trade costs or smaller market size. Finally, AKW use firm-level data from China to test the three predictions.

The replication carried out in this chapter consists of six parts: (a) re-examination of the first hypothesis on the relationship between productivity and export mode using the same dataset as AKW sourced from the World Bank's Enterprise Survey Data; (b) robustness checks of the first hypothesis using an extended sample period; (c) re-examination of the second hypothesis on the relationship between using an intermediary and directly exporting and unit value differentials; (d) robustness checks of the second hypothesis using data from earlier years and regional subsamples in the same year; (e) re-examination of the third hypothesis on the relationship between intermediary export share and destination market characteristics; (f) robustness checks of the third hypothesis using different data sources for key variables, data from earlier years and regional subsamples. A discussion of findings follows.

Using the programming code and some of the original data of AKW, I am able to reproduce their key findings. However, when I examine their hypotheses further, by using data from earlier years, by updating key variables representing different trade costs, by using alternative measures of trade costs and by examining subsamples of firms by geographic regions, I find that their results are not generally robust. My findings suggest that further research needs to be done to better understand the role of intermediaries in international trade markets.

The remaining chapter is organized as follows. Section 2 explains the theoretical framework of international trade with intermediaries. Section 3 describes the data and variables used for examining the hypotheses. Section 4 presents the replication results and robustness checks. Finally, Section 5 concludes.

2. 2 Theoretical background

Classic trade theories have contributed to our understanding of the causes and consequences of international trade using the concept of comparative advantage. Comparative advantage is attributed to technological differences in the Ricardian model and factor endowment differences in the Heckscher-Ohlin model. Trade between different countries or different industries occurs as long as the countries trading differ in their technologies or have different relative endowments of factors of production. The classic trade theories can only explain inter-industry trade between countries but cannot be used to explain intra-industry trade due to the clear incentive these models demonstrate for countries to export the good that it has a comparative advantage in and

import other good. However, intra-industry trade has been gaining trade share for decades. The New Trade Theory field addresses this mismatch between theory an empirical evidence. Krugman (1980) incorporates imperfect competition and consumer preference for variety to explain the empirical observation of intra-industry trade. As the availability of firm-level data has improved, empirical evidence has revealed that exporting and non-exporting firms co-exist in the same sector suggesting that trade models have to allow for firm heterogeneity (Aw, Chung, & Roberts, 2000; Castellani, 2002; Delgado, Farinas, & Ruano, 2002; Head & Ries, 2003). The Melitz (2003) model of heterogeneous firms demonstrates the relationship between firm productivity and participation in trade markets. It shows that the most productive firms will become exporters while less productive firms serve the domestic market only. Since Melitz (2003), a great number of studies have investigated the differences between exporters and non-exporters (see for example (Bernard, Eaton, Jensen, & Kortum, 2003; Bernard, Jensen, Redding, & Schott, 2007; Chaney, 2008; Melitz & Ottaviano, 2008; Verhoogen, 2008). However, this literature has ignored the existence of intermediaries in trade.

Intermediation is widely observed in empirical studies. For example, as the world's largest entrepôt economy, Hong Kong intermediates trade between China and other countries. During 1988-1998, 53% of Chinese goods were imported and distributed through Hong Kong. In 1998, 47% of Hong Kong's GDP originated from re-exports of Chinese goods (Feenstra & Hanson, 2004). Apart from Hong Kong, intermediaries are pervasive in other economies as well. In the early 1980's, 300

Japanese traders (non-manufacturer) accounted for 80% of Japan's trade (Rossman, 1984). In 2002, American intermediaries (wholesalers and retailers) accounted for 44% and 56% of exporting and importing firms and 11% and 24% of export and import value, respectively (Bernard, Jensen, Redding, & Schott, 2010).

Entrepôt trade, facilitated by countries such as in Hong Kong, Singapore and Dubai, shows the role that intermediaries can play in global exchange (Feenstra & Hanson, 2004). A research on multinational retailers in China also points to the role of intermediation in promoting imports (Emlinger & Poncet, 2016). Traders in entrepôt economies have informational advantage and specialize in matching manufacturers and customers across markets. Reducing information costs is likely to be the main incentive for buyers and sellers to trade through intermediaries (Feenstra & Hanson, 2004). Meanwhile, exporters can also benefit from saving transport costs, lowering the risks associated with long-distance travel and employ entrepôts to process goods when necessary (Feenstra & Hanson, 2004). Overall, intermediaries have multiple functions in the international market, such as searching and matching (distribution technologies) (Antràs & Costinot, 2011; Blum, Claro, & Horstmann, 2009) , managing inventory (Qu, Raff, & Schmitt, 2014) and quality-sorting (Tang & Zhang, 2012).

Ahn, Khandelwal, and Wei (2011), which this replicates, develop the Melitz (2003) model by incorporating an intermediary sector and predict the role of intermediary firms in promoting international trade.

2.2.1 Firm heterogeneity – Melitz (2003)

The models of international trade before Melitz assumed that firms are homogenous, which meant that all firms behave the same in an equilibrium. Melitz (2003) incorporated firm heterogeneity in labour productivity into the Krugman (1980) model, maintaining its other assumptions of constant elasticity of substitution (CES) preferences, monopolistic competition and increasing returns to scale. The idea of heterogeneous firms is consistent with the empirical fact that there exist firms of different capabilities within any industry and that only a fraction of firms in each sector are involved in exporting.

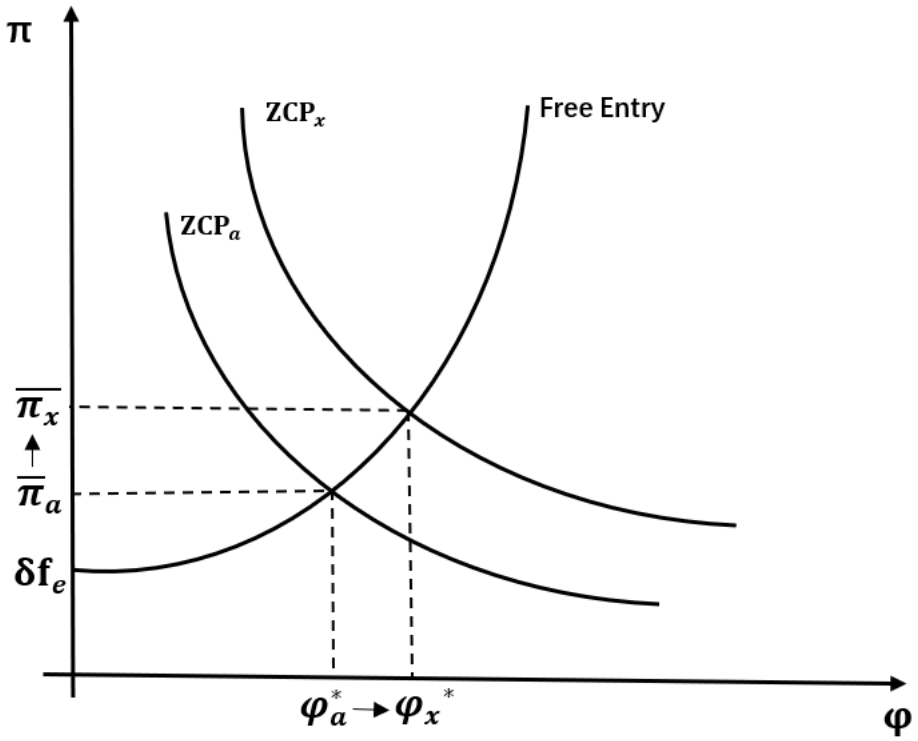
The starting point of the Melitz model is a closed economy where firms serve domestic market only. The model assumes that firms are identical before entry into the industry. Only after paying a fixed irreversible entry cost will a firm learn its own productivity - that is, each firm faces an uncertain production technology before making a sunk investment to supply a variety. After entry, a firm chooses how much to produce or, if facing a negative profit, it will exit. In a steady-state equilibrium, the aggregate variables, such as the price index, P, the aggregate expenditure and income, R, stay constant over time. The zero cut-off profit condition requires that firms remaining active in the market earn at least zero profit. If the profit were negative, the firm would not stay. Similarly, the free entry (FE) condition requires that the net present value of entry cover investment costs. These two conditions each give a relationship between

the average profit $\overline{\pi}$ and the cut-off productivity φ^*. Combining the two conditions gives a unique equilibrium pair $\overline{\pi}$ and φ^*, or the equilibrium in the closed economy.

The open-economy equilibrium differs from the closed economy equilibrium due to different cost functions. In the closed economy, each firm supplies one variety with a cost function that consists of a specific constant marginal cost and a fixed cost. When it comes to the open economy, a symmetry assumption applies, with the same wage level and the same aggregate variables as in the closed economy. However, firms that are involved in trade need to also cover a variable cost τ, which covers extra transport and tariff costs of trade, and a fixed cost f_x.

By comparing the equilibria in the closed and open economy, the model can display the impact of trade on firms. The FE condition is identical for the closed and the open economies, which means that we have the same requirement for the expectation of profitability in the closed economy and the open economy. However, in contrast to the closed economy, the zero cut-off productivity (ZCP) curve for an open economy is higher, leading to a higher cut-off productivity level and a larger average profit. The changes are represented in the Figure 2.1 below.

Figure 2.1 The impact of trade on the equilibrium cut-off φ^* and average profit $\overline{\pi}$



Source: Drawn by the author.

Figure 2.1 reveals that if a firm wants to enter the domestic market in an open economy, it must possess a greater technology than in the closed economy: $\varphi_x^* > \varphi_a^*$. This means that the firms the productivity levels of which are between φ_a^* and φ_x^* and that were active in the closed economy will have a negative profit in the open economy and therefore exit. Meanwhile, the open economy will have a higher average profit level: $\overline{\pi}_x > \overline{\pi}_a$. In other words, in the open economy, the "selection effect" co-exists domestically and abroad, which reallocates market shares towards more productive firms.

2.2.2 Trade model with intermediaries

AKW (2011) modify the Melitz (2003) model to allow for the existence of intermediaries, while maintaining the same assumptions of constant elasticity of substitution (CES) preferences, monopolistic competition, increasing returns to scale and firm heterogeneity in labour productivity. Different from the original model, AKW assume that the home country faces N asymmetric trading partners. AKW also only concentrate on the open-economy equilibrium because intermediaries are only involved in open trade. Moreover, the intermediary sector is perfectly competitive, with homogenous intermediary firms exporting on behalf of the manufacturers. In what follows, I will go through the theoretical model in AKW.

Incumbents in the market decide whether or not to participate in trade and their patterns of export based on their productivity. There are two modes of export – direct exporting and indirect exporting – associated with different compositions of trade cost. Direct exporting to a specific country j involves a bilateral fixed cost (f_x^j) and a bilateral variable cost (τ^j). By trading through an intermediary, manufacturers have to pay a fixed cost f_i ($f_i < f_x^j$), without any additional variable cost. Once a firm pays f_i, it can indirectly export to all countries and, thus avoid paying the direct trade costs f_x^j. In order to re-sell these varieties abroad, intermediaries need to incur additional variable costs, such as the cost of relabelling, packaging, etc. Thus, the indirect export price is higher than the direct export price. Due to the intermediary pricing the goods higher than the direct exporter, using intermediation technology results in lower sales.

Therefore, manufactures face a trade-off between paying a higher fixed cost that allows them to access their destination market directly leading to a lower price and more sales and incurring a lower fixed cost to export indirectly through intermediaries but selling less.

The assumptions above give us the following profits for the indirect exporter, the intermediary firm and direct exporter, respectively:

(a) Profit for indirect exporter

As assumed, indirect exporters do not need to pay fixed cost for a specific country j. Thus the manufacturer's profit of indirect exports is given by:

$$\pi_i^j(\varphi) = \frac{1}{\sigma}\gamma^{-\sigma}R^j(\frac{\tau^j}{\rho\varphi P^j})^{1-\sigma}, \quad (1)$$

where φ refers to the manufacturer's productivity, σ is the income elasticity of substitution, γ denotes the per-unit cost for the foreign market of a variety, R^j refers to the aggregate expenditure, τ^j represents the per-unit (iceberg) transport cost and P^j denotes the aggregate price.

(b) Profit for intermediary

Similar to indirect exporter, per-variety profit of the intermediary is:

$$\pi_{int}^j(\varphi) = \frac{1}{\sigma}\gamma^{-\sigma}(\gamma-1)R^j\left(\frac{\tau^j}{\rho\varphi P^j}\right)^{1-\sigma}. \quad (2)$$

(c) Profit for direct exporter

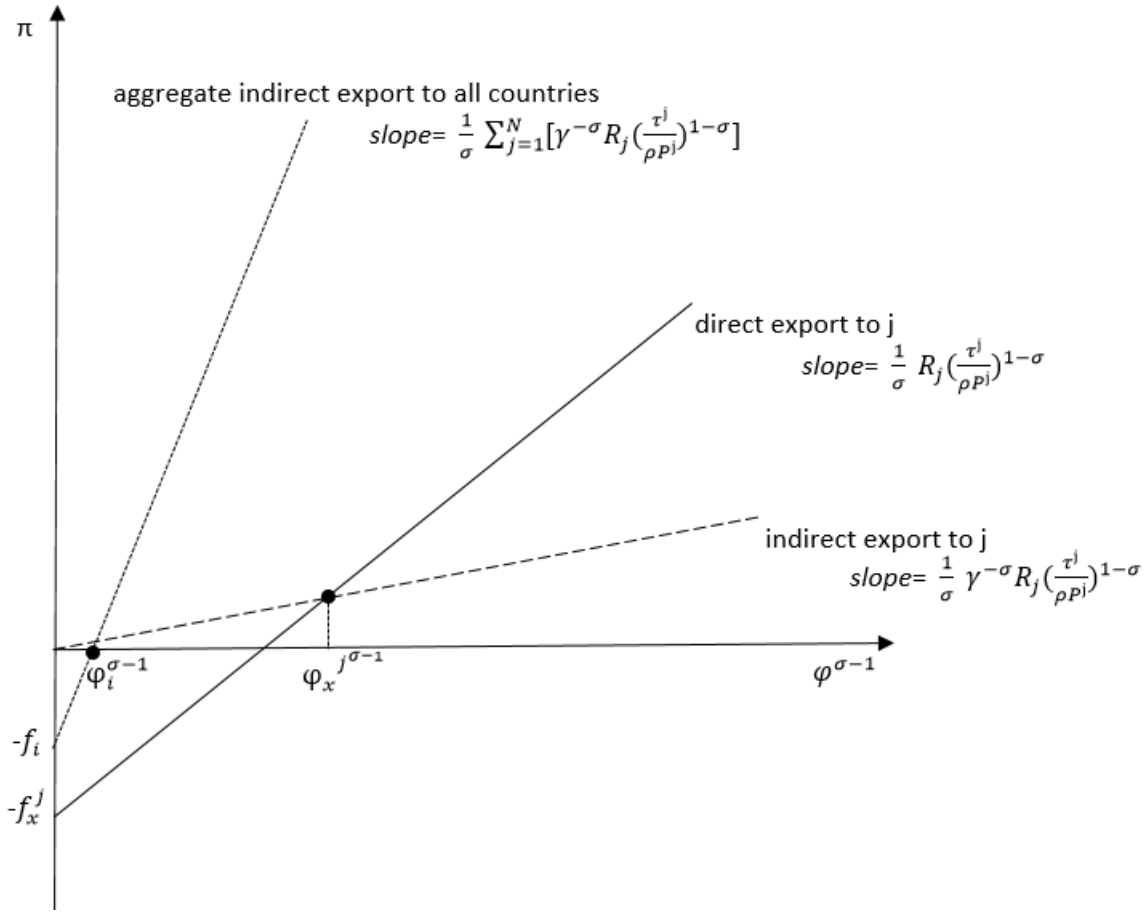
As in Melitz (2003), the profit of direct exporter is shown as:

$$\pi_x^j(\varphi) = \frac{1}{\sigma} R^j \left(\frac{\tau^j}{\rho \varphi P^j}\right)^{1-\sigma} - f_x^j, \quad (3)$$

where f_x^j refers to a bilateral fixed cost.

It can be verified that direct exporter's revenue must exceed indirect exporter's revenue within each destination country. This is due to the higher retail price of the indirectly exported goods and standard conditions for the demand function - because the indirect export price is higher, the demand for the variety the indirect exporter supplies will decrease. Figure 2.2 shows the profit curves for the different participants.

Figure 2.2 Profit curves and firm productivity



Source: Ahn et al. (2011).

Allowing for the intermediary sector leads to more options for exporting. Manufacturer can decide whether or not to draw support from an intermediary, depending on its own productivity. Direct exporting brings more revenue but is associated with higher cost than exporting through an intermediary.

Based on the profit functions in (1)-(3), we can infer the first hypothesis.

H1：For a specific market, firms of intermediate levels of productivity use intermediation, while the most productive firms choose to export directly.

In Figure 2.2, there are two key points, $\varphi_i^{\sigma-1}$ and $\varphi_x^{j^{\sigma-1}}$, dividing firms into three groups: the least productive firms, including firms that choose to exit or only sell domestically, firms with intermediate productivity, and the most productive firms. We can clearly see that a firm with productivity between $\varphi_i^{\sigma-1}$and $\varphi_x^{j^{\sigma-1}}$ gains a higher profit through intermediation than directly exporting and thus will become an indirect exporter. These firms of intermediate-level productivity will choose to pay a one-off intermediary fixed cost, f_i, which enables them to get access to all countries. They do not need to incur the iceberg cost and the fixed cost for a specific country associated with direct exporting, so their costs are lower than they would be if exporting directly. This means that intermediation helps firms overcome the higher costs of exporting. The reason why firms with productivity above $\varphi_x^{j^{\sigma-1}}$ will prefer trading directly with foreign consumers is that direct exporting gives the firm higher revenue per unit. Once firms have the productivity to cover the bilateral fixed cost (f_x^j) and variable cost (τ^j) of entering a specific market, they will gain a higher revenue to offset the cost, thus exceeding the profit from indirect exporters when the productivity is larger. Therefore, intermediation is expected to be associated with intermediate productivity only.

The second hypothesis is based on assumptions.

H2: Export price of intermediaries should be higher than that of direct exporters.

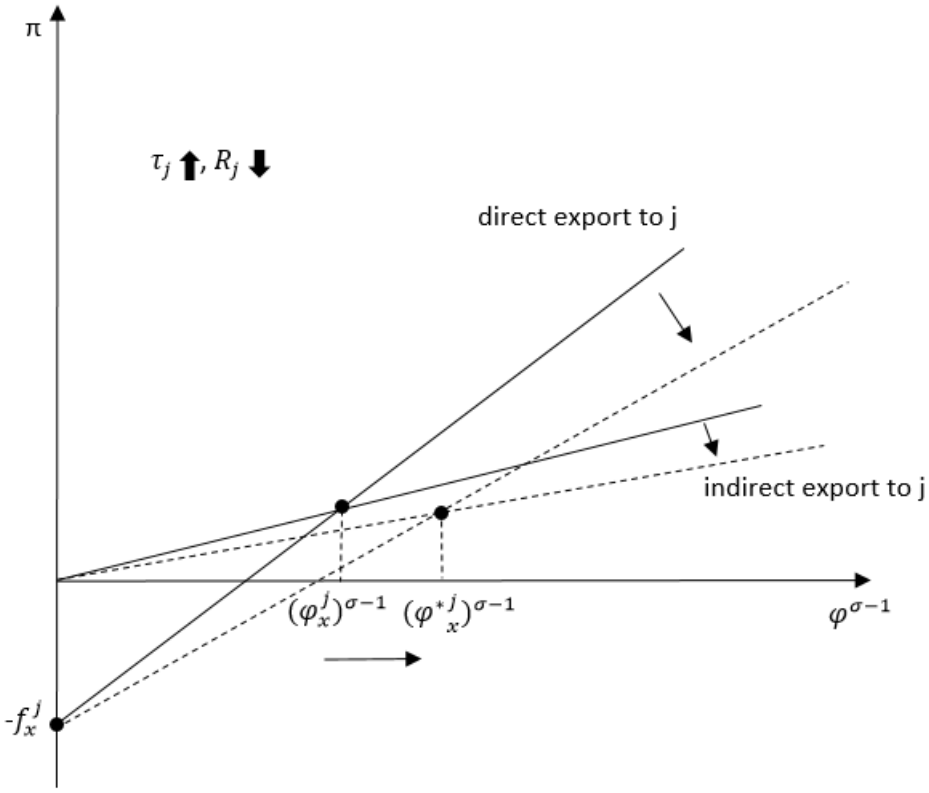
It is assumed that intermediaries face the same price as domestic consumers for a variety. However, while intermediary sector is setting up the distribution networks and exporting on behalf of the manufacturers, additional marginal cost will be incurred,

such as costs of simple processing, including sorting or packaging, or service activities, such as marketing or transport. Therefore, even though the model assumes that no fixed costs are paid by intermediaries, these variable costs still cannot be avoided, and finally will be passed to the foreign consumers. This will lead to a higher indirect export price.

H3: Export share of intermediaries is associated with the destination country's characteristics.

Intermediaries help manufacturers to access countries of higher trade costs or smaller market size, which means that intermediary shares will be correlated with country characteristics.

Figure 2.3 Trade costs, market size and indirect exports

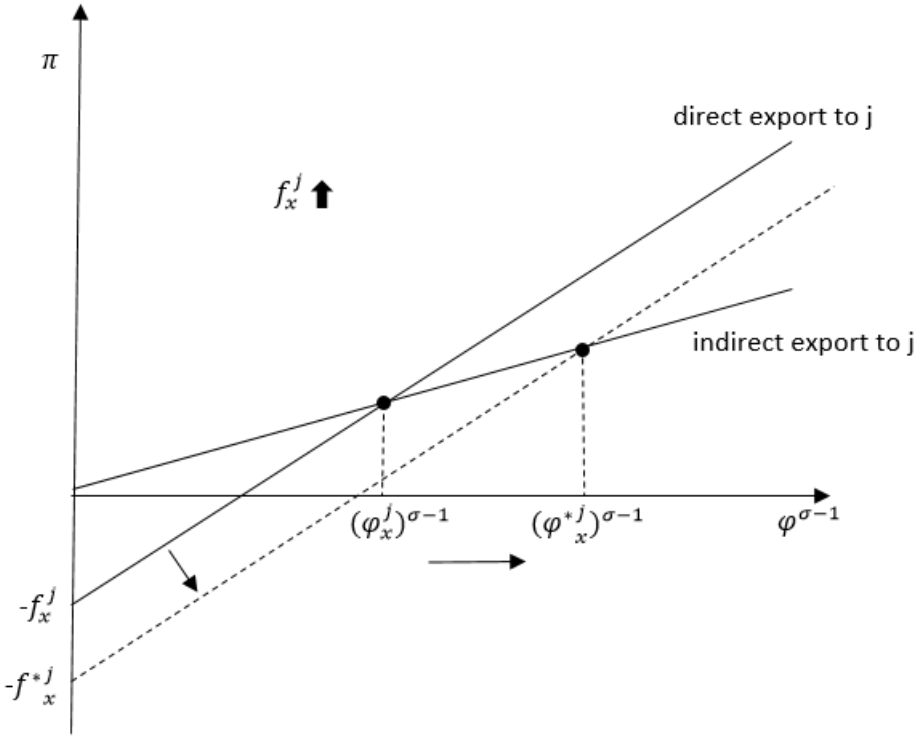


Source: Ahn et al. (2011).

Figure 2.2 shows how firms of different productivities choose the method to access foreign markets. Figure 2.3 shows how changes in the variable cost, τ_j (iceberg transport cost), and the aggregate expenditure or income of the destination market, R_j, affect the share of firms exporting by different modes. Here, the slope of direct export profit curve is $\frac{1}{\sigma} R_j(\frac{\tau^j}{\rho P^j})^{1-\sigma}$, and the slope of indirect export profit curve is $\frac{1}{\sigma} \gamma^{-\sigma} R_j(\frac{\tau^j}{\rho P^j})^{1-\sigma}$ where σ denotes the income elasticity of substitution ($\sigma > 1$). A decrease in R_j or an increase in τ_j reduces the slope of both curves and makes the profit curves of direct exporting and indirect exporting flatter. Therefore, the

productivity cut-off level for direct exporting will go up to φ^{*j}_{x}. With a constant productivity level for indirect export, φ_i, this will lead to a higher intermediary share in the economy. In other words, a country with higher variable trade costs or a smaller market size (lower income) is likely to have a higher intermediary share. For a destination market that is difficult to enter, more manufacturers will choose to draw support from intermediaries, rather than exporting directly.

Figure 2.4 Fixed costs and indirect exports



Source: Ahn et al. (2011).

Figure 2.4 shows a situation with higher fixed cost for direct exporting, with all other things being equal. It can be seen that the increase of bilateral fixed cost from f_x^j to f^{*j}_x will make the profit curve of direct exporting move downward, thus leading to

a higher cut-off productivity level required for direct export ${\varphi^*}_x^j$ to be the preferred method. Similar to Figure 2.3, this will cause the indirect export share to go up. In other words, when manufacturers have to pay a higher fixed cost to enter a market, they will prefer to consider the help of intermediation.

Combining these two figures allows us to conclude that smaller countries and countries with higher variable costs and higher fixed costs of entry are likely to be correlated with higher indirect export share through intermediaries. Intermediary firms are more important in countries that are difficult to enter.

2.3 Data & variables

To test the three theoretical hypotheses about the use of intermediaries in international trade, AKW mainly employ two datasets: China Customs Data and Enterprise Survey Data (Chinese firms only).

The China Customs Data records firm-level trade data over the 2000-2005 period. The database targets Chinese firms that were involved in international trade and reports rich and detailed trade information for each firm-product-partner transaction associated with import and export activities of the firms. However, only export information is needed for the testing of the AKW model. The same data have been employed by other studies, such as Manova and Zhang (2009) and Manova, Wei, and Zhang (2015). Products are classified at the 8-digit HS level and the dataset includes trade values (in US dollar), quantities and prices for each firm-product-partner pair. The dataset also includes the firm's name as well as an exclusive *firmid*, making it possible to conduct

comparisons across time periods. We also know the trade partner (destination country), *firmtype* that describes the ownership structure of the firm and includes state-owned enterprises (SOE), privately-owned enterprises, collectively-owned enterprises, fully foreign-owned enterprises, Chinese foreign cooperative enterprises, sino-foreign equity joint ventures and others and *tradetype* that covers up to 14 trade types, distinguishing special trade types (processing trade, assembly trade) from general trade. In 2005, up to 233 countries and regions were involved in trade with Chinese firms. However, the China Customs data does not indicate if a firm uses intermediaries to export, so this dataset cannot be used to give evidence of the relationship between productivity and export mode.

The Enterprise Survey Data was collected by World Bank, with the purpose of investigating the relationship between productivity and the investment climate, such as access to finance, the level of corruption, infrastructure and service investment, the level of crime, the degree of competition, the labour stock and obstacles to growth for Chinese firms. In the survey, the firms report the proportions of their establishment's sales exported directly and through a distributor, respectively. The survey also records productivity information. Thus, this dataset can be used to test the relationship between productivity and export mode. The survey data is available for 2002, 2003 and 2012. AKW uses the data from 2002-2003 and my replication study also uses data from 2012. The data provides information of the industry, average number of permanent and temporary workers, total sales and direct and indirect export shares.

In order to study the relationship between firm productivity and export mode, AKW employ three different measurements to proxy productivity – *sales*, *employment* and *labour productivity*. The direct and indirect export shares represent the different export modes. The exact definitions of these and subsequent variables described are given in Table 2.1.

A key variable for the empirical estimation is *intermediary*. A firm is classified as an intermediary firm if it acts as an agent that buys from suppliers to sell to final consumers or if it acts as an intermediary that helps connect buyers and sellers, e.g. looking for suppliers, finding and stimulating buyers, choosing buy and sell prices, deciding the terms and conditions of transactions, managing the payment, holding inventories, etc. (Spulber, 1996). Intermediaries can include wholesalers, retailers, agents or brokers, and an intermediary may or may not take ownership of the product, service or property that they help to intermediate. Because the exact nature of the firm's business is not known from the survey, however, AKW use a method that identifies a firm as an intermediary firm if it has the English-equivalent meaning of "importer", "exporter" and/or "trading" in its name.

To analyse how intermediary firms affect the indirect export share in different countries, AKW use a set of variables to capture the market characteristics. They use *distance* and Most Favoured Nation tariff (*MFN tariff*) to proxy variable cost τ^j , *GDP* to proxy market size, and *importing procedures*, measured as the number of documents required for importing, to proxy fixed cost f_x^j. They also include the ethnic *Chinese*

population in the destination country because it is believed that Chinese firms find it easier to directly export to countries with a larger Chinese population.

Table 2.1 Description of variable and data source.

Variable	Definition	Source
Direct export share	Percentage of firm's sales exported directly	World Bank's Enterprise Survey Data
Indirect export share	Percentage of firm's sales exported indirectly (through a distributor)	World Bank's Enterprise Survey Data
Sales	Total sales 1 year ago	World Bank's Enterprise Survey Data
Employment	Average number of permanent workers plus temporary workers 1 year ago	World Bank's Enterprise Survey Data
Labour productivity	$\frac{sales}{employment}$	World Bank's Enterprise Survey Data
Unit value	$\frac{value\ of\ sales}{quantity\ sold}$	China Customs Data
Intermediary	= 1 if the firm is an intermediary and = 0 otherwise	China Customs Data
Firm size	Firm's total export value	China Customs Data
Intermediary export share	Share of intermediary exports	China Customs Data

	of total country-HS6 exports	
Distance	Air distance in nautical miles between the trading country pairs	https://www.timeanddate.com/worldclock/distance.html
GDP	Gross domestic product	World Bank's World Development Indicators
Chinese population	Size of the ethnic Chinese population per country	Ohio University Shao Centre
Importing procedures	Number of documents required for import in China	World Bank's Doing Business Report
MFN tariff	Most Favoured Nation duty rate treatment	World Bank WITS

I endeavoured to use the same data as AKW for my replication study. However, due to the China Customs Data being proprietary, the authors of AKW were not able to share the original data for the purpose of my replication study while they were able to pass along their code and some key variable data – *intermediary*, *importing procedures* and *MFN tariff*. I therefore had to collect my data independently, which means that there may be some discrepancies between my data and the original data used by AKW. The main difference is that the China Customs Data I have is annual data, while the original data seems to be monthly, which is likely to result in the deviations of aggregated data and difference in observations. AKW do not mention the data source

of *distance*. I follow Roberts (2004) to use the air distance in nautical miles between the trading country pairs sourced from the website given in Table 2.1. Due to frequent updating of online databases, the data of some key variables I collected independently, such as GDP, importing procedures and MFN tariff, may be different even if they are collected for the same years as AKW.

2.4 Empirical model and results

This section provides empirical evidence for the three hypotheses derived from the AKW model, both from AKW's own empirical study and my replication study. I report the findings of AKW and my replication study first and follow up with robustness checks. I focus on the results and replication of AKW Tables 4-6 only, which are the tables that endorse the three hypotheses I want to test.

2.4.1 Productivity and export mode

Due to the trade costs involved in different export modes, hypothesis 1 of AKW considers that exporting activities imply two types of sorting pattern: (i) the most productive firms choose to directly export and, (ii) firms of intermediate levels of productivity export through intermediaries. Regression models 1-3, given in Equation (4), investigate the share of direct exports of all exports as a function of log productivity and log productivity squared where the productivity is measured by sales in model 1, employment in model 2 and labour productivity in model 3. I also control for industry fixed effects.

$$\text{Direct export share}_{ij} = \alpha + \beta_1(\text{Log Productivity}_i) + \beta_2(\text{Log Productivity}_i)^2 + \mu_j + \varepsilon_{ij}, \quad (4)$$

where subscript i refers to firm, j to industry. μ_j is industry fixed effect.

Regression models 4-6, given in Equation (5), investigate the share of indirect exports of all exports as a function of log productivity and log productivity squared where the productivity is again measured by sales in model 4, employment in model 5 and labour productivity in model 6 and where industry fixed effects are controlled for.

$$\text{Indirect export share}_{ij} = \alpha + \gamma_1(\text{Log Productivity}_i) + \gamma_2(\text{Log Productivity}_i)^2 + \delta_j + \varepsilon_{ij}, \quad (5)$$

where subscript i refers to firm, j to industry. δ_j is industry fixed effect. The regression model is Ordinary Least Squares.

The first hypothesis of the AKW model predicts a positive relationship between productivity and directly exporting – only the most productive firms directly export while less productive firms either use an intermediary or do not export at all. It also predicts an inverted-U shape relationship between productivity and indirect exporting – firms with intermediate productivity use intermediaries more intensively as their productivity increases as they are importing more but the use of intermediaries eventually starts to decrease as firms switch to exporting directly.

While the hypothesis talks about the export modes when firms enter a given market, the Enterprise Survey Data do not report exports by separate market. It is therefore impossible to examine the relationship within a single market, and therefore AKW test the prediction across all countries. Even though firms of intermediate productivity are

likely to directly access some foreign markets and export to others through intermediaries, AKW expect that high productivity firms directly export to more countries and thus have higher direct export share than less productive firms, while less productive firms can draw support distributors, giving them a higher indirect export share than more productive firms.

2.4.1.1 Replication results of the relationship between productivity and export mode

The original results and the replication results are reported in Table 2.2. The left-hand side columns of models 1-3 in Table 2.2 show the estimation results for direct exports using *sales*, *employment* and *labour productivity* as proxies of productivity, respectively. AKW find a linear relationship between productivity and direct export share when *employment* and *labour productivity* are used as proxies for productivity but no significant result when *sales* is used as a proxy for productivity. This means that AKW found support for the hypothesis that the more productive firms serve more markets directly. The results of indirect export share are reported in the left-hand side columns of models 4-6. AKW report significant coefficients for both the log and the squared log terms of the three different proxies for productivity, which indicates an inverted-U shape relationship between productivity and indirect export share as was predicted by the model. These results indicate that firms of intermediate productivity are more likely to turn to intermediary as the export channel as was predicted by the model.

My replication results, found on the right-hand side column of each model, find the exact same coefficient estimates as the original paper. The only difference between my results and those of AKW are that my R-squared values and number of observations in models 2 and 3 exactly match those reported by AKW in models 3 and 2, respectively. Similarly, my R-squared values and number of observations in models 5 and 6 match those reported by AKW in models 6 and 5, respectively. I suspect, therefore, that those values were inadvertently swapped in the original paper rather than any differences in data or code.

To summarise, AKW find supportive evidence of the first hypothesis and my replication confirms that.

2.4.1.2 Robustness checks of the relationship between productivity and export mode

In order to further examine the first hypothesis, I update the Enterprise Survey Data to include year 2012. In 2012, 2700 firms were interviewed, including firms from manufacturing, service, construction and transport sectors. Like AKW, I only look at the manufacturing sector, which gives me 1692 firms in 2012 compared to 2629 firms in 2002 and 2003. Among them, 355 (21%) of the firms report positive direct export sales. After adding the firms with positive indirect export sales but zero direct export sales, a total of 552 (33%) of the manufacturing firms are involved in exporting.

Table 2.3 reports the firm-level summary statistics for Chinese manufacturing firms in 2002 & 2003 and 2012. It illustrates the differences in direct export share, indirect export share and the three productivity measures between the two survey periods. I observe that the mean value of the direct export share reduced slightly from 0.13 to 0.09 from 2002-2003 to 2012, while the mean of the indirect export share remained at 0.05. The median values of both variables were 0 in both survey periods. The mean value of sales increased from 408,739 in 2002 & 2003 to 505,007 in 2012 and the median value increased from 93,207 to 225,000. Firms in 2012 reported less employment in terms of both mean and median values. This is likely due to the development of labour-saving technology. While firms tended to employ fewer workers, I should still expect to see more productive firms employing more workers compared to less productive firms, which means that this measure of productivity should still be valid.

My robustness check that reruns the regression models with the 2012 data, found in Table 2.4, indicates that not all of the results in AKW are robust. For each of the six models found in Table 2.4, the left-hand-side column indicates the original results, also found in Table 2.2, and the right-hand-side column indicates the results of my robustness check. In models 2 and 5 where employment is used as the proxy for productivity, I find that the results using the 2002-2003 data extend to 2012. I continue to find evidence of the positive linear relationship between employment and the direct export share (model 2) and the inverted-U shape relationship between employment and

the indirect export share (model 5) in the 2012 data, which supports the finding that firms that employ more workers are more likely to serve foreign consumers directly and that firms with intermediate levels of employment use intermediaries more frequently than either smaller or larger firms.

When it comes to using sales as the proxy for productivity in models 1 and 4, however, my 2012 results are different from the original AKW results for 2002-2003. While AKW found no relationship between sales and direct export share in 2002-2003, I found an inverted-U shape relationship in 2012, which means that for the largest firms, increasing the size of the firm reduces direct export share, contrary to prediction. However, the maximum of the predicted direct export share curve occurs at log sales value of 23, and in the dataset, there are only eight firms (0.5%) that report sales larger than this peak. This indicates that most of the firms lie on the left side of the peak, which means firms with larger sales are more likely to have direct export share, consistent with the hypothesis, until we get to the very largest firms. Furthermore, while AKW found an inverted U-shaped relationship between sales and indirect export share in 2002-2003 in model 4, I found no significant relationship in 2012.

Last, when using labour productivity as the proxy for productivity in models 3 and 6, my 2012 results again do not confirm with the AKW results for 2002-2003. My 2012 results indicate no relationship between labour productivity and direct export share and a U-shape relationship between labour productivity and indirect export share while AKW found a positive and an inverted U-shape relationship, respectively. Based on

this 2012 prediction, firms of intermediate productivity are less likely to choose intermediary to export, which is opposite to the AKW hypothesis. The minimum of the predicted indirect export share function occurs at a log labour productivity of 14, and all but 109 firms (6%) report labour productivity that is smaller than the minimum, which suggests that for most firms, the share of indirect export share decreases as they grow.

To sum up, according to the updated results, I find support for the first hypothesis that intermediaries play an important role for less productive manufacturers only when I use employment to measure productivity. When I use sales to measure productivity, the results show evidence of larger firms exporting more directly, while the results are totally against the hypothesis of the model when I use labour productivity as a proxy for productivity.

2.4.2 Intermediation and unit values

In the AKW model, intermediary sector needs to establish foreign distribution networks and thus incurs additional marginal costs and finally passes to the foreign customer. The second hypothesis predicts that the unit value, or the average export price of the good, is greater for firms using intermediaries than for direct exporters. To test the hypothesis, the regression model in AKW, the baseline form of which is found in Equation (6), regresses the log unit value of firm *f* selling product *p* to country *c* on a dummy variable that takes a value of one if the firm uses an intermediary and zero otherwise:

$$\text{Log Unit value}_{fcp} = \alpha + \beta\text{Intermediary}_f + \varepsilon_{fcp}, \quad (6)$$

where subscript f refers to firm, c to destination country, and p to HS8 product. Unit values normally differ from product to product, and it is also typical that the ownership of firms affects prices. Models 1 and 2 in Table 2.5 control for product-ownership fixed effects. Additionally, firm size might also affect the unit value, and Models 2 and 3 add a quartic firm size control to account for that. Model 3 also controls for country-product-ownership fixed effect. The export destination country is considered because the marginal costs of exporting to different countries are generally different. The regression model used is Ordinary Least Squares.

2.4.2.1 Replication results of the relationship between using an intermediary and unit value differentials

The original results and the replication results are presented in Table 2.5 where the original results are from columns 1-3 of Table 5 in AKW. Due to the problem of data unavailability, I am unable to re-examine the role of product characteristics found in columns 4-6 in Table 5 in AKW.

Column 1 in Table 2.5 presents the results of model 1, column 2 presents the results of model 2 and column 3 presents the results of model 3. The left-hand side of each column has the original results and the right-hand side has the replication results. Model 1 in column 1 reports the findings when product-ownership fixed effects are controlled for. Consistent with the hypothesis, intermediary firms have a significant positive coefficient, which means that intermediaries charge higher price than direct

exporters. Model 2 in column 2 adds quadratic firm-size control to the regression in Column 1. The regression results continue to indicate that intermediary firms charge higher prices than direct exporters although the size of the coefficient is now lower. After including country-product-ownership fixed effects in model 3 found in column 3, unit values of intermediary firms decrease further but remain positive and significant. My replication results confirm these results although I find smaller coefficients in each of the three models than those found by AKW. The likely reason for why my coefficients are different from those of AWK is that I sourced my data independently and therefore do not having exactly the same data as AKW. This is evidenced by the fact that when I strictly complied with the regression code of AKW, I had more observations than what AKW have.

2.4.2.2 Robustness checks of the relationship between using an intermediary and unit value differentials

I carry out two robustness checks on hypothesis 2. First, I rerun the model using data from years 2002-2004 while the original results were obtained from data for 2005 only. Second, I examine separately the data from the three geographic subsamples of firms from eastern, central and western China, respectively.

AKW use customs data from 2005 only to estimate the results in their Table 5 (our Table 2.5). I want to test for the robustness of this result by replicating the test for each of the other years that the data is available for, 2000-2004. Table 2.6 presents the findings of the results. The first row includes the 2005 results that were already given

in Table 2.5 for the three models that my data allows me to replicate from AKW's Table 5. The subsequent rows present the findings for years 2004, 2003, 2002, 2001 and 2000, respectively. While my results for 2002 and 2001 give support to hypothesis 2 and are consistent with the AKW results in Table 5, my results for years 2004, 2003 and 2000 are not. In 2004, and 2000 I get a significant coefficient with the right sign when only product-ownership fixed effects are controlled for but when I add the quadratic firm size control and/or the country fixed effects, the coefficients become insignificant or get the wrong sign. In 2003, all three specifications have a coefficient that is significant but with the wrong sign.

As another robustness check, I split the data into three subsamples, East, Central and West, based on the geographic area of exporter, to account for the vastly different levels of economic development from east to west. It is well-known that the economic development of China started on the East Coast and has moved westward since. East includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan. Among the whole sample, East dominates the export market, representing 92.7% of the observations. Central includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hunan and Hubei. West includes Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, Inner Mongolia and Guangxi. I rerun the regressions in Table 2.5 using 2005 data separately for the three regions.

Table 2.7 reports the results from the robustness check that controls for the region's economic development. I find significant and positive coefficients for the intermediary dummy variable in the east only, and the coefficient in the west and central regions are significant and negative. This finding is opposite to the assumption and hypothesis. It is commonly believed that intermediary firms incur costs to build their own distribution networks and help less productive firms export their products to foreign consumers, so charge higher unit values than direct exporters. In western and central regions of China, it is even more difficult for less productive firms to access foreign markets due to less developed transportation infrastructure and longer distance to destination countries. Generally, therefore, one would expect intermediaries to incur more costs in the western and central regions than in the east. However, my results do not support the hypothesis. Thus, by examining subsamples of firms by geographic regions, the results of AKW are not generally robust.

2.4.3 Facilitating trade

The main prediction of the AKW model is that the destination market's characteristics are associated with the export share of intermediaries. The trade costs differ between different foreign markets, and intermediaries are hypothesised to help lower-productivity firms to export to markets with higher trade costs. Therefore, countries that are more difficult to reach are hypothesised to have a larger intermediary export share. AKW model this hypothesis as

$$\text{Intermediary export share}_{cp} = X_c'\beta + \alpha_p + \varepsilon_{cp}, \quad (7)$$

where subscript c refers to destination country and p to HS6 product code. The dependent variable in the model is the intermediary export share of Chinese exporting firms in a foreign market, expressed at the level of a good (HS6) but aggregated over all firms exporting to the market as firm-level data is not available for the export market.

The vector X_c' contains characteristics of the destination market that proxy for trade costs and market size and includes the log of distance to the market (Models 1-4), log of GDP of the destination market (Models 1-4), the log of Chinese population in the destination country (Models 2-4), the number of importing processes required to reach the foreign market (Models 3-4) as well as the MFN tariff rate of the good in the foreign market (Model 4). β is a vector of coefficients. α_p is product fixed effect.

2.4.3.1 Replication results - trade facilitation

Table 6 in AKW table reports the empirical evidence of this hypothesis, reproduced in my Table 2.8 together with my replication results. Models 1-4 are given in columns 1-4, respectively, with the AKW results on the left-hand side and my replication results on the right-hand-side of each column. In each of the four models, AKW find strong support that the trade share of intermediaries increases with distance to the country. A country that is further away is more costly to get to, and the intermediary firms help alleviate these trade costs. AWK also find strong support in all four models that the GDP of the destination country reduces the trade share of intermediaries. This is likely because a richer country is more developed and have fewer obstacles for importing firms. The AKW models 2-4 find that

having a larger ethnic Chinese population in the destination market reduces the use of intermediaries, likely because the Chinese expats can help the exporting firms lower the information costs of accessing a new market. AKW also find evidence in models 3-4 that the number of importing processes increases the use of intermediaries, supporting the hypothesis that intermediaries are used more when the process of exporting is complex. Last, in model 4, AKW find strong evidence that a higher tariff leads to more trade intermediation. A tariff is another form of a trade cost and this result gives further support that increases in trade costs lead to more use of intermediaries.

My replication results provide estimates with consistent sign and significance to AKW even though I have a slightly different number of observations due to some differences in data. Thus, my replication results confirm the results of AKW.

2.4.3.2 Robustness checks–trade facilitation

I carry out three robustness checks to test hypothesis 3. First, I use two alternative sources of data for the number of import processes. Second, I rerun the model using data from years 2002-2004 while the original results were obtained from data for 2005 only. Last, I examine separately the data from the three geographic subsamples of firms from eastern, central and western China, respectively.

The data on the number of importing processes is published by the World Bank. I have the original data from the authors of AKW but I also sourced it from a printed

book, World Bank's Doing Business 2006, as well from an online database also published by the World Bank. All three versions are slightly different. Table 2.9 shows the summary statistics for three data sources for the variable measuring the number of import documents. The data from the authors and the online database have the same number of observations, minimum and maximum, but different median and mean values, while the data from printed book report different values in all dimensions.

Table 2.10 reports the results of this robustness check. Column 1 includes the original results of AKW also found on the left-hand side of column 4 in Table 2.8. Column 2 includes my replication results using the trade process data from the authors. This is also found on the right-hand size of column 4 in Table 2.8. Columns 3 and 4 include the replication results when I use the alternative printed data source and the online data source, respectively. I find that most of the results of model 4 in Table 2.8 are robust to the source of the trade process data. However, when it comes to the variable measuring the number of required documents itself, the coefficient in column 3 where the data is from the printed book is no longer significant. However, when I use the online source for the data, the coefficient for the trade process variable is the same as it is column 2 where I reproduced the original model using data from the authors. This suggests that the data from the authors matches the online database the best.

The results in AKW Table 6 discussed above were generated using data from 2005 only. My next robustness check includes rerunning Model 4 from AKW Table 6 using data from 2000, 2001, 2002, 2003 and 2004, respectively. In this robustness check, I

am able to update my key variables GDP and MFN tariffs but keep the other variables at their 2005 values due to limitations in data availability. Keeping the distance variable constant is clearly not an issue - there is no change in the distance between exporting and importing countries over time unless in some relatively rare circumstances when country borders have moved. The variable measuring the Chinese population is obtained from the Ohio University Shao Centre. This variable is collected in different regions in different time periods, and because I do not have time series data for the variable, I simply assume that it was the same in 2000 – 2004 as it was in 2005. The last variable - the number of required importing documents - is only available for the 2006 publication that reports the information as it was in January 2005, so I also keep it constant for my robustness checks.

The results of the robustness check for years 2000-2004 are given in Tables 2.11 – 2.13, where Tables 2.11 and 2.12 focus on only one key coefficient from the regression model given in Equation (7) with the three sources of data for the number of required import documents while 2.13 gives the results of the entire model after dropping the variable measuring the number of import documents.

Table 2.11 reports the coefficients for the number of importing processes across the three sources of data and years 2000-2005. The 2005 results on the first row can also be found in Table 2.10 and show that in 2005 I had the predicted positive significant coefficient for this variable when using the data from the authors or the data available online but not when the data was taken from the printed volume. A similar

result is found for years 2000-2004 – the coefficients are positive and significant when the data is from the authors or from the online database but when I use the data from the printed source, I find significant results only for years 2000 and 2003.

Table 2.12 reports the coefficients on the MFN tariff rate from the same regressions as the results in table 2.11. The first row reports the results also found in Table 2.10 that showed that higher MFN tariff rates encourage the use of export intermediaries. The remaining rows show the results from 2004-2005 and demonstrate that the 2005 result is not robust. Most of the coefficients are insignificant or they are significant but have the opposite sign than what the model predicted.

Table 2.13 reports the results for 2000-2005 for all the variables in the model when I drop the variable measuring the number of import documents required. I do this because I only have data from year 2005 and thus the regressions for previous years were mixing data across years. Because I have one fewer variables, the coefficients for year 2005 differ in size slightly from those in Table 2.10 but maintain their significance levels and their consistency with prediction – the use of intermediaries increases in the distance to and the MFN tariff of the export partner and decreases in the GDP and ethnic Chinese population of the export partner. My robustness checks indicate that the result for the distance and GDP are very robust. I also find support that countries that have a larger ethnic Chinese population are less likely to use intermediary firms to import from China, although this result is not significant for years 2002-2004. The MFN–tariff result,

however, is generally not robust – on top of 2005, I find a significant coefficient only for year 2003 and only at 10% significance level.

My last robustness check re-examines the relationship between intermediary export share and market characteristics after separating the data into regional subsamples. Table 2.14 reports summary statistics from the China customs data divided between the three subregions, East, Central and West. It is clear from Table 2.14 that East exports the most, accounting for 91.8% of total export value, and has the lowest intermediary share of exports. The AKW model predicts that more productive firms are more likely to export directly, which is consistent with what we see in the summary statistics. Next, I rerun the regression model for 2005 (original results in Table 2.10) for the three regional subsamples. The results are found in Tables 2.15-2.16. Table 2.15 shows the coefficient measuring the effect of the number of trade processes on intermediary export share from the regression model in Equation (7). The first row is for the full sample, also found in Table 2.10, and shows the positive support for the number of import documentations encouraging the use of intermediaries when using the online data on the number of import documents required. My robustness check of splitting the data into subsamples shows that this result is driven by the results of the East and cannot be seen in the West and Central subsamples. Note, however, that the majority of the trade volume comes from the East, so the lack of significant result in the rest of China could be due to a small number of observations.

Last, Table 2.16 shows the coefficients for the MFN tariff rates from the regression model in Equation (7). In the full sample results, also found in Table 2.10, I found that the intermediary export share increases in the MFN tariff rate of the importing country. After rerunning the regression for the three subsamples, I find robust results for all the three versions of importing procedures for the West. The Central region only supports the prediction when using online data, while the East has a significant coefficient with the predicted sign for the printed and online data sources but not for the data from the authors.

2.5 Conclusion

Modern trade-theory models focus on heterogeneity of firm productivity to explain why a firm exports (Melitz, 2003). These models find that firms of higher productivity will participate international markets while those of lower productivity will focus on the domestic market only. However, these models ignore the existence of a third type of firm – intermediaries that do not produce themselves but that aid manufacturers reach export markets. Ahn et al. (2011) introduce intermediation into the theoretical model of Melitz. In their model, intermediary firms and direct exports have different trade costs, which drives the decision of the manufacturer to choose whether to export at all and if so, whether to do that directly or use an intermediary. The AKW model produces three testable hypotheses to investigate the role of intermediaries in exporting. First, they predict that the most productive firms export directly, the firms with intermediate level of productivity use intermediaries to export and the least productive firms sell

domestically only. Second, they predict that the prices, or unit values, of goods sold by intermediaries are more expensive than those sold by direct exporters due to their differences in per-unit costs of exporting. Last, they predict that certain export market characteristics affect the propensity to use intermediaries in exporting. In particular, firms are more likely to use intermediaries when exporting to countries that are further away, have more required importing processes to get the goods through customs, have a lower GDP and have fewer ethnic Chinese people as residents.

AKW test their hypothesis using the World Banks's Enterprise Survey Data from 2002 and 2003. They find empirical evidence that largely supports their three hypotheses. In particular, they find that the most productive firms export directly and that firms of intermediate productivity use intermediaries to reach foreign customers. Furthermore, they compare the prices between direct exporters and intermediaries, finding support for the hypothesis that higher trade costs encourage the use of intermediaries. Last, they estimate the effect of country characteristics on intermediary export share and conclude that intermediaries promote exports to countries that are more difficult to access.

My study replicates the empirical models of AKW and adds some robustness checks. Generally, by using the programming code of AKW, some of their original data and other data sourced independently, I am able to reproduce the key findings of Ahn et al. (2011). I find the same effects of firm productivity on different export mode choices, endorsing the prediction that less productive firms are more likely to depend

on intermediaries to export. However, I find somewhat smaller differences between direct exporters' and intermediaries' unit values that what was found by AKW but my results otherwise support their prediction. My results also find evidence in favour of intermediaries facilitating trade with countries of longer distance, lower GDP, more required documents for imports and higher tariff rates.

My first robustness check uses the Enterprise Survey Data from 2012 to compare with the original results that used the data from 2002-2003. I find that only one of the three productivity measures – employment - has coefficients consistent with the hypothesis. Thus, based on the updated data, I cannot find robust evidence to support that firms' export modes depend on productivity, particularly the indirect export mode.

My next robustness check examines the relationship between unit value and intermediary share of exports by using data from 2000-2004. My evidence is a little bit mixed. I have strong evidence supporting the hypothesis in 2001 and 2002 and just weak or no evidence for years 2000, 2003 and 2004. I then divide the full sample of firms in 2005 into different geographic regions – west, central and east region. Surprisingly, intermediaries in west and central regions report significantly negative coefficients, indicating that direct exporters in these regions charge higher prices than intermediaries, which is against the hypothesis. However, in the east where most of the international trade originates, the evidence supports the AKW hypothesis.

My next robustness checks use three sources of a key variable – the number of required importing procedures. I get mixed results, depending on which version of the

importing procedures I use. The online version data gives results close to the authors' version, supporting the hypothesis, but this is not true for the data from the printed source. My results for the effect of the MNF tariff on intermediary export share in my robustness checks for 2000-2004 do not support the AKW prediction. When it comes to subsamples by regions, I find evidence of the number of importing processes increasing the use of intermediaries only in the subsample for the east. My evidence of the use of intermediaries increasing in the MFN tariff levels is the strongest in the west.

To conclude, my replication study generally finds supportive evidence of intermediaries facilitating trade. However, when I examine the AWK hypotheses further, by using data from earlier years, by updating key variables, by using alternative measures of some key variables, and by examining subsamples of firms by geographic regions, I find that their results are not generally robust. My findings suggest that further research needs to be done to better understand the role of intermediaries in international trade markets.

Apart from the implications for the trade model and theory, my results also show some implications for trade policy. While it is not easy to improve trading partner's market size or decrease the fixed trading cost to a specific country, my results, from the perspective of intermediated trade, provide supportive evidence for the effect of pursuing free trade agreements on promoting trade flows. For example, according to Table 2.8, a 10 percentage point decrease would decrease the share of intermediary exports by 0.34 percentage points, holding other variables constant, which reports the

largest effect among other variables. It demonstrates that a preferential tariff arrangement lowering the MFN tariff towards zero would decrease the trading cost barriers, benefit manufacturers and help them directly exporting more to partners. The growing exports would consequently lead to higher economic growth as indicated by the export-led growth hypothesis. Furthermore, as the manufacturers export more and learn more knowledge about the foreign market, new technologies and management techniques, the labour productivity would increase. My findings confirm that the pursuit of free trade agreement policy would lower the frequency of using intermediation technique and promote trade flows.

2.6 References

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Table 2.2 Export mode and firm productivity – AKW Table 4 reproduction.

	Direct export share						Indirect export share					
	(1)		(2)		(3)		(4)		(5)		(6)	
	Orig	Rep	Orig	Rep	Orig	Rep	Orig	Rep	Orig	Rep	Orig	Rep
{Log Sales}	0.015	0.015					0.034***	0.034***				
	[0.013]	[0.013]					[0.009]	[0.009]				
{Log Sales}^{2}	0.0010	0.0010					-0.002***	-0.002***				
	[0.0007]	[0.0007]					[0.000]	[0.000]				
{Log Employment}			0.041*	0.041*					0.039**	0.039**		
			[0.024]	[0.024]					[0.016]	[0.016]		
{Log Employment}^{2}			0.001	0.001					-0.003**	-0.003**		
			[0.002]	[0.002]					[0.001]	[0.001]		
{Log Labour Productivity}					0.024**	0.024**					0.016**	0.016**
					[0.010]	[0.010]					[0.007]	[0.007]
{Log Labour Productivity}^{2}					0.001	0.001					-0.001*	-0.001*
					[0.001]	[0.001]					[0.001]	[0.001]
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.12	0.12	0.08	**0.11**	0.11	**0.08**	0.05	0.05	0.05	0.05	0.05	0.05
Observations	2469	2469	2340	**2364**	2364	**2340**	2570	2570	2437	**2461**	2461	**2437**

Notes: Table uses Chinese firm information in 2002 and 2003 from the World Bank's Enterprise Survey data. All regressions include industry fixed effects. The constant in each regression is not reported. Standard errors in brackets. Significance: * 10%; ** 5%; ***1%. "Orig" represents original paper. "Rep" represents reproduction. Differences between the original results and replication results are set in bold within the table.

Table 2.3 Firm-level summary statistics for Chinese firms, 2002 & 2003 and 2012– summary statistics for robustness check.

	2002 & 2003		2012	
	Mean	Median	Mean	Median
Firms	2629		1692	
Direct export share	0.13	0.00	0.09	0.00
Indirect export share	0.05	0.00	0.05	0.00
Sales (¥)	200,044,400	16,223,000	200,247,400	20,000,000
Employment	491	172	300	94
Labour Productivity	408,739	93,207	505,007	225,000

Notes: Table reports summary statistics for Chinese firms from the World Bank's Enterprise Survey Data.

Table 2.4 Export mode and productivity - AKW Table 4 robustness check, using data from 2012.

	Direct export share						Indirect export share					
	(1)		(2)		(3)		(4)		(5)		(6)	
	Orig	Upd	Orig	Upd	Orig	Upd	Orig	Upd	Orig	Upd	Orig	Upd
{Log Sales}	0.015	0.092**					0.034***	-0.010				
	[0.013]	[0.038]					[0.009]	[0.028]				
{Log Sales}^{2}	0.0010	-0.002*					-0.002***	0.000				
	[0.0007]	[0.0011]					[0.000]	[0.001]				
{Log Employment}			0.041*	0.050**					0.039**	0.041***		
			[0.024]	[0.020]					[0.016]	[0.014]		
{Log Employment}^{2}			0.001	-0.002					-0.003**	-0.004***		
			[0.002]	[0.002]					[0.001]	[0.001]		
{Log Labour Productivity}					0.024**	0.050					0.016**	-0.112**
					[0.010]	[0.068]					[0.007]	[0.048]
{Log Labour Productivity}^{2}					0.001	-0.002					-0.001*	0.004**
					[0.001]	[0.003]					[0.001]	[0.002]
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.12	0.06	0.08	0.07	0.11	0.03	0.05	0.04	0.05	0.05	0.05	0.05
Observations	2469	1691	2340	1690	2364	1690	2570	1691	2437	1690	2461	1690

Notes: Table uses Chinese firm information in 2012 from the World Bank's Enterprise Survey data. All regressions include industry fixed effects. The constant in each regression is not reported. Standard errors in brackets. Significance: * 10%; ** 5%; ***1%. "Orig" represents original results. "Upd" represents reproduction results estimated from 2012 data.

Table 2.5 Unit value differential and use of intermediaries - AKW Table 5 partial reproduction.

	(1)		(2)		(3)	
	Orig	Rep	Orig	Rep	Orig	Rep
$\{Intermediary\}_f$	0.067***	0.064***	0.051***	0.045***	0.023***	0.017***
	[0.005]	[0.005]	[0.004]	[0.004]	[0.004]	[0.004]
Quartic firm size controls	No	No	Yes	Yes	Yes	Yes
Fixed effects	po	po	po	po	cpo	cpo
R-squared	0.79	0.79	0.79	0.79	0.85	0.85
Observations	4,594,598	5,193,328	4,594,598	5,193,328	4,594,598	5,193,328

Notes: Table regresses firms' log unit value (at the country-product level) on intermediary dummy and firm size controls in 2005. The symbols for the pair fixed effects are product (p), ownership (o) and country (c). The constant in each regression is not reported. Standard errors are clustered by product. Significance: * 10%; ** 5%; *** 1%. “Orig” represents original paper. “Rep” represents reproduction.

Table 2.6 Unit value differential and use of intermediaries, 2000-2005 - robustness checks on AKW Table 5.

	(1)	**(2)**	**(3)**
$\{Intermediary\}_f$			
2005	0.064***	0.045***	0.017***
	[0.005]	[0.004]	[0.004]
Observations	5,193,328	5,193,328	5,193,328
2004	0.019***	-0.005	-0.003
	[0.004]	[0.004]	[0.003]
Observations	4,166,561	4,166,561	4,166,559
2003	-0.011***	-0.037***	-0.023***
	[0.004]	[0.003]	[0.003]
Observations	3,358,635	3,358,635	3,358,635
2002	0.031***	0.015***	0.022***
	[0.004]	[0.004]	[0.004]
Observations	2,688,711	2,688,711	2,688,711
2001	0.037***	0.013***	0.026***
	[0.004]	[0.004]	[0.004]
Observations	2,019,600	2,019,600	2,019,600
2000	0.008*	-0.019***	-0.003
	[0.004]	[0.004]	[0.004]
Observations	1,731,608	1,731,608	1,731,580
Quartic firm size controls	No	Yes	Yes
Fixed effects	po	po	cpo

Notes: The dependent variable is the firms' log unit values from 2000 to 2005. The symbols for the pair fixed effects are product (p), ownership (o) and country (c). Standard errors in brackets. Significance: * 10%; ** 5%; *** 1%.

Table 2.7 Unit value differential and use of intermediaries, 2005 - robustness checks on AKW Table 5 with regional subsamples.

	(1)	**(2)**	**(3)**
$\{Intermediary\}_f$			
Full sample	0.064***	0.045***	0.017***
	[0.005]	[0.004]	[0.004]
Observations	5,193,328	5,193,328	5,193,328
West	-0.084***	-0.101***	-0.057***
	[0.011]	[0.011]	[0.013]
Observations	166,825	166,825	166,825
Central	-0.098***	-0.117***	-0.058***
	[0.010]	[0.010]	[0.013]
Observations	224,526	224,526	224,526
East	0.073***	0.052***	0.022***
	[0.005]	[0.004]	[0.004]
Observations	4,815,809	4,815,809	4,815,809
Quartic firm size controls	No	Yes	Yes
Fixed effects	po	po	cpo

Notes: The dependent variable is the firms' log unit values in 2005. It shows the results of different regions. “West” includes Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, Inner Mongolia, Guangxi. “Central” includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hunan, Hubei. “East” includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan. The symbols for the pair fixed effects are product (p), ownership (o) and country (c). Standard errors in brackets. Significance: * 10%; ** 5%; *** 1%.

Table 2.8 Intermediary export share and country characteristics, 2005 - AKW Table 6 reproduction.

	(1)		(2)		(3)-AKW		(4)-AKW	
	Orig	Rep	Orig	Rep	Orig	Rep	Orig	Rep
$\{\text{Log Distance}\}_c$	0.032***	0.027***	0.026***	0.029***	0.025***	0.031***	0.025***	0.030***
	[0.008]	[0.009]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.009]
$\{\text{Log GDP}\}_c$	-0.022***	-0.021***	-0.021***	-0.019***	-0.019***	-0.019***	-0.019***	-0.017***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]
$\{\text{Log Chinese Population}\}_c$			-0.002*	-0.003**	-0.004*	-0.003***	-0.004*	-0.004***
			[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
$\{\text{\# of Importing Procs}\}_c$					0.003**	0.004***	0.003**	0.004***
					[0.001]	[0.001]	[0.001]	[0.001]
$\{\text{MFN Tariff}\}_{hc}$							0.059**	0.034*
							[0.022]	[0.020]
HS6 FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.15	0.15	0.16	0.16	0.17	0.17	0.18	0.17
Observations	267,201	263,878	221,373	227,304	207,594	212,901	185,975	188,120

Notes: Table regresses the intermediary export (at the country – HS6 level) on country characteristics in 2005. "AKW" represents the data for {# of Importing Procs} sourced from the authors. This table uses the {MFN Tariff} I get from the author. Standard errors in brackets. Significance: * 10%; ** 5%; *** 1%.

Table 2.9 Summary statistics for three data sources for the number of import documents variable.

	Observations	Median	Mean	Min	Max
AKW	151	9	9.10	3	19
Report	171	7	8.08	2	21
Online	151	11	10.77	3	19

Notes: Table regresses the intermediary export (at the country – HS6 level) on country characteristics in 2005. There are three data sources for {# of Importing Procs}. "AKW" represents the data I get from the authors. "Report" represents the data from Doing Business PDF file. "Online" represents the data from the online database.

Table 2.10 Intermediary export share and country characteristics,2005 – AKW Table 6 reproduction using three data sources for the number of import documents variable.

	(1)-Orig	(2)-AKW	(3)-Report	(4)-Online
$\{\text{Log Distance}\}_c$	0.025***	0.030***	0.026***	0.029***
	[0.007]	[0.009]	[0.009]	[0.009]
$\{\text{Log GDP}\}_c$	-0.019***	-0.017***	-0.018***	-0.016***
	[0.003]	[0.003]	[0.003]	[0.002]
$\{\text{Log Chinese Population}\}_c$	-0.004*	-0.004***	-0.004***	-0.004***
	[0.001]	[0.001]	[0.001]	[0.001]
$\{\text{\# of Importing Procs}\}_c$	0.003**	0.004***	0.001	0.004***
	[0.001]	[0.001]	[0.001]	[0.001]
$\{\text{MFN Tariff}\}_{hc}$	0.059**	0.034*	0.060**	0.048**
	[0.022]	[0.020]	[0.023]	[0.023]
HS6 FEs	Yes	Yes	Yes	Yes
R-squared	0.18	0.17	0.17	0.17
Observations	185,975	188,120	188,120	189,030

Notes: Table regresses the intermediary export (at the country – HS6 level) on country characteristics in 2005. There are three data sources for {# of Importing Procs}. "AKW" represents the data I get from the authors. "Report" represents the data from Doing Business PDF file. "Online" represents the data from the online database. This table uses the {MFN Tariff} I get from the author. Standard errors in brackets. Significance: * 10%; ** 5%; *** 1%.

Table 2.11 Intermediary export share and country characteristics, 2000-2005 – robustness checks of AKW Table 6 using data from 2000-2004 and the three different sources for the number of import documents variable.

	(1)-AKW	(2)-Report	(3)-Online
$\{\#\ of\ Importing\ Procs\}_c$			
2005	0.004***	0.001	0.004***
	[0.001]	[0.001]	[0.001]
2004	0.002*	-0.0002	0.003**
	[0.001]	[0.001]	[0.001]
2003	0.005***	0.002*	0.004**
	[0.001]	[0.001]	[0.002]
2002	0.005***	0.002	0.005***
	[0.002]	[0.001]	[0.002]
2001	0.006***	0.001	0.005***
	[0.002]	[0.002]	[0.002]
2000	0.006***	0.003*	0.005***
	[0.002]	[0.001]	[0.001]
HS6 FEs	Yes	Yes	Yes

Notes: Table regresses the intermediary export (at the country – HS6 level) on country characteristics. It shows the results of {# of Importing Procs} from 2000 to 2005. "AKW" represents the data I get from the author. "Report" represents the data from Doing Business PDF file. "Online" represents the data from the online database. This table uses {# of Importing Procs} in 2005 for all the previous years. The MFN tariff data I use in this table is obtained from World Bank WITS database. Standard errors in brackets. Significance: * 10%; ** 5%; *** 1%.

Table 2.12 Intermediary export share and country characteristics, 2000-2005 – robustness checks of AWK Table 6 using data from 2000-2004 and the three different sources for the number of import documents variable.

	(1)-AKW	(2)-Report	(3)-Online
$\{\text{MFN Tariff}\}_{hc}$			
2005	0.034*	0.060**	0.048**
	[0.020]	[0.023]	[0.023]
2004	-0.007	-0.004	-0.005
	[0.007]	[0.007]	[0.007]
2003	0.008	0.014	0.018*
	[0.009]	[0.010]	[0.011]
2002	-0.006***	-0.004*	-0.005**
	[0.002]	[0.002]	[0.002]
2001	-0.008	0.009	0.010
	[0.009]	[0.014]	[0.014]
2000	-0.008	0.005	0.009
	[0.009]	[0.013]	[0.012]
HS6 FEs	Yes	Yes	Yes

Notes: Table regresses the intermediary export (at the country – HS6 level) on country characteristics. It shows the results of {MFN Tariff} from 2000 to 2005. "AKW" represents the data I get from the author. "Report" represents the data from Doing Business PDF file. "Online" represents the data from the online database. This table uses {# of Importing Procs} in 2005 for all the previous years. The MFN tariff data I use in this table is obtained from World Bank WITS database. Standard errors in brackets. Significance: * 10%; ** 5%; *** 1%.

Table 2.13 Intermediary export share and country characteristics, 2000-2005 - robustness checks using data from 2000-2004.

	2005	**2004**	**2003**	**2002**	**2001**	**2000**
$\{\text{Log Distance}\}_c$	0.026***	0.037***	0.042***	0.041***	0.041***	0.036***
	[0.009]	[0.009]	[0.008]	[0.009]	[0.008]	[0.009]
$\{\text{Log GDP}\}_c$	-0.018***	-0.024***	-0.023***	-0.022***	-0.022***	-0.025***
	[0.002]	[0.004]	[0.004]	[0.004]	[0.003]	[0.004]
$\{\text{Log Chinese Population}\}_c$	-0.004***	-0.001	-0.004	-0.003	-0.003*	-0.006***
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
$\{\text{MFN Tariff}\}_{hc}$	0.078***	-0.003	0.023*	-0.002	0.011	0.015
	[0.025]	[0.007]	[0.013]	[0.002]	[0.016]	[0.013]
HS6 FEs	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.17	0.23	0.24	0.23	0.23	0.25
Observations	195,496	110,719	101,581	100,781	94,032	83,893

Notes: Table regresses the intermediary export (at the country – HS6 level) on country characteristics from 2000 to 2005. It drops the variable {# of Importing Procs}. Standard errors in brackets. Significance: * 10%; ** 5%; *** 1%.

Table 2.14 Export values by firm type, 2005 - summary statistics for subregions East, Central and West.

Year	Total value ($ million)	Percentage in full sample (%)	Direct export value	Intermediary export value	Intermediary value share (%)
Full sample	761,620	100	166,046	595,573	21.8
West	26,237	3.4	11,049	15,188	42.1
Central	36,200	4.8	16,327	19,873	45.1
East	699,167	91.8	138,671	560,496	19.8

Notes: Table reports summary statistics from China customs data in 2005. It shows export shares by firm type in different regions. "West" includes Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, Inner Mongolia, Guangxi. "Central" includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hunan, Hubei. "East" includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan.

Table 2.15 Intermediary export share and number of import documents variable, 2005 – robustness checks using regional subsamples and the three data sources for the number of import documents variable.

	(1)-AKW	(2)-Report	(3)-Online
$\{\#\ of\ Importing\ Procs\}_c$			
Full sample	0.004***	0.001	0.004***
	[0.001]	[0.001]	[0.001]
West	0.001	-0.003	0.001
	[0.002]	[0.002]	[0.002]
Central	0.006	0.003	0.002
	[0.004]	[0.003]	[0.003]
East	0.005***	0.002	0.004***
	[0.001]	[0.001]	[0.001]
HS6 FEs	Yes	Yes	Yes

Notes: Table regresses the intermediary export (at the country – HS6 level) on country characteristics in 2005. It shows the results of {# of Importing Procs} in different regions. "West" includes Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, Inner Mongolia, Guangxi. "Central" includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hunan, Hubei. "East" includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan. This table uses the {MFN Tariff} I get from the author. Standard errors in brackets. Significance: * 10%; ** 5%; *** 1%.

Table 2.16 Intermediary export share and MFN tariffs, 2005 - robustness checks using regional subsamples and the three data sources for the number of import documents variable.

	(1)-AKW	(2)-Report	(3)-Online
$\{\text{MFN Tariff}\}_{hc}$			
Full sample	0.034*	0.060**	0.048**
	[0.020]	[0.023]	[0.023]
West	0.164**	0.195**	0.168**
	[0.073]	[0.079]	[0.070]
Central	0.066	0.092	0.106*
	[0.059]	[0.069]	[0.061]
East	0.027	0.057**	0.048**
	[0.021]	[0.023]	[0.024]
HS6 FEs	Yes	Yes	Yes

Notes: Table regresses the intermediary export (at the country – HS6 level) on country characteristics in 2005. It shows the results of {MFN Tariff} in different regions. "West" includes Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, Inner Mongolia, Guangxi. "Central" includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hunan, Hubei. "East" includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan. This table uses the {MFN Tariff} I get from the author. Standard errors in brackets. Significance: * 10%; ** 5%; *** 1%.

Chapter 3. Spillover Effects and Export Performance: A Meta-analysis

3.1 Introduction

The export-led growth hypothesis states that exports play an important role in promoting economic growth. Empirical studies generally support this hypothesis, especially for developing countries. For example, Lin & Li (2003) find that a 10% increase in exports contributed to a 1% growth in GDP in China the 1990s. Ray (2011) reports the existence of a long-run relationship in India between exports and economic growth. And Kılavuz and Topcu (2012) estimate a positive effect of exports on growth for 22 developing countries. Based on these and similar empirical findings, there is much interest among researchers and policy-makers in understanding why firms export and in policies that encourage exporting.

With respect to understanding why firms export, modern theory has focused attention on the role of productivity heterogeneity among firms (Bernard, Eaton, Jensen, & Kortum, 2003; Melitz, 2003). In Melitz (2003), firms need to pay entry costs to participate in the international trade market. This induces a "productivity threshold". Only the more productive firms can overcome these costs, engage in the export market, and make profits. Less productive firms only serve the domestic market. Firms with a productivity advantage thus self-select into export markets.

Empirical studies show support for this model in both developed and developing countries. Using U.S manufacturing data, Bernard, Jensen, Redding, and Schott (2007) identify different characteristics between exporters and non-exporters. Exporters are larger, more productive, and more capital- and skill-intensive. Aw, Chung, and Roberts (2000) found evidence of self-selection in Taiwanese manufacturing plants. Entrants to export market are more productive, and plants with lower productivity tend to exit. Head and Ries (2003) investigated export performance in Japan and confirmed that productivity is positively related to firms' decisions

to export. Similar findings are reported for Italy (Castellani, 2002), Spain (Delgado, Farinas, & Ruano, 2002), Germany (Arnold & Hussinger, 2005), and other countries.

Thus, productivity is a vital factor that enables firms to enter foreign markets. Firms can support their own efforts to export by enhancing their productivity. They can invest in research and innovation (Crépon, Duguet, Mairessec, & Technology, 1998; Griffith, Huergo, Mairesse, & Peters, 2006; Wakelin, 2001) or improve human resource management (Huselid, 1995). The existence of externalities also opens up a role for government. In particular, government can encourage exports by introducing export promotion policies (Westphal, 1990) or establishing industrial districts and economic zones (Becchetti, De Panizza, & Oropallo, 2007; Zeng, 2011).

Externalities can arise for a number of reasons. Prominent are agglomeration economies, first studied in urban economics. The idea behind agglomeration economies comes from the observation that, in most countries, economic activities are geographically concentrated. Examples are Silicon Valley-style concentrations in the U.S. (Ellison & Glaeser, 1997), and regional clusters of exporters in Russia (Cassey & Schmeiser, 2013a). One type of agglomeration economy is urbanization, which refers to externalities arising from the geographical concentration of all economic activities. By locating at the same place as other firms, a firm can take advantage of the local labour market. Regions with a higher concentration of firms generally possess a larger labour market, which may reduce the searching and matching costs of firms and workers, improving firms' performance (Duranton & Puga, 2004). Relatedly, workers may be attracted by local amenities. This, in turns attracts firms, resulting in spatial concentration with its consequent economies (Greenstone, Hornbeck, & Moretti, 2010).

Another type of agglomeration economy is due to transportation costs. Firms can reduce transportation costs by purchasing services and intermediate goods from local suppliers

(Krugman, 1991). Transportation costs can also be reduced through the sharing of local facilities such as port facilities, airports and other logistic centres (Duranton & Puga, 2004). Natural advantages can initiate spatial concentrations that are further supported by the associated reduction in transportation costs. Greenstone et al. (2010) provides examples, such as the oil and processing industries.

Another type of agglomeration economy is localization, which refers to externalities arising from the spatial concentration of related industries. Firms tend to benefit from intra-industry linkages, such as spillovers from sector-specific technological knowledge (Choquette & Meinen, 2015). One source of technological knowledge spillovers is workers. Firms frequently hire workers previously employed by other firms in the industry. This enables them to acquire specific production techniques or knowledge from those firms. Firms can also benefit from inter-industry spillovers. For example, firms in upstream sectors (suppliers) and downstream sectors (buyers) may pass on information about foreign markets, facilitating entry into export markets (Kneller & Pisu, 2007). In summary, localization economies enable sharing of specific production inputs through supplier-buyer linkages, knowledge, labour pools and technology (Malmberg, Malmberg, & Lundequist, 2000).

A third channel of externality economies is spillovers from multinational enterprises (MNEs). Foreign direct investment (FDI) affects firms' economic performance in host countries through direct and indirect technology transfers. Proximity to foreign firms is likely to result in imitation by indigenous firms, therefore promoting skill upgradation and research and development (R&D) activities (Greenaway, Sousa, & Wakelin, 2004). Apart from R&D spillovers from FDI, firms may benefit from the competition arising from foreign firms' entry (Kneller & Pisu, 2007). Competition forces domestic firms to improve their productivity. This improved productivity can make it profitable for them to start exporting.

FDI can also generate informational spillovers (Aitken, Hanson, & Harrison, 1997). MNEs may have advantages in information about market structure, consumer tastes, and distribution and logistics networks in foreign countries. Domestic firms that gain access to this knowledge can save entry costs, facilitating access to international markets. While FDI reduces the sunk costs of entering foreign markets and positively affects the export propensity of recipient firms, it can also help the non-FDI recipient firms to overcome financial constraint through region-specific external economies. For example, these firms may employ transportation infrastructure and access to information about foreign consumers that MNEs or FDI recipients bring with them (Kemme, Nikolsko-Rzhevskyy, & Mukherjee, 2014).

Of particular interest are spillovers that come directly from exporters. The spatial concentration of exporters can promote construction of specialized transportation infrastructure, e.g. roads, railways or ports, airports or storage facilities (Aitken et al., 1997). Domestic firms, by taking advantage of these facilities, may find it easier to enter trade markets. Another way by which spillovers from exporters might occur involves information externalities. Proximity to exporters may bring specific knowledge about destination countries and the demand for certain types of products. This can make it easier for non-exporting firms to begin exporting (Koenig, Mayneris, & Poncet, 2010).

Koenig et al. (2010) provide evidence that French firms benefitted from the presence of product-specific and destination market-specific exporters in the same location. Cassey & Schmeiser (2013a) build a trade model to explain exporter clusters by shipment destination. They use Russian customs data to support the existence of destination-specific external economies. In the cluster, firms find it easy to get information about how to export to a particular destination market. They also benefit from economies of scale generated from containerization. Cassey & Schmeiser (2013b) report similar evidence for the U.S.

While most theoretical studies model spillovers as having positive effects, it should be noted there are exceptions. Farole & Winkler (2013) argue that agglomeration may generate negative spillovers on exports due to congestion costs. This can increase the prices of production factors such as land, capital, labour, and transportation. Further, Bao, Ye, & Song (2016) argue that agglomeration may lead to over-competition among exporters, thus bringing down the prices of exported goods, negatively impacting the incentive of other firms to export.

In summary, the spillover-export hypothesis states that spillovers from (i) agglomeration economies (urbanization and localization) (Greenaway & Kneller, 2008; Malmberg et al., 2000), (ii) FDI (Joseph & Reddy, 2009; Lu, Tao, & Zhu, 2017; Lutz & Talavera, 2004) and (iii) exporters (Bannò, Giuliani, & Zaninotto, 2015; Choquette & Meinen, 2015; Harasztosi, 2016) affect the probability of firms participating in export markets and producing exports. Externality economies are usually hypothesized to be beneficial by reducing fixed or variable trade costs, transferring technology, stimulating innovation, and gaining information about foreign markets. This enables firms to be more productive, which makes it profitable to enter international trade markets. They also can make it easier for firms to find and access foreign markets.

While theoretical models have the ability to clearly distinguish different types of spillovers with differing effects on firms' export performance, distinguishing these types and effects in empirical work can be challenging. For example, spillovers might arise from proximity to MNEs in the same location (Buck, Liu, Wei, & Liu, 2007; Cieślik & Hagemejer, 2014; Kemme, Nikolsko-Rzhevskyy, & Mukherjee, 2014), or same industry (Fu, 2011; Lutz & Talavera, 2004; Zhao, Liu & Buck, 2017), or through vertical linkages in upstream and downstream industries (Anwar & Nguyen, 2011; Kneller & Pisu, 2007). Alternatively, they could arise from the agglomeration of exporters (Hu & Tan, 2016; Kang, 2016; Koenig, 2009;

Malmberg et al., 2000), or exporters in the same industry (Alvarez, 2007; Bao, Shao, & Song, 2014; Barrios, Görg, & Strobl, 2003).

Further, when studying firms' export performance, there are many dimensions to consider. Kox (2013) decomposes exports into a decision on whether to export, a decision on destination market, a decision on products, and a decision on quantities and price. Some papers focus on the extensive export margin; i.e., the participation decision (Greenaway & Kneller, 2007; Mañez, Rochina, & Sanchis, 2004; Mayneris & Poncet, 2013; Muñoz-Sepúlveda & Rodriguez, 2015). While other papers focus on the intensive export margin; i.e., export quantity, volume and value (Becchetti et al., 2007; Chen, Sheng, & Findlay, 2013; Cieślik & Hagemejer, 2014; Lutz, Talavera & Park , 2008).

While the previous discussion highlighted empirical evidence of spillovers positively affecting exports, it should be emphasized that overall empirical evidence is mixed. For example, Aitken et al. (1997) estimate a positive relationship between FDI spillovers and the export decision of Mexican manufacturing firms, but find no spillover effects from the general presence of exporters. Clerides, Lach, & Tybout (1998) find that proximity to local exporters positively influences the export participation decision of Colombian firms in the apparel and textiles industries, but find negative industry spillover effects in the chemical industry. Malmberg et al. (2000) report that the export value of Swedish firms is positively affected by export firms in the same region but different industries, while export firms operating in the same industry do not promote export value. Becchetti and Rossi (2000) estimate positive externalities of geographical agglomeration on the export intensity of Italian firms, but little effect on the probability of starting to export. Barrios, Görg, & Strobl (2003) find no evidence of spillover effects from other firms' exporting activities. Bernard & Jensen (2004) study different types of spillovers from exporters – state-specific but outside the industry, industry-

specific but outside the state, and state and industry-specific – however, they do not find evidence of spillover effects on the decision to export for U.S. manufacturing plants.

As foreshadowed above, there is no consensus on whether spillovers have a positive influence on exports, and, if so, how large. Neither is there consensus on the primary transmission mechanisms. Further, little is known about why studies obtain different results.

To answer these questions, I conduct a Meta-Regression Analysis (MRA) of the spillover-export empirical literature. I collect 3359 estimates of spillover effects on export performance from 99 primary studies. My final sample of 3025 estimated effects finds evidence of publication bias in the empirical literature, with the literature preferring estimates that report a positive relationship between spillovers and exports

After accounting for this bias, I estimate that the overall effect of spillovers on export is statistically significant but quite small. When I next analyse heterogeneity in estimated spillover effects, I find that a number of variables are significantly related to differences in estimated effects across studies, but the size of the associated effects is small.

The remainder of this chapter is structured as follows. Section 2 describes how I collected the studies and built the sample of spillover estimates for the meta-analysis. Section 3 explains the effect of spillovers on export. Section 4 explores publication bias in the literature. Section 5 discusses the potential determinants of variation in spillover effects. Section 6 uses Bayesian Model Averaging to identify important variables in explaining the differences across studies. Section 7 presents my estimation results. Section 8 concludes.

3.2 The dataset of Spillover-Export estimates

I conducted a literature search following the protocol recommended by Stanley et al. (2013). I initially employed two categories of keywords: (i) “Export” keywords and (ii)

"Spillovers" keywords. Each of the two categories included a variety of keywords. "Export" keywords were "export", "trade", "export decision", "export propensity", "export intensity", "export share", "export performance" and "firm performance". "Spillovers" keywords were "agglomeration", "urbanization", "localization", "external economies", "externality", "spillovers", "export spillovers", "FDI spillovers", "spatial spillovers", "geographical spillovers", "sectoral spillovers" and "industrial spillovers". I searched the literature using a combination of keywords from the "Export" and "Spillovers" groups in various search engines such as Web of Science, Google Scholar, Scopus, JSTOR, EBSCO, ProQuest and RePEc. My initial search yielded over 350 studies, including peer-reviewed journal articles, working papers, conference proceedings, doctoral dissertations and master theses.

I further narrowed down these studies to eliminate any papers that did not satisfy the following inclusion criteria: (i) empirical study, (ii) dependent variable is export, and (iii) spillover variable is included in the regression. I only included estimated spillover effects derived from studies examining the following general relationship:

$$Export = \alpha Spillover + \beta Controls + \varepsilon, \quad (1)$$

where $Export$ is a measure of a firm's export performance, $Spillover$ is a measure of the external impact from other firms and $Controls$ refer to control variables included in the regression.

Most studies estimate the export relationship using firm-level data, but some studies aggregate data at the sector-level, regional-level or ownership-level (state-owned enterprises, collective-owned enterprises or private-owned enterprises). Some studies focus on domestic firms, specifically investigating spillover effects on domestic firms' export behaviour. Other papers include both domestic and foreign firms. Few studies distinguish foreign firms from domestic firms.

Following Heckman (1979), some studies use a two-step export decision-making procedure. The first step involves the decision of whether or not to export; i.e., the extensive export margin. Here, $Export$ is a dummy variable that takes the value 1 if a firm reports a positive export value. In the second step, firms decide how much to export; i.e., the intensive export margin. Here, $Export$ is measured by variables such as export volume, export value, and export intensity (ratio of exports in total sales). Other studies only focus on one aspect, using either the export decision or export value as the object of study. As long as the study estimates spillover effects on some aspect of exports, I include it in my sample.

Researchers are interested in better understanding the different transmission mechanisms of spillovers. These include external effects from other firms located in the same region or same industry, spillovers generated from supplier-buyer relationships with firms in upstream or downstream industries, and spillover effects from MNEs or exporters. Not just the transmission mechanism, but also the nature of the spillover is of interest to researchers. For example, spillovers can arise from R&D activities, technology adoption, or foreign market information sourced from other firms. Consequently, there are multiple measures of $Spillover$, including total sales or total exports of other firms, total number of employees working in other firms, total output of other firms, the number of other firms, the number of exporters, R&D expenditures by other firms, the ratio of R&D expenditures to total sales by other firms, and others. In order to investigate these different mechanisms and types of spillovers, I include all of these in my study.

Each of these studies was read carefully to see whether it was eligible according to the criteria. As a result, the sample was reduced to 115 studies. I next explored whether some of these studies were duplicates. In some cases, my sample included both a working paper version and peer-reviewed journal version. Some studies even had three versions: two working papers

and a journal article. In these cases, I eliminated working papers and kept the final, published version. I did this because it was my judgement that the final version represented the most reliable results. This caused my sample to shrink to 106 papers.

I omitted estimated effects that came from regressions having interaction terms and/or quadratic specifications of the spillover variable. Given the specifications

$$\text{Export} = \beta_0 + \beta_1 Spillover + \beta_2 Spillover \cdot C + \beta_3 C \text{ and}$$

$$\text{Export} = \beta_0 + \beta_1 Spillover + \beta_2 Spillover^2,$$

the associated marginal effects are given by (i) $\frac{\partial \text{Export}}{\partial \text{Spillover}} = \beta_1 + (\beta_2 \cdot C)$ and (ii) $\frac{\partial \text{Export}}{\partial \text{Spillover}} = \beta_1 + (2 \cdot \beta_2 \cdot Spillover)$. In these cases, it would be wrong to use the estimated coefficients of β_1 and β_2 as individual effect estimates, because they incompletely comprise the full marginal effect. One could calculate marginal effects for given values of C and $Spillover$, respectively. However, the associated standard errors would require information about the covariances of the estimates of β_1 and β_2, and that information is not available. For these reasons, I eliminated these studies. This reduced the sample to 99 papers with a total number of 3,359 estimated effects.

The final issue I dealt with concerned outliers. Outliers can distort the results of regression analysis if they are sufficiently large in absolute value. Given the large number of observations I had, and given the large size of some of the outliers (see below), I felt it was appropriate to drop the bottom and top 5% of estimates. This left me with a final sample of 98 papers[1] comprised of a total number of 3,025 estimated effects.

[1] Details of these papers are shown in Appendix.

Table 3.1 summaries some characteristics of the studies in my sample. The earliest empirical analysis was published in 1997 and the most recent empirical study was published in 2017[2]. 84 of the studies were published in peer-reviewed journals. Two are PhD theses. One is Master thesis. Eleven are working papers.

The majority of papers are individual country studies. Only two use cross-country data to examine spillover effects. 69 of the studies use panel data and 24 use cross-sectional data. Five use both. With respect to the dependent variable, 46 studies are interested in the extensive margin of exports, examining whether non-exporters benefit from spillovers and start exporting. 19 focus on the intensive margin of exports, testing whether spillovers are associated with exporters exporting more products or exporting to more countries. The remaining 33 studies use a two-stage, export decision-making procedure, investigating the impact of spillovers on both extensive and intensive export margins. The number of estimated effects per study varies widely, from 1 to 204.

All the data in my sample were independently coded by two coders (I was one of them). Inconsistencies were discussed on an individual basis until the discrepancies could be reconciled. I emphasise that all search and coding closely followed the MAER-NET protocols (Stanley et al., 2013).

3.3 The effect of spillovers on export

Researchers use a wide variety of measures of spillovers and export performance to estimate the spillover-export relationship. This makes direct comparison of estimated effects impossible. Accordingly, I follow the common practice (cf. Doucouliagos, 2011) of transforming the original estimates into partial correlation coefficients (PCCs). The PCC uses

[2] I finished my literature search in March 2018.

the estimated effect's t-value, and the degrees of freedom (df) from the associated regression equation, to produce a unit-free measure of effect:

$$PCC_i = \frac{t_i}{\sqrt{t_i^2 + df_i}} \ , \tag{2}$$

where t_i is the t-value of the estimated coefficient, df_i is the degrees of freedom of the associated regression equation, and $-1 \leq PCC_i \leq 1$. The standard error of the PCC is given by:

$$s.e.(PCC_i) = \sqrt{\frac{1 - PCC_i^2}{df_i}} \ . \tag{3}$$

As a statistical measure, the PCC can be calculated directly from commonly reported estimation output using the associated t-statistics. It has nothing to do with the particular units that are used to measure the dependent and independent variables. Also, it takes values over a well-defined range (-1 to 1). The closer a PCC is to ± 1, the larger is the effect. Doucouliagos (2011) provides a set of guidelines for how to interpret the practical significance of PCCs. He explores the actual distribution of PCC found in empirical economics and summarizes "reasonable" thresholds, making it feasible to treat PCC as a measure of economic effect.

The subsequent analysis uses PCC_i as the measure of effect and $s.e.(PCC_i)$ as its standard error. This allows one to compare the different estimated coefficients from the different studies for strength of effect.

Figure 3.1 provides a scatter graph of spillover estimates (PCCs) over time. While the estimated PCC values are decreasing to zero, but they do not converge over time. The line presents a slightly negative linear relationship between the spillover estimates and the year when the study was first published.

Figure 3.2 presents two histograms. The top panel represents the distribution of t-values in the final sample, and the bottom panel shows the corresponding PCC values. As is apparent from the top panel, there is a wide range of t-values in the original studies, ranging from -3 to 18. The bottom panel displays the corresponding PCC values. These are closely clustered around zero.

Table 3.2 reports further information about the t- and PCC values in my study. The mean t-statistic is 2.09. The mean PCC value is 0.016. According to Doucouliagos (2011), in empirical economics, PCC values below 0.07 are categorized as "small" in size, PCC values around 0.17 are "moderate" in size, and PCC values above 0.32 are "large". According to this standard, the majority of estimates in my study are "small", even very small, in size. This indicates that, despite all the research attention that has been devoted to this subject, the effect of spillovers on exports is not very important in economic terms.

Figure 3.3 illustrates the heterogeneity in PCC values for China. My sample contains 21 studies that investigate the relationship between spillovers and firm export performance in China. From the box plot in Figure 3.3, we can see that, even for the same country, there is substantial variability in spillover effects both within and across studies.

Figure 3.4 consists of a "forest plot", which allows one to compare the variability of estimated effects across the full sample. The plot employs a "Fixed Effects" (FE)[3] weighting scheme. This means that PCC values are weighted by their standard errors, with more precise estimates getting greater weight. For each study, the "diamond" shows the weighted average

[3] The assumptions underlying the FE and following RE estimators in a meta-analysis study are as follows: (i) estimated effects across studies are characterized by heteroskedasticity, (ii) estimated effects from the same study are correlated, and (iii) estimated effects across studies are uncorrelated. FE also assumes that all the estimated effects have the same population mean value and the only reason that produces different estimates is sampling error. RE assumes that studies have different underlying population effects.

of the estimates from that study. Also included is a 95% confidence interval around the average.

The majority of studies report small effect sizes with tight confidence intervals, though there a few studies with wide confidence intervals. Not reported in Figure 3.4 is a measure of variability of effect sizes. I^2 is a measure of effect heterogeneity after one accounts for the heterogeneity one would expect from sampling error. The I^2 value for my study is 99.5%, indicating that most of the heterogeneity across estimated effects is due to real differences in their value, and not simply sampling error. Possible explanations include the fact that studies use different measures for export performance and spillovers. In addition, studies estimate different functional forms, use different estimation techniques, study different samples of countries or industries, and analyse different time periods. I will explore this further in my MRA.

The final item of interest in Figure 3.4 is given in the last column. This reports the percentage weight assigned to each study. While this is admittedly difficult to see, Study 3 (Mayneris & Poncet, 2013) accounts for a disproportionate large weight in calculating the sample effect size average. This one study receives a weight of 53.7%. This raises concern that the Fixed Effects approach may rely too much on one or a few studies in its estimation. This will lead me to also use the "Random Effects" (RE) estimator, which I describe in greater detail below.

In order to see whether study and data characteristics can explain the variability in PCC values, Table 3.3 reports average (unweighted) PCC values stratified by study and data characteristic values.[4] While this analysis is crude, it does provide a first look at how PCC values change with sample characteristics. The first panel reports mean PCC values by

[4] Details of these sample characteristics are further reported in Table 3.5.

different types of spillover mechanisms. Accordingly, it does not appear that the heterogeneity in PCC values can be explained by different transmission mechanisms. There are 1,640 estimates of the effect of exporter spillovers and these have a mean PCC value of 0.016. 1,574 estimates focus on spillovers from the same industry, with a corresponding mean PCC value of 0.015. FDI spillovers have the same mean estimated effect, with somewhat fewer estimates (1,204). Spillovers from the same region have the largest mean estimated effect (0.018), based on 1,559 estimates. From a practical perspective, these differences are very minor.

Another possible explanation for effect heterogeneity lies in how spillovers are measured. The studies in my sample alternatively use export values, employment, output, R&D investments of other firms, and the number of other firms to measure spillovers. Approximately 35% of spillover effects use a measure based on the number of firms. 26% of estimates measure spillovers using the export value of other firms. Around 15% of estimates use employment, output or R&D expenditures of other firms to proxy spillovers.

Within this category, spillover measures based on Output and R&D are associated with the largest relative effect sizes (0.022 and 0.021, respectively). In contrast, measures based on value, employment and number measures are associated with lower mean PCC values. Again, in light of Doucouliagos' (2011) size thresholds, these differences are negligible. Likewise, there are little observable difference when the sample is stratified by type of export performance, or firm ownership, or by country/region. The same holds when effect sizes are broken out by type of estimation, or publication characteristic.

Again, while not large in absolute size, there do appear to be differences in effect sizes when the sample is stratified by industry. On average, studies that focus on manufacturing have a mean PCC value of 0.017. Service industries are associated with somewhat larger estimates (0.026). On the other side, food industries have effect sizes that are exceedingly

small (0.009), and the average effect size for IT industries is negative (-0.005). Data characteristics also show some differences, with the largest effect sizes associated with cross-sectional data (0.036). Nevertheless, all of these differences are small when judged by the size criteria recommended by Doucouliagos (2011).

3.4 Testing for publication bias

Publication selection bias is an important concern in meta-analyses. This occurs when statistically significant findings are preferred by editors, reviewers and researchers (Stanley, 2008). Researchers may choose to ignore insignificant estimated effects and continue to try new specifications and estimation techniques until they obtain estimates that are significant. This leads to an over-representation of larger, more significant effects, which serves to inflate estimates of a literature's mean effect size. Doucouliagos and Paldam (2013) conclude that most of the empirical literature in economics suffers from publication bias. In this section, I test for publication bias in the literature studying the effects of spillovers on exports.

3.4.1 Funnel Plots

An informal test for publication bias is the "funnel plot". It is a simple, graphical tool commonly applied in meta-analyses (Egger et al., 1997). A funnel plot plots estimated effects (here PCC values) on the horizonal axis against precision (the standard error of the PCCs) on the vertical axis. Estimates at the top of the plot have the smallest standard errors and thus are most precise. These should reliably locate around the true effect size. As precision decreases (moving downward on the vertical axis), the estimates become more dispersed. In the absence of publication selection, the only differences in estimated effects will be due to sampling error, and the estimates should be symmetrically distributed with a funnel shape. Alternatively, if the funnel plot shows a skewed and asymmetric distribution of estimates, with estimates clustered

on one side, especially for PCCs with less precision, that suggests the presence of publication selection.

Figure 3.5 produces the funnel plot for all the 3,025 estimates in my sample. Each point represents one estimated effect. Figure 3.6 calculates a median PCC value for each of the 98 studies and displays those in the associated funnel plot. Each point represents one study. Both figures show dispersion at the top of the plot. Because estimates at the top indicate higher precision, the wide scattering of these points at the top of the funnel is evidence of heterogeneity in true spillover effects. Both Figures 3.5 and 3.6 show evidence of positive publication bias, as the distribution of PCC values lies asymmetrically to the right of the sample mean PCC value.

3.4.2 Funnel asymmetry test

A more rigorous, statistical test for the presence of publication bias is provided by the Funnel Asymmetry Test (FAT). It explores the relationship between estimated effects (here PCC values) and their standard errors. If the estimated estimates are significantly correlated with their standard errors, it indicates the presence of publication bias (Card, 1995). The FAT estimates the following specification:

$$PCC_i = \beta_0 + \beta_1 se(PCC_i) + \varepsilon_i, \qquad (4)$$

where PCC_i is the partial correlation coefficient of the spillover effect estimate, $se(PCC_i)$ is the standard error of the PCC, β_0 is the average PCC value after correction for publication bias, β_1 measures the magnitude of publication bias, and ε_i is the error term. A test of publication bias equates to a test of the null hypothesis, $H_0: \beta_1 = 0$. Rejection of this hypothesis is treated as evidence of publication bias (Doucouliagos & Paldam, 2013).

Table 3.4 presents the results of the FAT. Like many other meta-analyses, I use two estimation procedures – Fixed Effects and Random Effects estimation. Further, I employ two weighting schemes for each. Weight 1 gives equal weight to each estimate, while Weight 2 gives equal weight to each study. I do the latter to avoid giving disproportionate weight to studies that have a lot of estimates.

The first four columns report the results of testing for publication bias. The publication bias term (*FAT*) in the first row is the $se(PCC_i)$ variable in Equation (4). The *FAT* coefficients come from estimating β_1. Across both estimation procedures and both weighting schemes, I find that the publication bias estimates are positive and statistically significant, with the FE estimates being larger than the RE estimates and Weight 2 estimates being larger than Weight 1 estimates. Therefore, I reject the null hypothesis of no publication bias and find evidence of positive publication bias; namely, the reported spillover effects on export are biased upwards from their true effect size.

The constant term β_0 in Equation (4) represents the mean spillover effect ("Mean Effect") after controlling for publication bias. I find some differences across the regressions. The FE estimates in Column (1) and (2) are numerically the same, but the Weight 1 estimate is statistically insignificant, whereas the Weight 2 estimate is significant. Meanwhile, the RE estimates in Column (3) and (4) are both statistically significant, with larger mean effect sizes than the FE estimates, indicating a positive relationship between spillover variables and export performance after correcting for publication bias.

The mean effect coefficients in last two columns use the RE estimator[5]. I drop the $se(PCC_i)$ variable in Equation (4), and thus do not correct for publication bias. In the presence of positive publication bias, the uncorrected estimates in Column (5) and (6) are

[5] According to the results of "forest plot", we prefer to use the RE estimator.

larger than the results in Column (3) and (4), respectively, which is consistent with my prediction.

In summary, the results from Table 3.4 suggest that spillover effects reported in the literature are biased, due to the preference of choosing relatively large, positive estimates.

3.5 Factors that cause spillover estimates to differ across studies

To investigate the heterogeneity in spillover estimates in the literature, I employ a large number of variables to categorize each estimate/study. Variable definitions are given in Table 3.5. The variables are categorized into ten groups: spillover mechanism, spillover measure, export performance, ownership of firm, countries examined, industries examined, estimation method, data characteristics, control variables and publication characteristics.

Group 1: Spillover mechanism

One possible reason why spillover estimates differ across studies may be that studies investigate different spillover channels on a firm's export performance. Essentially, these channels may have different impacts on a firm's ability of acquiring information about foreign markets, adopting new technology or decreasing production costs. To capture the variation in channels, the "Spillover mechanism" group consists of four categories of spillover mechanisms – spillovers from same region (*Spill_reg*), from same industry (*Spill_ind*), from FDI (*Spill_FDI*), and from exporters (*Spill_ex*). The omitted category are other types of spillover mechanisms.

Group 2: Spillover measure

There is no commonly employed measure of spillovers in the literature. To examine whether differences in spillover measures affect estimates of spillover effects, spillover measures are grouped into six categories. *Number* is a a common measure of spillovers, with

35 percent of the estimated effects based on specifications where the number of other firms from the same region/industry, or number of other firms involved in FDI, or number of other exporting firms were used to measure spillovers. *Value* is another common measure of spillovers, with 26 percent of the estimates employing export value to measure spillovers. Other measures of spillovers are *Employment*, *Output*, and *R&D investment* of other firms. The reference group includes other spillover measures not captured by any of the above-listed categories.

Group 3: Export performance

Studies also differ in how they measure firms' export performance. The majority of estimates (68%) focus on a firm's extensive export margin; i.e., whether non-exporting firms become exporters. However, researchers also pay attention to the intensive export margin, examining whether incumbent exporting firms export more goods, or types of goods, or trade with more foreign markets. To capture these differences, dummy variables are created for the extensive margin (*Binary*) and the intensive margin (*Export_other*). The latter group constitutes the reference category.

Group 4: Ownership of firm

In the FDI spillover literature, it is generally taken for granted that a technology gap exists between domestic and foreign firms. The implication is that domestic firms benefit more from FDI than foreign firms. 47 percent of the estimated effects in my sample focus on spillover effects affecting domestic firms. The dummy variable *Domestic* represents this category. *Non-domestic* picks up cases where the study focuses on foreign firms or, more commonly, firm ownership information is not provided.

Group 5: Countries examined

The effect of spillover variables on exports may differ across countries. Firms in countries having lower economic and financial development may benefit more from spillover effects, and thus have their export performance impacted more. Accordingly, I group observations into *OECD* and *Non-OECD* countries, with non-OECD countries being the reference category.

Group 6: Industries examined

It may also be the case that certain industries are more impacted from spillovers than others. To explore this possibility, I include industry categories. The majority of estimated effects are for the manufacturing industry (77%). Other categories include *Service*, *IT*, *Food* and *Other_industry* (reference group).

Group 7: Estimation method

A commonly employed factor to explain heterogeneity in estimated effects is estimation method. A variety of estimation techniques were used to generate the estimates in my sample. I construct eight (non-mutually exclusive) categories to classify the different methods: *OLS/GLS* (Ordinary Least Squares/Generalized Least Squares), *Probit/Logit/Tobit*, *Other_estimation*, *Nonspherical*, *Endogeneity*, *Categorical*, *Sample selection* and *Panel_FE*. 71 percent of the estimates come from Probit/Logit/Tobit estimation, and 37 percent from panel fixed effects.

Group 8: Data characteristics

In order to investigate whether data characteristics are responsible for effect heterogeneity, I use the following variables (again, not mutually exclusive) to identify differences in the data used by the original studies: *Panel* (whether the original study used panel data), *Cross-sectional* (whether the original study used cross-sectional data), *Firm-level* (whether the unit of observation in the original study was the firm), *Aggregated* (whether the original study used

observations at an aggregated level like a region or industry), *Sample size* (number of observations), *Time span* (length of sample period used by the original study) and Average year (midpoint of the sample period used by the original study)

Group 9: Control variables

When investigating why firms export, theoretical and empirical studies have emphasized the importance of firm characteristics (e.g. Melitz, 2003; Bernard & Jensen, 2004; Aitken et al., 1997). This category of variables is designed to identify the control variables used by the respective original study. As noted above, spillovers have a variety of mechanisms through which they can affect firms' exports (via labour, technology, production, etc.). Controlling for the quality and other features of the associated factors may affect the size of estimated spillover effects. For this reason, studies commonly include control variables to capture these influences. I create dummy variables for the most common control variables used by original studies: *Firm size*, *Labour quality*, *Capital*, *Productivity*, *R&D investment*.

Group 10: Publication characteristics

The last category of data and study characteristics I include in my analysis is publication characteristics. The quality of a study may affect estimates of spillover effects. For this reason, I include several variables to control for quality: *Published* (whether the study was published in a peer-reviewed journal), *Pubyear* (the year of publication), *Impact* (the RePEc impact factor of the journal) and *Study citations* (the number of Google Scholar citations the study had at the time of my data collection).

3.6 Bayesian Model Averaging

The most straightforward way to investigate which, if any, data and study characteristics can explain the heterogeneity of estimated spillover effects in the literature, is to run a

regression with the dependent variable being the estimated effect, and the right hand side variables consisting of all the variables described in the previous section. However, with 37 explanatory variables (36 data and study characteristics), spurious correlations are bound to occur, and combined with multicollinearity, this makes it difficult to identify the real factors that drive differences in estimated effects. This problem is known as the specification uncertainty issue. To deal with this issue, some researchers have turned to Bayesian Model Averaging (BMA).

With 37 variables, there are 2^{37} possible variable combinations. Conceptually, BMA estimates all possible regression models. Of course, it can't actually run that many combinations, but by employing sophisticated sampling procedures, it can estimate the most important, several thousands of regression specifications and use the results from those regressions to determine probable coefficient values. Specifically, results from thousands of regression equations are averaged, weighted by the relative likelihoods of the respective regressions. The resulting weighted average of a variable's coefficients provides an estimate of that variable's ability to explain differences in estimated effects.

In addition to the weighted average of coefficient estimates ("Posterior Mean"), BMA also reports two other values of interest. The posterior inclusion probability ("PIP") can be roughly interpreted as the probability that a given regressor belongs in the "true" regression. BMA also reports the "Conditional Positive Sign", which can be roughly interpreted as the probability that the respective variable is associated with larger spillover effects.

Figures 3.7 and 3.8 graphically illustrate the results from the BMA analysis. Both analyses use the Random Effects estimator, with the two different weighting schemes ("Weight1" and "Weight2") corresponding to the two figures.[6] The columns in the figure represent individual

[6] According to the results of "forest plot", I prefer to report the RE estimator.

regression models, with the width of the columns representing their relative likelihood. A wider column means that that particular regression model provided a better fit of the data. Variables on the vertical axis are sorted by their posterior inclusion probabilities (PIPs) in descending order. Thus the variables that consistently appear in the best models are listed at the top of the vertical axis. A blue cell indicates that the variable's coefficient is estimated to be positive in that regression. A red cell indicates that the respective estimate is negative. No colour indicates the variable is not included in that particular regression. Thus a row that is consistently blue (red) means that that variable is consistently estimated to be associated with larger (smaller) spillover effects.

In Figure 3.7, we see that the best model includes all the explanatory variables, and has a 14 percent "probability" of being the true model. The top 1000 models, out of 2^{37} models, account for a cumulative inclusion probability of 65 percent. I am particularly interested in the effects associated with the different spillover mechanisms. As is clear from the figure, the variables *Spill_ind*, *Spill_reg*, *Spill_FDI* and *Spill_ex* are consistently estimated to have positive coefficients, meaning that these types of spillover mechanisms are associated with larger spillover effects compared to the reference category, which is all other spillover mechanisms. Note, however, that the figure has nothing to say about the size or significance of the estimated effects. Note also that the variable *Citation* is an example of a variable that is sometimes associated with larger spillover effects and sometimes smaller spillover effects, depending on the particular model it appears in.

Figure 3.8 provides another look, this time using the alternative Random Effects (Weight2) estimator. While the best model once again is estimated to be the model with the full set of regressors, its posterior probability is only 1 percent. The top 1000 models have a cumulative "probability" of including the true model of only 20 percent. Most of the spillover mechanisms

are again associated with larger estimated spillover effects, with the exception of *Spill_ex*, which is now consistently estimated to be associated with smaller effects.

As noted above, while the figures provide some useful insights, they do not provide information about the sizes of the respective effects. Havranek, Rusnak, and Sokolova (2017) recommend the following guide for interpreting the strength of a variable's effect based on its PIP value: PIP values between 0.5 and 0.75 are regarded as "weak" effects. PIP values between 0.75 and 0.95 are regarded as "substantial" effects. PIP values between 0.95 and 0.99 are regarded as "strong". PIP values over 0.99 are regarded as "decisive". However, it should be noted that a variable can have a high PIP value if it is consistently significant in the individual regressions, even though its economic size may be negligible.

The left side of Table 3.6 reports results using the Random Effects (Weight1) estimator. The right side uses the Random Effects (Weight2) estimator. To aid in interpreting the results in the table, I yellow-highlight all those variables where, for both the Weight1 and Weight2 estimates, (i) the PIP indicates that the variable is "decisive", and (ii) the signs of the Posterior Mean are the same. I red-highlight those variables where (i) both PIP values are larger then 0.99, and (ii) the signs of the Posterior Means are different.

Generally speaking, the results are similar for the two estimators. A number of variables are both decisive and have same-signed Posterior Means: *Spill_reg, Spill_ind, Spill_FDI, Service, Value, Employment, Size, Panel,* and *Average Year*. However, recalling that Doucouliagos (2011) set the threshold for "small" at 0.07, the sizes of the respective Posterior Means indicate that most of these variables have very small economic effects.

The two weighting schemes also produce some differences. With Weight1, all the explanatory variables have PIP values larger than 0.75, indicating that all of the variables have a "substantial" influence on the estimated spillover effect. In contrast, with Weight2, the

following variables have PIP values less than 0.75: *Binary* (suggesting that type of export behaviour is not an important determinant of spillover effects), *Manufacturing*, *Output*, *Number*, *Capital*, *Productivity*, *OECD*, *Probit/Logit/Tobit*, *Nonspherical*, and *Impact*. While the signs of the Conditional Mean values of the respective variables are generally the same, there are two variables that are both "decisive" for Weight1 and Weight2, but have opposite signs: *Spill_ex* and *Food.*

In summary, BMA provides an approach to evaluate which potential variables are important in explaining why spillover effect estimates differ across studies. My BMA analysis did identify a number of variables as being consistently "important", based on their PIP values. However, none of the Posterior Mean values achieved sizes of economic importance. Further, the fact that the two weighting schemes occasionally produced different results indicates that further analysis is warranted.

3.7 Meta-regression results

While BMA has its uses, it also has its shortcomings. One shortcoming is that the results do not represent estimates from any one regression. That, of course, is also its strength. However, in MRA, where so many variables are dummy variables whose interpretation depends on the omitted, benchmark category, the fact that the interpretation of the variables changes across BMA regressions can be a problem.

This is particularly relevant if we are interested in multiple-category variables, such as the different spillover mechanism variables. The coefficient of *Spill_reg* means something different when *Spill_ind, Spill_FDI,* and *Spill_ex* are included in the regression, compared to when these variables are omitted. Averaging the respective coefficient estimates can be misleading.

Accordingly, in this last section, I report the results of two sets of regressions. The first set consists of a regression specification that includes all of the data and study characteristic variables, plus the *SE* variable to control for publication bias. The second set of regression equations uses a backwards stepwise algorithm to determine a "best" specification. The stepwise regression procedure employs the Bayes Information Criterion (BIC) to winnow down the full set of variables to the one with the best (lowest) BIC value. BIC has the property that it is asymptotically consistent, choosing the true specification among alternatives as the sample size becomes infinitely large.

Because I am particularly interested in spillover mechanisms, and because I want the interpretation of the respective spillover coefficients to be consistent, I force the stepwise regression algorithm to keep all of the spillover variables in the regression. I estimate this specification using four estimation methods: Fixed Effects (Weight1), Fixed Effects (Weight2), Random Effects (Weight1), and Random Effects (Weight2). In the interests of space, and because of my focus on spillover mechanisms, Table 3.7 only reports estimates for the four spillover mechanism variables.

In comparing the results across estimation methods (columns) and variable specifications (panels) it is apparent that none of the variables are consistently significant across columns and panels. The variable *Spill_reg* comes closest, being significant in four of the eight regressions. It is also consistently positive. However, as we have seen multiple times now, the sizes of the estimated coefficients indicate that the economic importance of this variable is very small: the respective estimates range from 0.002 to 0.009.

Indeed, none of the spillover mechanism variables rise to a level of economic importance in any of the regression equations. As a result, I conclude that none of the spillover mechanisms

are markedly different from the others when it comes to having a substantial, economic impact on spillover effects.

3.8 Conclusion

A belief among many researchers and policy makers is that the economy is characterized by significant externalities. In particular, firms can acquire improved productivity, production cost savings, and new technologies from "spillovers" generated by other firms. Given the importance of exports for economic growth, a substantial literature has risen to investigate whether spillovers can impact firms' export performance.

To investigate that literature, I conduct a meta-analysis. I collect a total of 3,025 estimated spillover effects from 98 studies. While this sample is characterized by a great deal of heterogeneity – different studies employ different variable measurements, model specifications, sample selection and estimation procedures – all of them focus on estimating the effect of spillovers on exports. Because of this heterogeneity, it is not possible to directly compare estimated coefficients across studies. As a result, I follow the widely employed practice of converting coefficient estimates to partial correlation coefficients (PCC).

My analysis produces three main findings. First, I find evidence that the spillover effects reported in the literature are biased, indicating a preference for positive estimates of spillover effects.

Second, I estimate that the mean, true spillover effect is very small. Doucouliagos (2011) suggests that PCC values of 0.07 should be considered "small". I estimate a mean, true spillover effect of approximately 0.02 before correcting for publication bias. Correcting for publication bias makes this even smaller.

Third, while I find that some data and study characteristics are statistically significant determinants of spillover effects, none of the estimates indicate that any of the variables has an important economic effect. In particular, while some of the spillover mechanisms are statistically significant, the associated estimates are never large in absolute size. From a practical perspective, the differences between the respective spillover mechanisms are negligible.

Thus, to borrow the title of another meta-analysis (Zigraiova & Havranek, 2016), my analysis suggests that the relationship between spillovers and exports may be “Much Ado About Nothing”.

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3.10 Appendix

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Table 3.1 Study characteristics

Study	Publication Type	Country	Data Period	Data Type	Dependent Variable	No. of Estimates
Malmberg et al. (2000)	Journal	Sweden	1994	Cs	Export value	24
Koenig (2009)	Journal	France	1987-1992	Panel	Exporter	18
Mayneris and Poncet (2013)	Journal	China	1998-2007	Panel	Exporter	124
Karpaty and Kneller (2011)	Journal	Sweden	1991-2001	Panel	Both	30
Alvarez (2007)	Journal	Chile	1990-1996	Panel	Exporter	15
Barrios et al. (2003)	Journal	Spain	1990-1998	Panel	Both	16
Hu and Tan (2016)	Journal	China	2001-2006	Panel	Both	39
Kinuthia (2016)	Journal	Kenya, Malaysia	2000-2005	Panel	Exporter	14
Harasztosi (2016)	Journal	Hungary	1994-2003	Panel	Exporter	49
Chen et al. (2013)	Journal	China	2001-2003	Cs, panel	Both	42
Choquette and Meinen (2015)	Journal	Denmark	1996-2006	Panel	Exporter	194
Ma (2006)	Journal	China	1993-2000	Panel	Exporter	86
Greenaway and Kneller (2008)	Journal	UK	1990-2002	Panel	Exporter	24
Andersson and Weiss (2012)	Journal	Sweden	1998-2004	Panel	Exporter	103
Kemme et al. (2014)	Journal	India	2001-2006	Panel	Both	15
Anwar and Nguyen (2011)	Journal	Vietnam	2000	Cs	Both	34
Poncet and Mayneris (2013)	Journal	France	1999-2003	Panel	Exporter	66
Sun (2010)	Journal	China	2000-2003	Panel	Both	10
Özler et al. (2009)	Journal	Turkey	1992-2001	Panel	Exporter	1
Kneller and Pisu (2007)	Journal	UK	1993-1999	Panel	Both	42
Kang (2016)	Journal	Chile	2000-2003	Panel	Exporter	57
Bao et al. (2014)	Journal	China	2000-2006	Panel	Exporter	29
Koenig et al. (2010)	Journal	France	1999-2003	Panel	Both	104
Cieślik and Hagemejer (2014)	Journal	Poland	2000-2008	Panel	Both	52
Cassey and Schmeiser (2013)	Journal	Russia	2003	Cs	Export value	4
Mañez et al. (2004)	Journal	Spain	1992-2000	Panel	Exporter	3
Bannòet al. (2015)	Journal	Italy	2005-2008	Cs, panel	Both	15
Antonietti and Cainelli (2011)	Journal	Italy	2003	Cs	Both	36
Buck et al. (2007)	Journal	China	1998-2001	Panel	Both	8
Bernard and Jensen (2004)	Journal	USA	1987-1992	Panel	Exporter	6

Study	Publication Type	Country	Data Period	Data Type	Dependent Variable	No. of Estimates
Cainelli et al. (2014)	Journal	Italy	2004-2006	Panel	Exporter	16
Zhao et al. (2017)	Journal	China	2000	Cs	Both	15
Greenaway et al. (2004)	Journal	UK	1992-1996	Panel	Both	12
Lutz and Talavera (2004)	Journal	Ukraine	1998-1999	Panel	Export value	4
Ito et al. (2015)	Journal	China	2001-2007	Panel	Exporter	26
Vargas (2017)	Journal	Mexico	2004-2010	Panel	Exporter	83
Abegaz (2016)	PhD Thesis	Ethiopia	1996-2010	Panel	Exporter	132
Lutz et al. (2008)	Journal	Ukraine	1997-2000	Panel	Export value	78
Echeverria, R. A. (2006)	PhD Thesis	Chile	1999-2003	Panel	Both	8
Gashi et al. (2014)	Journal	31 transition countries	2002-2008	Cs, panel	Export value	24
Kox (2012)	Working paper	Netherlands	2002-2005	Panel	Exporter	8
Phillips and Ahmadi‐Esfahani (2010)	Journal	Australia	2005	Cs	Exporter	55
Castillo and Silvente (2011)	Working paper	Spain	2000-2006	Panel	Exporter	14
Joseph and & Reddy (2009)	Journal	India	1993-2008	Panel	Export value	32
Lawless (2009)	Journal	Ireland	1985-1999	Panel	Exporter	12
Yi (2014)	Journal	China	2002-2003	Panel	Exporter	32
Farole and Winkler (2013)	Journal	76 low- and middle-income countries	2011	Cs	Exporter	37
Ruane and Sutherland (2005)	Working paper	Ireland	1991-1998	Panel	Both	13
Sun, S., & Anwar, S. (2017)	Journal	China	2005-2007	Panel	Export value	4
Iwasaki et al. (2011)	Journal	Hungary	2003-2005	Panel	Exporter	38
Muñoz-Sepúlveda and Rodriguez (2015)	Journal	Spain	2001-2010	Panel	Exporter	3
Rodríguez-Pose et al. (2013)	Journal	Indonesia	1990-2005	Panel	Both	20
Van Beers and Van Der Panne (2011)	Journal	Netherlands	2001	Cs	Both	12
Díez-Vial and Fernández-Olmos (2014)	Journal	Spain	2010	Cs	Export value	2
Lu et al. (2017)	Journal	China	1998-2007	Panel	Both	2
Greenaway and Kneller (2007)	Journal	UK	1990-1998	Panel	Exporter	1
Silvente and Giménez (2007)	Journal	Spain	1994	Cs	Exporter	46

Study	Publication Type	Country	Data Period	Data Type	Dependent Variable	No. of Estimates
Roper and Love (2002)	Journal	UK, Germany	1991-1994	Panel	Exporter	5
Díez-Vial and Fernández-Olmos (2013)	Journal	Spain	2010	Cs	Both	6
Sun and Anwar (2016)	Journal	China	2002-2007	Panel	Export value	3
Clerides et al. (1998)	Journal	Colombia	1986-1991	Panel	Exporter	6
Burlina (2017)	Journal	Italy	1998-2006	Panel	Exporter	23
Kesidou and Szirmai (2008)	Journal	Uruguay	2004	Cs	Export value	9
Chevassus-Lozza and Galliano (2003)	Journal	France	1995	Cs	Both	10
Mittelstaedt et al. (2006)	Journal	USA	2002	Cs	Exporter	12
García-Cabrera et al. (2017)	Journal	Spain	2006	Cs	Exporter	12
Ciani and Imbruno (2017)	Journal	Bulgaria	2004-2006	Panel	Export value	204
Franco and Sasidharan (2010)	Journal	India	1995-2006	Panel	Both	27
Yang and Tsou (2015)	Journal	China	2004-2006	Panel	Exporter	8
Faruq (2012)	Journal	Ghana	1992-2004	Panel	Exporter	7
Fu (2011)	Journal	China	2000-2007	Panel	Both	54
Todo (2011)	Journal	Japan	1998-2005	Panel	Exporter	1
Braymen et al. (2011)	Journal	USA	2007	Cs	Both	22
Becchetti et al. (2007)	Journal	Italy	1998	Cs	Export value	18
Wang et al. (2014)	Journal	China	2001-2007	Panel	Export value	18
Jung and Lee (2014)	Journal	Korea	1991-1999	Panel	Exporter	9
Duran and Ryan (2014)	Journal	Chile	2001-2004	Cs, panel	Both	61
Conti et al. (2014)	Journal	Italy	2003	Cs	Exporter	43
Aitken et al. (1997)	Journal	Mexico	1986-1990	Panel	Exporter	32
Sahu and Narayanan (2015)	Working paper	India	2000-2014	Panel	Both	8
Yi and Wang (2012)	Journal	China	2002-2003	Panel	Exporter	64
Banga (2006)	Journal	India	1996-2000	Panel	Export value	21
Zhao and Zou (2002)	Journal	China	1994	Cs	Both	2
Becchetti and Rossi (2000)	Journal	Italy	1990	Cs	Both	16
Yang and He (2014)	Journal	China	1998-2007	Panel	Export value	4
Sun (2012)	Journal	China	2000-2007	Panel	Export value	5

Study	Publication Type	Country	Data Period	Data Type	Dependent Variable	No. of Estimates
Opartpunyasarn (2007)	Master thesis	Thailand	2003	Cs	Both	3
Sjöholm (2003)	Journal	Indonesia	1996	Cs	Exporter	26
Sun et al. (2012)	Working paper	China	1998-2007	Panel	Both	6
Ramos and Moral-Benito (2013)	Working paper	Spain	2005-2011	Cs, panel	Exporter	15
De Rosa (2006)	Working paper	Russia	1996-2001	Panel	Both	66
Brunow and Grünwald (2015)	Working paper	Germany	1996-2009	Panel	Export value	119
Benli (2016)	Journal	Turkey	2003-2013	Panel	Both	12
Bacchiocchi et al. (2010)	Working paper	Italy	2005	Cs	Exporter	3
Stojcic et al. (2014)	Journal	Croatia	2004-2010	Panel	Export value	8
Keshari (2016)	Working paper	India	2004-2011	Panel	Exporter	3
Cassey and Schmeiser (2013)	Journal	USA	2003	Cs	Export value	1
Dumont et al. (2010)	Working paper	Belgium	1999-2005	Panel	Exporter	64

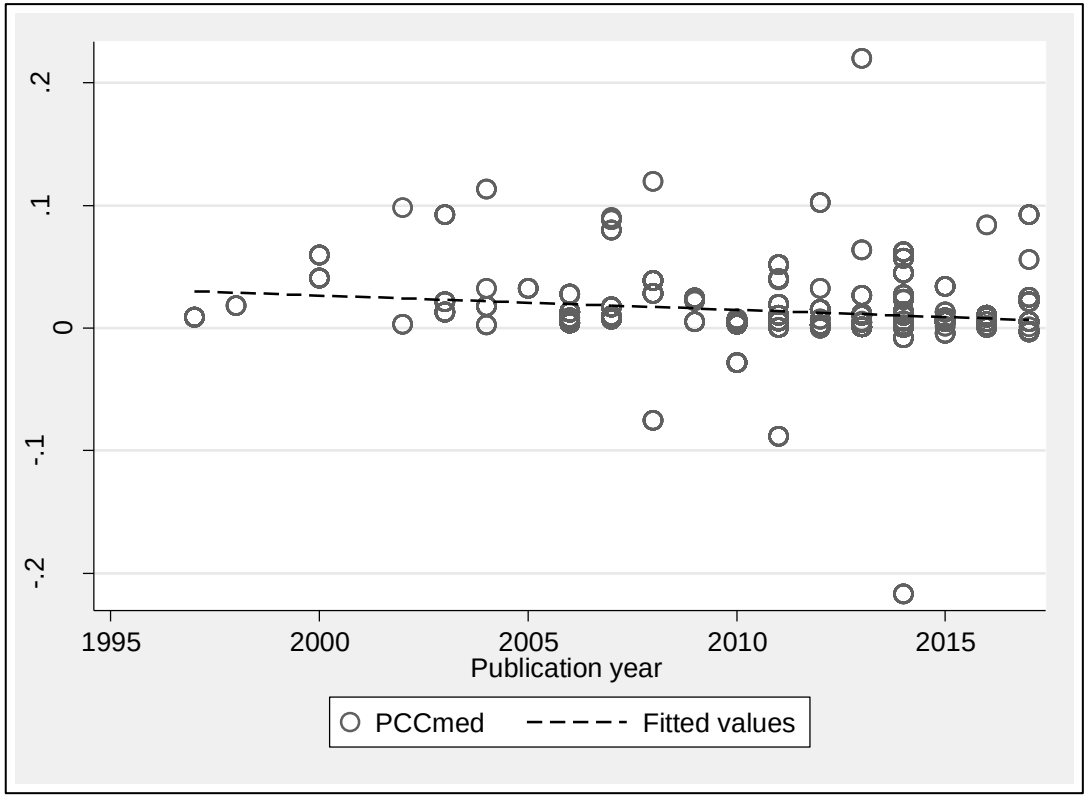


Figure 3.1 Median PCC corresponding to the overall spillover effects on export performance reported in individual studies

Note: The horizontal axis is the year when the study was first published and the vertical axis is median PCC corresponding to the effects of spillovers on export in individual studies. The line presents the linear fit.

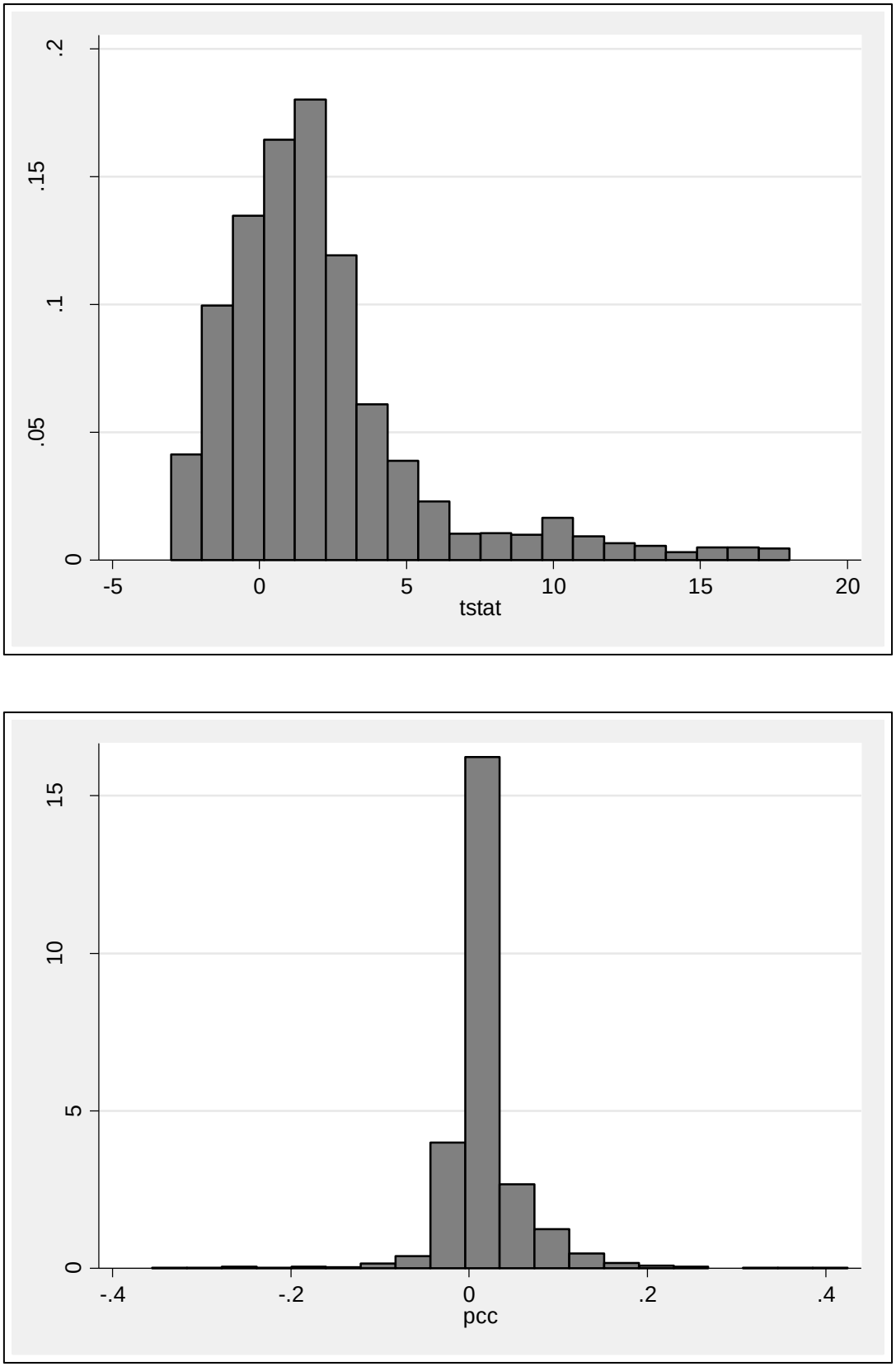


Figure 3.2 Histograms of t-stat and PCC values on overall spillovers

Table 3.2 Selected characteristics of the data

Variables	Observations	Mean	Std. Dev.	Min	Max
t-stat	3025	2.091	3.564	-3.01	18.037
PCC	3025	0.016	0.045	-0.355	0.424
S.E of PCC	3025	0.014	0.019	0.001	0.137
Pubyear	3025	2012	4.222	1997	2017
Mid-point of sample year	3025	2001.4	3.993	1988	2011
Time span	3025	6.281	4.158	1	15

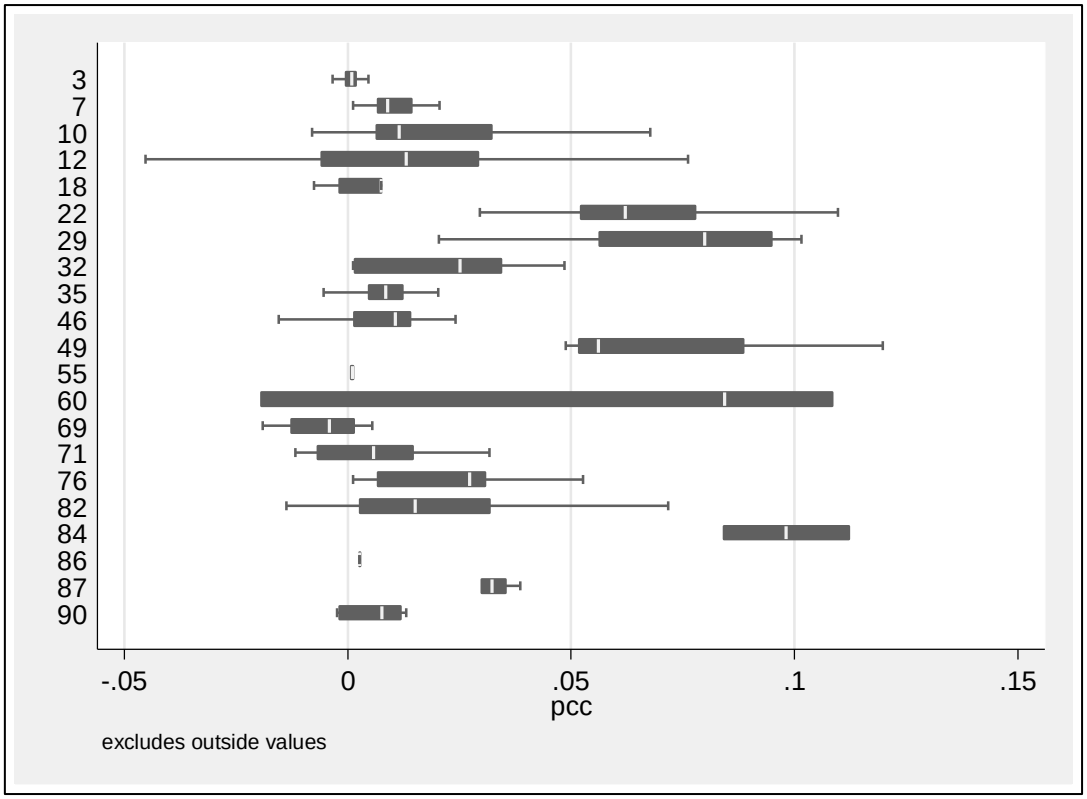


Figure 3.3 Heterogeneity in the estimates of spillover effects for China

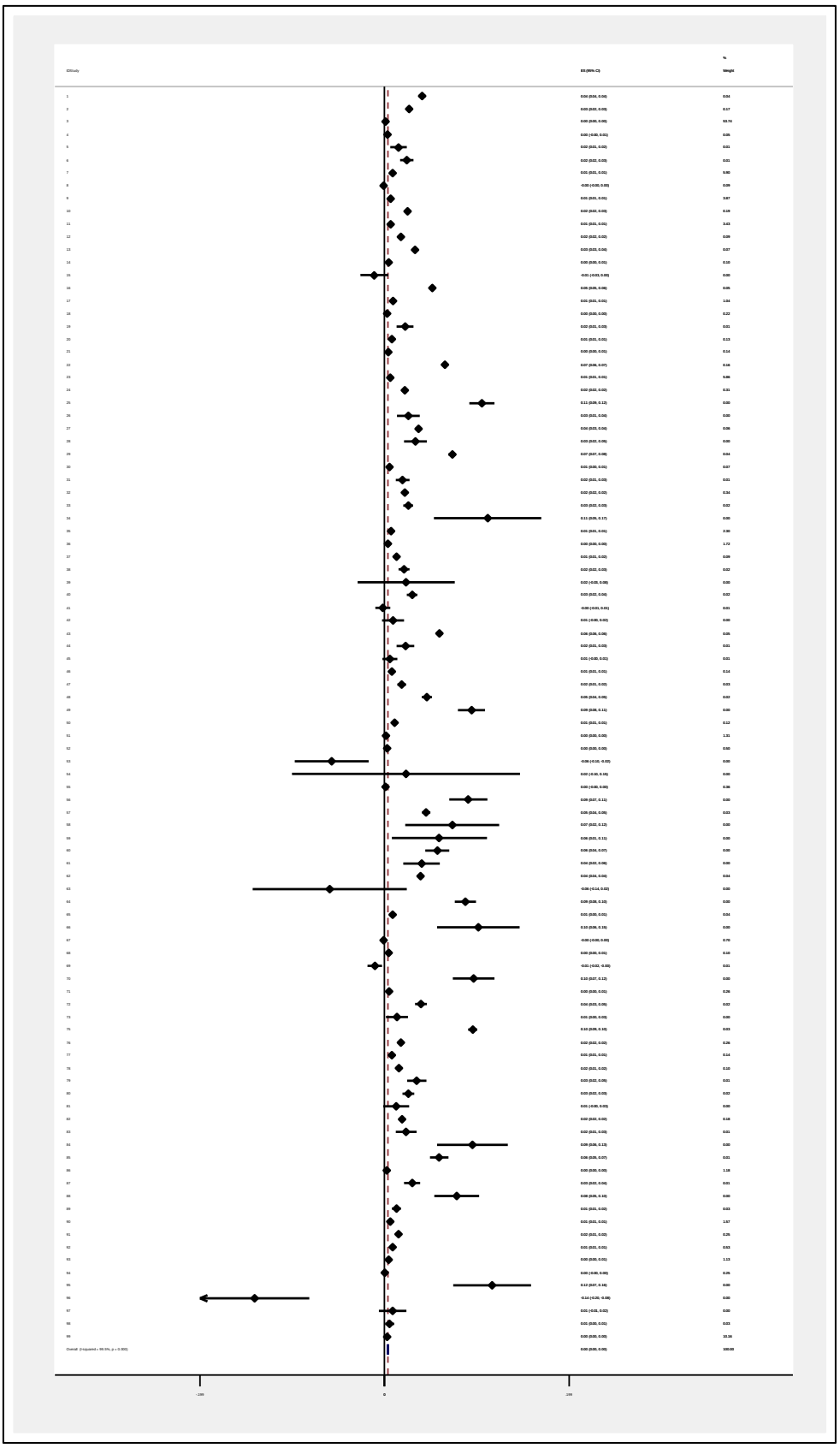


Figure 3.4 Forrest plot of Studies (Fixed Effects)

Table 3.3 Distribution of PCC values by variable values

Variables	Observations	Mean	Std. Dev.	Min	Max
By spillover mechanisms					
Spill_reg	1559	.0183675	.0471953	-.3554379	.4242375
Spill_ind	1574	.0154035	.0425954	-.2483121	.3629302
Spill_FDI	1204	.0151096	.0370397	-.2402756	.3191294
Spill_ex	1640	.0164389	.0356022	-.12309	.4242375
By measure of spillovers					
Value	799	.0121543	.0367075	-.2402756	.4242375
Employment	246	.0127548	.0465713	-.2240095	.2277287
Output	140	.0223494	.0369854	-.0456716	.2316697
Number	1070	.0147548	.0434302	-.2402756	.2626149
R&D_ms	58	.0210041	.0593603	-.2402756	.2569222
Other_ms	746	.0198215	.0516655	-.3554379	.3629302
By type of export performance					
Binary	2048	.0157726	.0390704	-.2048753	.2626149
Export_other	977	.0154018	.0543319	-.3554379	.4242375
By type of response firms					
Domestic	1429	.0133504	.0344243	-.1757937	.2626149
Non-domestic	1596	.0177145	.0519184	-.3554379	.4242375
By country/region					
OECD	1489	.015923	.0428562	-.2240095	.2626149
Non-OECD	1536	.015391	.0461747	-.3554379	.4242375
By industry group					
Manufacturing	2317	.0165756	.0404222	-.2402756	.4242375
Service	89	.0255075	.0391954	-.0646918	.1101912
IT	86	-.0054194	.0750081	-.3554379	.3191294
Food	81	.0092906	.1105024	-.2483121	.3629302
Other_industry	452	.0141317	.0358082	-.2240095	.1893754
By estimation characteristics					
OLS/GLS	826	.0148714	.054019	-.3554379	.4242375
Probit/Logit/Tobit	2149	.0158185	.0407847	-.2483121	.3629302
Nonspherical	662	.0156063	.0460246	-.2402756	.2422852
Endogeneity	380	.0207345	.0574173	-.3554379	.3191294
Categorical	200	.0274315	.0418069	-.0493687	.2154408
Sample selection	204	.083144	.0450775	-.2483121	.3629302
Panel_FE	1121	.0096688	.0273472	-.2267686	.2092325

Variables	Observations	Mean	Std. Dev.	Min	Max
By data characteristics					
Cross-sectional	512	.03603	.0786812	-.3554379	.4242375
Panel	2513	.0115012	.0320887	-.2483121	.3629302
Aggregated	256	.0089111	.0606646	-.2402756	.4242375
Firm-level	2769	.0162762	.0427334	-.3554379	.3629302
By publication characteristics					
Published	2563	.0162809	.0465075	-.3554379	.4242375
Non-published	462	.012169	.0315147	-.2483121	.3629302

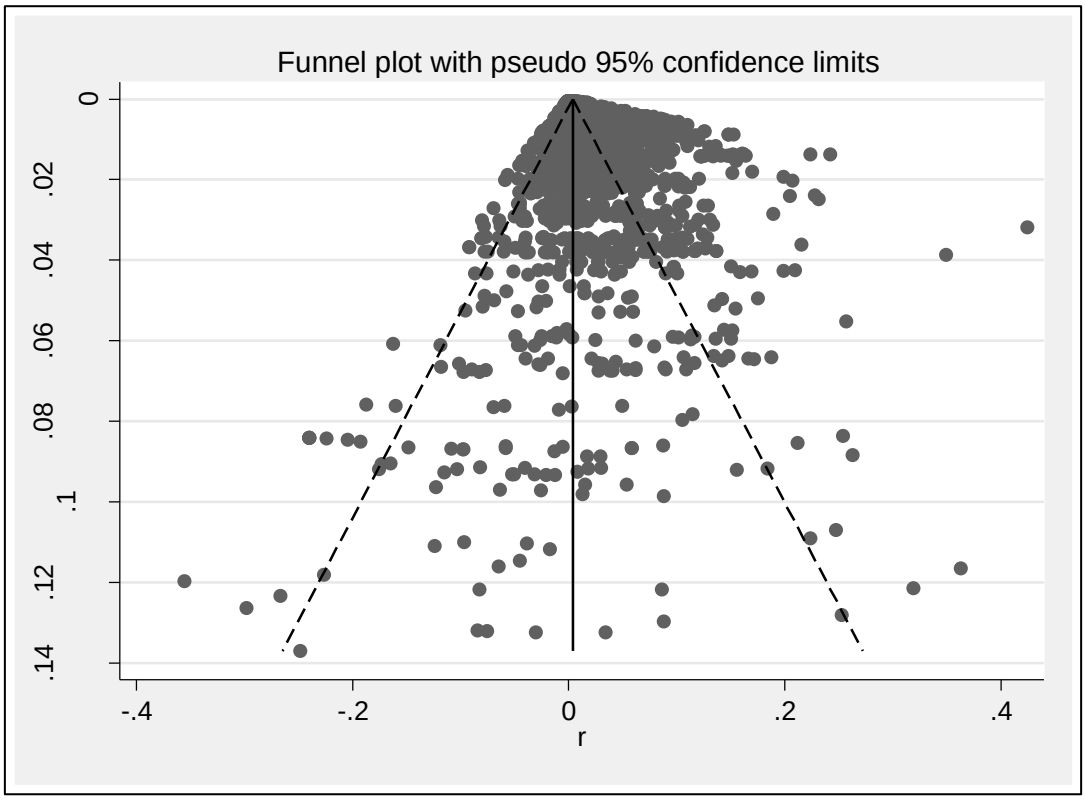


Figure 3.5 Funnel plot for PCC values (all values)

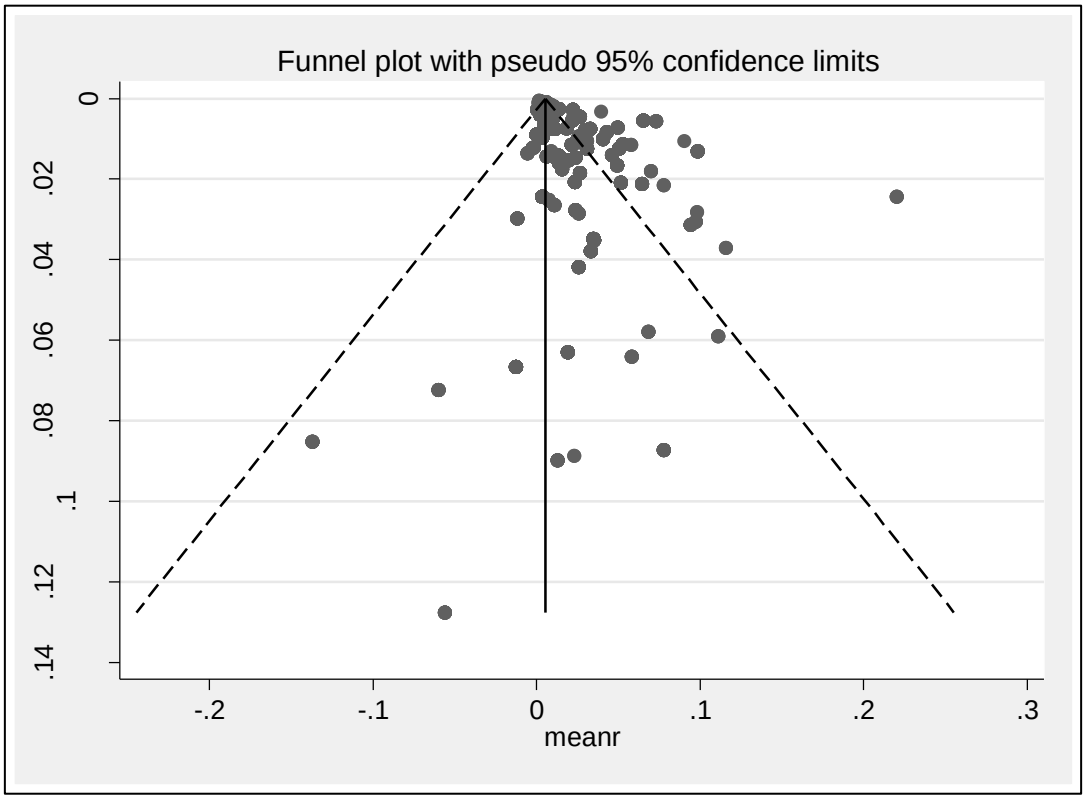


Figure 3.6 Funnel plot for PCC values (study median values)

Table 3.4 Funnel Asymmetry Test (FAT)

	Fixed Effects (Weight1) (1)	*Fixed Effects (Weight2) (2)*	*Random Effects (Weight1) (3)*	*Random Effects (Weight2) (4)*	*Random Effects (Weight1) (5)*	*Random Effects (Weight2) (6)*
(1) FAT	1.684*** *(5.40)*	2.337*** *(7.33)*	0.587*** *(3.18)*	0.733** *(2.54)*	---	---
(2) Mean Effect	0.002 *(1.45)*	0.002** *(2.32)*	0.009*** *(4.14)*	0.017*** *(5.32)*	0.015*** *(6.92)*	0.024*** *(8.66)*
Observations	3025	3025	3025	3025	3025	3025

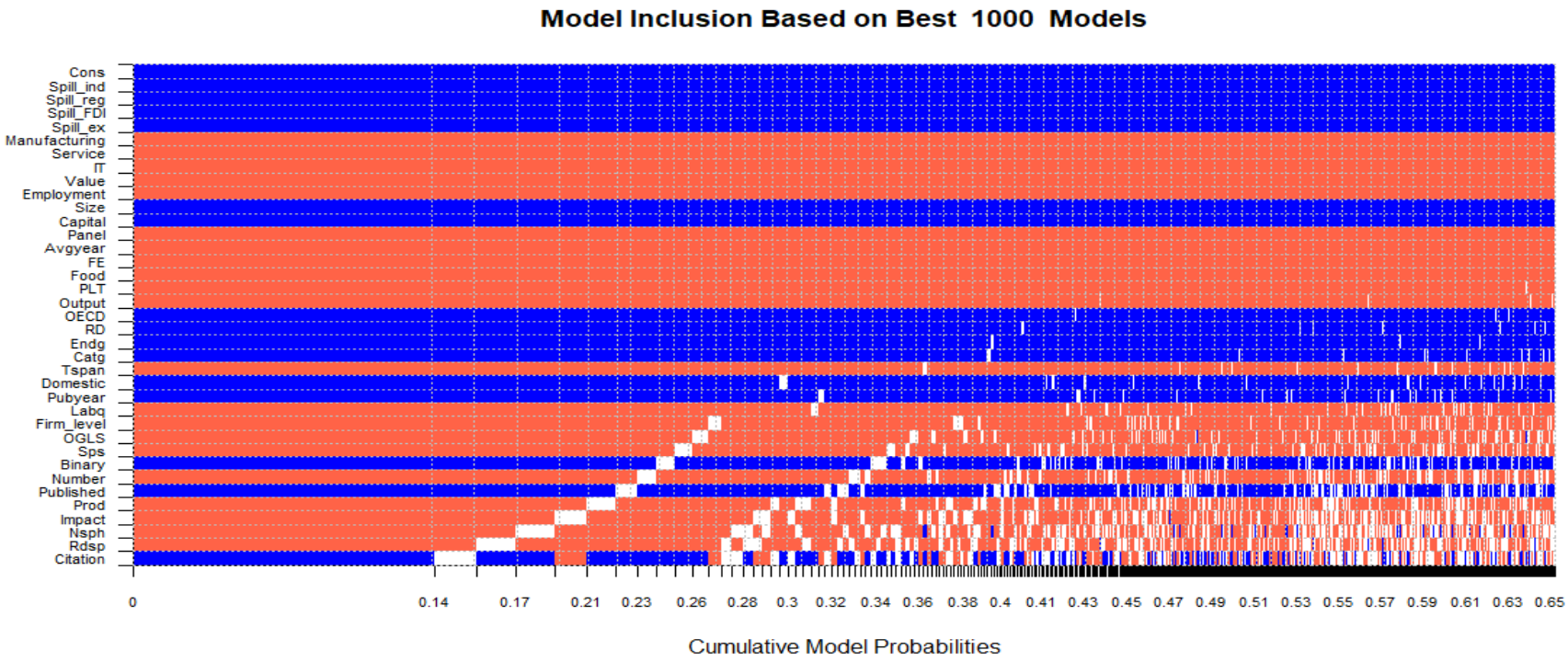
Note: Values in Row (1) and Row (2) come from estimating β_1 and β_0, respectively, in Equation (4). t-statistics in parentheses. Standard errors are clustered by study for all of the estimation procedures. Significance: * 10%; ** 5%; *** 1%.

Table 3.5 Description of study characteristics

Variable	Definition
PCC	The transformed coefficient of the spillover effects on export
S.E. of PCC	The estimated standard error of the partial correlation coefficient
By spillover mechanisms	
Spill_reg	= 1 if spillovers are from same region
Spill_ind	= 1 if spillovers are from same industry
Spill_FDI	= 1 if spillovers are from FDI
Spill_ex	= 1 if spillovers are from exporters
By measure of spillovers	
Value	= 1 if spillovers are measured by export value
Employment	= 1 if spillovers are measured by employment
Output	= 1 if spillovers are measured by output
Number	= 1 if spillovers are measured by number of firms
R&D_ms	= 1 if spillovers are measured by R&D expenditures
Other_ms	= 1 if spillovers are measured by other variables (omitted)
By type of export performance	
Binary	= 1 if the dependent variable is exporter dummy / indicator
Export_other	= 1 if the dependent variable is not binary variables (omitted)
By type of response firms	
Domestic	= 1 if domestics firms' exports are studied
Non-domestic	= 1 if non-domestics firms' exports are studied (omitted)
By country/region	
OECD	= 1 if study examines OECD countries
Non-OECD	= 1 if study examines non-OECD countries (omitted)
By industry group	
Manufacturing	= 1 if data are for manufacturing industries
Service	= 1 if data are for service industries
IT	= 1 if data are for IT industries
Food	= 1 if data are for food industries
Other_industry	= 1 if data are for other industries (omitted)
By estimation characteristics	
OLS/GLS	= 1 if the estimation procedure is OLS / GLS
Probit/Logit/Tobit	= 1 if the estimation procedure is Probit/Logit/Tobit
Other_estimation	= 1 the estimation procedure is other method (omitted)
Nonspherical	= 1 if the estimation methods accounts for nonspherical errors
Endogeneity	= 1 if the estimation methods accounts for endogeneity

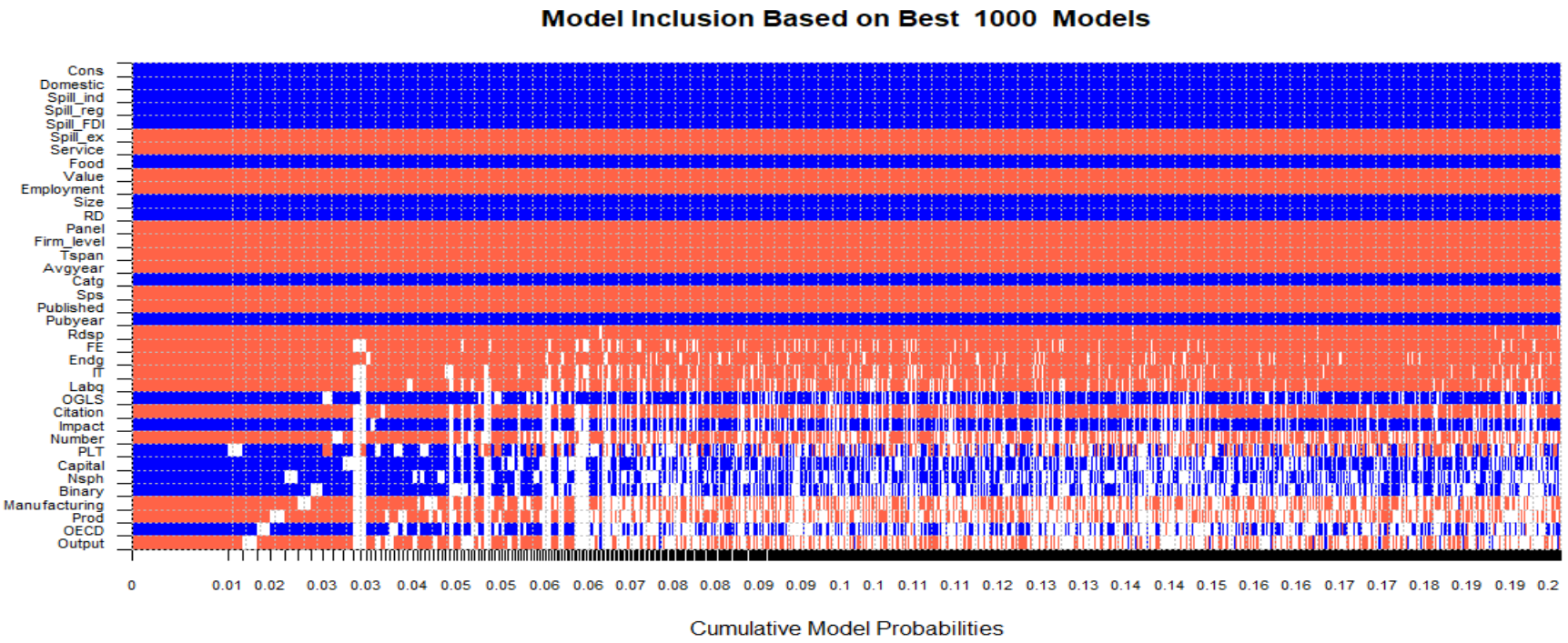
Variable	Definition
Categorical	= 1 if the dependent variable is multinomial variable
Sample selection	= 1 if the estimation methods accounts for sample selection
Panel_FE	= 1 if fixed effects are used in the estimation
By data characteristics	
Panel	= 1 if study uses panel data
Cross-sectional	= 1 if study uses cross-sectional data (omitted)
Firm-level	= 1 if study uses firm-level data
Aggregated	= 1 if study uses aggregated data (omitted)
Sample size	The observations of study
Time span	The length of data period
Average year	Midpoint year of data
Control variables	
Size	= 1 if specification controls for firm size
Labour quality	= 1 if specification controls for firm labour quality
Capital	= 1 if specification controls for firm capital / assets
Productivity	= 1 if specification controls for firm productivity
R&D investment	= 1 if specification controls for firm R&D expenditures
By publication characteristics	
Published	= 1 if the study was published in a peer-review journal
Pubyear	The year of publication
Impact	The RePEc impact factor of the journal. Collected in April 2018
Study citations	The Google Scholar citations of the study. Collected in April 2018

Figure 3.7 Visual Representation of BMA Analysis (*Random Effects-Weight1*)



NOTE: Each column represents a single model. Variables are listed in descending order of posterior inclusion probability (PIP) and have all been weighted according to the *Random Effects – Weight 1* case. Blue indicates that the variable is included in that model and estimated to be positive. Red indicates the variable is included and estimated to be negative. No colour indicates the variable is not included in that model. Further details about this plot is given in Zeugner (2011).

Figure 3.8 Visual Representation of BMA Analysis (*Random Effects-Weight2*)



NOTE: Each column represents a single model. Variables are listed in descending order of posterior inclusion probability (PIP) and have all been weighted according to the *Random Effects – Weight 2* case. Blue indicates that the variable is included in that model and estimated to be positive. Red indicates the variable is included and estimated to be negative. No colour indicates the variable is not included in that model. Further details about this plot is given in Zeugner (2011).

Table 3.6 Bayesian Model Averaging Analysis

Variable	*Random Effects (Weight1)*			*Random Effects (Weight2)*		
	PIP	*Post. Mean*	*Cond. Pos. Sign*	*PIP*	*Post. Mean*	*Cond. Pos. Sign*
Spill_reg	1.00	0.003	1.00	1.00	0.002	1.00
Spill_ind	1.00	0.005	1.00	1.00	0.001	1.00
Spill_FDI	1.00	0.001	1.00	1.00	0.003	1.00
Spill_ex	1.00	0.001	1.00	1.00	-0.006	0.00
Binary	0.89	0.002	1.00	0.52	0.001	1.00
Domestic	0.97	0.003	1.00	1.00	0.009	1.00
Manufacturing	1.00	-0.010	0.00	0.51	-0.001	0.00
Service	1.00	-0.021	0.00	1.00	-0.027	0.00
IT	1.00	-0.017	0.00	0.86	-0.009	0.00
Food	1.00	-0.021	0.00	1.00	0.037	1.00
Value	1.00	-0.009	0.00	1.00	-0.009	0.00
Employment	1.00	-0.009	0.00	1.00	-0.018	0.00
Output	1.00	-0.008	0.00	0.45	0.000	0.03
Number	0.88	-0.002	0.00	0.62	-0.002	0.00
R&D	0.75	-0.001	0.01	0.99	-0.010	0.00
Size	1.00	0.007	1.00	1.00	0.015	1.00

Variable	*Random Effects (Weight1)*			*Random Effects (Weight2)*		
	PIP	*Post. Mean*	*Cond. Pos. Sign*	*PIP*	*Post. Mean*	*Cond. Pos. Sign*
Labour quality	0.96	-0.003	0.00	0.81	-0.003	0.00
Capital	1.00	0.007	1.00	0.60	0.001	1.00
Productivity	0.82	-0.002	0.00	0.48	0.000	0.00
R&D investment	0.99	0.005	1.00	1.00	0.009	1.00
OECD	0.99	0.004	1.00	0.46	0.000	0.98
Panel	1.00	-0.030	0.00	1.00	-0.019	0.00
Firm-level	0.93	-0.005	0.00	1.00	-0.018	0.00
Time span	0.98	-0.001	0.00	1.00	-0.001	0.00
Average year	1.00	-0.002	0.00	1.00	-0.002	0.00
OLS/GLS	0.91	-0.007	0.00	0.76	0.006	1.00
Probit/Logit/Tobit	1.00	-0.014	0.00	0.61	0.000	0.63
Nonspherical	0.75	-0.001	0.04	0.53	0.001	1.00
Endogeneity	0.99	0.005	1.00	0.90	-0.004	0.00
Categorical	0.99	0.006	1.00	1.00	0.015	1.00
Sample selection	0.90	-0.003	0.00	1.00	-0.015	0.00
Panel_FE	1.00	-0.005	0.00	0.91	-0.005	0.00
Published	0.87	0.002	1.00	1.00	-0.015	0.00
Pubyear	0.97	0.001	1.00	1.00	0.001	1.00

Variable	*Random Effects (Weight1)*			*Random Effects (Weight2)*		
	PIP	***Post. Mean***	***Cond. Pos. Sign***	***PIP***	***Post. Mean***	***Cond. Pos. Sign***
Impact	0.80	-0.002	0.00	0.74	0.004	1.00
Study citations	0.75	0.000	0.74	0.75	0.000	0.00

Table 3.7 Meta-Regression Analysis

(*Focusing on Spillover Variables*)

Variable	*Fixed Effects (Weight1) (1)*	*Fixed Effects (Weight2) (2)*	*Random Effects (Weight1) (3)*	*Random Effects (Weight2) (4)*
All Control Variables Included				
Spill_reg	0.002**	0.003**	0.004	0.007
	(2.43)	*(1.98)*	*(1.14)*	*(1.40)*
Spill_ind	0.003**	0.002	0.006**	0.006
	(2.36)	*(1.20)*	*(2.16)*	*(1.26)*
Spill_FDI	-0.002	0.001	0.002	0.002
	(-1.58)	*(0.42)*	*(0.45)*	*(0.51)*
Spill_ex	0.006**	0.005**	0.003	0.003
	(2.47)	*(2.48)*	*(0.97)*	*(0.62)*
Control Variables Selected Via Backwards Stepwise Regression				
Spill_reg	0.002***	0.004**	0.004	0.009*
	(3.72)	*(2.33)*	*(1.10)*	*(1.84)*
Spill_ind	0.002***	0.002	0.004	0.006
	(2.69)	*(1.20)*	*(1.62)*	*(1.23)*
Spill_FDI	-0.002**	0.002	0.002	0.004
	(-2.01)	*(0.75)*	*(0.47)*	*(0.86)*
Spill_ex	0.006***	0.006***	0.004*	0.006
	(3.62)	*(4.64)*	*(1.83)*	*(1.16)*

NOTE: The top panel reports the results of estimating a regression specification with the full set of data and study characteristics, plus the SE variable to control for publication bias. The bottom panel estimates a regression specification in which the variables are selected via a backwards selection algorithm (see the text for details). Note that the four spillover variables are forced into all regression specifications, and only the results for these variables are reported in the table in the interests of space. The top value in each cell is the coefficient estimate, and the bottom value in parentheses is the associated t-statistic. The four WLS estimators (Fixed Effects-Weight1, Fixed Effects-Weight2, Random Effects-Weight1, and Random Effects-Weight2) are described in Section 3. All four estimation procedures calculate cluster robust standard errors. *, **, and *** indicate statistical significance at the 10-, 5-, and 1-percent level, respectively.

Chapter 4. Spillover Effects from Exporters to Chinese Firms: Direct Exporters vs. Intermediaries

4.1 Introduction

In economic models of international trade and heterogeneous firms, productivity plays an important role in a firm's export decision (Bernard, Jensen, Redding, & Schott, 2007; Chaney, 2008; Melitz, 2003; Verhoogen, 2008). If a firm is productive enough to cover the fixed and variable costs of exporting to a particular country, it can become an exporter. The hypothesis of this type of a sorting pattern leads to studies focusing on factors that affect a firm's productivity.

However, there are other factors than productivity that affect the firm's export decision and performance. Barriers to export can also arise due to the costs of gathering information relevant to the export market. The costs of entering a new market include costs associated with acquiring knowledge about demand, such as what products the consumers in the market are more likely to demand, and of how to distribute goods and establish networks abroad. It is possible that the costs of gathering this type of knowledge are reduced when the firm is connected in some way to existing exporters.

External economies exist when the firm benefits from the presence of other firms (Buchanan & Stubblebine, 1962). These external effects can directly improve a firm's productivity or they can lower the cost of information. In regard to new and existing exporters, external economies originating from incumbent exporters are hypothesised to reduce fixed or variable trade costs, aid in technology transfers, stimulate innovation and help firms gain vital information about foreign markets.

The externalities discussed in the literatures of productivity and exports are generally referred to as spillovers or neighbourhood effects. The reasons for the existence of such externalities are many-fold. *Agglomeration* economies feature prominently in the literature and refer to external effects or spillovers that result from many firms being co-located in a geographic region. By locating at the same place as other firms, a firm can take advantage of the local labour market (Duranton & Puga, 2004) and the local infrastructure facilities (Greenstone, Hornbeck, & Moretti, 2010). Firms can also reduce transportation costs due to proximity to local suppliers and/or buyers (Krugman, 1991). *Urbanisation* refers to the advantages derived from all local economic activities while *localisation* refers to the additional advantages that firms derive from the spatial concentration of related industries.

Spillovers from sector-specific technological knowledge or spillovers from information about consumer preferences and markets can be generated through intra-industry linkages (Choquette & Meinen, 2015) or supplier-buyer linkages (Kneller & Pisu, 2007).

Spillover effects may also arise due to the presence of more productive firms, such as multinational enterprises (MNEs). According to Blomström and Kokko (1998), there are three main channels that may create spillovers from MNEs to increase domestic firm's productivity: movements of highly skilled employees from MNEs, learning advanced production technologies from MNEs and updating production techniques due to the competition from MNEs. Foreign direct investment (FDI) affects firms'

economic performance in host countries through direct and indirect technology transfers. Indigenous firms are likely to learn from foreign firms, therefore stimulating more investment in upgrading skills and research and development (R&D) activities (Greenaway, Sousa, & Wakelin, 2004).

Moreover, spillover effects may come directly from exporters. Exporters can be more productive than non-exporting firms and possess more knowledge about foreign destination markets and consumer tastes, both of which can create spillovers. These potential information spillovers can help non-exporters save entry costs, facilitating access to international markets (Koenig, Mayneris, & Poncet, 2010).

A large number of empirical studies have investigated the productivity spillovers from FDI to indigenous firms (Barrios & Strobl, 2002; Girma, 2005; Girma, Görg, & Pisu, 2008; Kathuria, 2000; Kokko, Tansini, & Zejan, 1996; Liu, Siler, Wang, & Wei, 2000; Takii, 2005; Wei & Liu, 2006). In the same vain, I want to investigate whether different spillovers from other exporters affect a firm's export performance. Entry costs of trade, such as acquiring knowledge about foreign demand, establishing distribution networks and investment in R&D on new products that suit the tastes of foreign consumers, affect a firm's capacity to penetrate foreign markets (Hu & Tan, 2016). As these entry costs are associated with knowledge, it is possible that incumbent exporters generate information spillovers and have a positive impact on other firms' export performance.

A large portion of the theoretical trade models and empirical studies that investigate why firms export simply consider all exporters as manufacturers (Bernard, Eaton, Jensen, & Kortum, 2003; Bernard & Jensen, 2004; Lawless & Whelan, 2014; Melitz, 2003), ignoring the prevalence of intermediary firms in international trade.

The role that intermediary firms play in trade has received increasing attention from both theoretical and empirical points of view in the last ten years or so (Ahn, Khandelwal, & Wei, 2011; Akerman, 2010; Blum, Claro, & Horstmann, 2009; Felbermayr & Jung, 2008). Lack of information on how to access specific foreign markets and on the products that could be successful in those markets greatly affects a firm's trade activities and as such is an important barrier to trade. Intermediary firms, possessing informational advantage and specialising in matching manufacturers and consumers across markets, can help firms that cannot afford the trade costs associated with information to participate in international trade markets.

Given the direct role that intermediaries play with knowledge acquisition and distribution, it is natural to think that they could potentially have even a *larger* spillover effect associated with information transfers than manufacturing exporters while, unlike manufacturing exporters, they are unlikely to be a source of any technology transfers. Thus, it is a priori unclear whether exporters would gain more or less from the presence of other intermediary exporters than the presence of other manufacturing exporters. Empirical evidence indicates that intermediary firms promote the extensive margin of trade, that encourage more manufacturing firms to become exporters or to introduce

new goods to new markets (Ahn et al., 2011; Martincus, Estevadeordal, Gallo, & Luna, 2010). However, the impact of intermediary firms on existing exporters, the intensive margin of trade, is still unexplored.

In Chapter 2 of this thesis, I found evidence that intermediaries help less productive Chinese firms transfer from non-exporters to indirect exporters, which implies that intermediaries played a role in increasing the extensive margin of trade. In Chapter 3 I found that the average overall effect of spillovers on exports is statistically significant but economically negligible. I concluded that externalities affecting a firm's export performance are mainly driven by productivity and information spillovers and found that the most effective spillover channel is from other exporters instead of region-specific spillovers, industry-specific spillovers or spillovers associated with FDI. As none of the empirical studies included in the meta-analysis chapter distinguish intermediaries from manufacturing exporters, it remains a question whether intermediary firms and direct exporters differ in terms of the spillovers they create.

Following on the conclusions and findings from my previous two chapters, the purpose of this chapter is to study the spillover effects from exporting firms on incumbent exporting manufacturers' export performance, or intensive margin, as well as to compare the spillover effects from direct exporters and intermediary firms, respectively.

I chose China as my focus due to the availability of the China Customs data that provides firm, good and destination -level information on exports, allowing me to test

a number of different hypotheses on the presence of export spillovers. Also, while my replication chapter looks at how intermediaries promote the extensive margin of Chinese manufacturers, this chapter contributes to the literature by examining the role intermediary firms play in facilitating the intensive margin of Chinese manufacturers.

More generally, this chapter contributes to the somewhat mixed evidence provided by the literature on the effect of spillovers on the intensive margin of exporters. Most importantly, the chapter is the first one to my knowledge to differentiate between the spillovers from other manufacturing exporters and intermediary exporters when studying the intensive margin of firms, further contributing to the understanding of why spillovers exist.

I examine five different spillover sources to shed light on where agglomeration can have the largest potential to help with firms' export behaviour. I start by examining spillovers from geographic proximity to exporters, or general agglomeration, also referred to as urbanisation. Here I do not control for the export markets or goods but only the number of other exporters in the region. My second spillover variable examines the concentration of exporters exporting the same products, or product-specific agglomeration. This spillover variable is calculated for the national data and thus does not control for the region of the exporter. It also does not control for the destination market. The third spillover variable measures regional agglomeration of exporters exporting the same product, also referred to as localisation. This does not control for the destination. The fourth spillover variable measures the local concentration of

exporters with the same destination market, or destination-specific agglomeration. Here I am not controlling for the product. The fifth and final spillover variable measures the local concentration of exporters exporting the same product to the same destination market, or product and destination-specific agglomeration.

I use a firm's export volume as an indicator of the intensive margin[7]. I compare the spillovers from direct exporters and intermediary firms to shed light to why the spillovers exist. As intermediary firms are not involved in the manufacturing process, they cannot provide information on the adoption of new production technologies by foreign firms and thus the likely source of the spillover is reducing the cost of acquiring knowledge. When the spillovers are generated by manufacturing exporters, however, the source of the spillover can be either technology or knowledge based. However, since the size of the knowledge spillover can vary between intermediaries and manufacturing exporters, I have no a priori prediction on which of the spillover effects would be larger overall.

I find positive and statistically significant evidence for all of the above spillover variable types, regardless of whether they originate from direct exporters or intermediaries. I find that destination-specific agglomeration has by far the largest effect on the intensive margin of an exporter, irrespective of the firms being in the same industry as the exporter. I find only small differences between direct exporters and

[7] Other indicators commonly used to measure intensive margin include export value, export value as a ratio of total sales and export volume as a ratio of total output. I discuss in Section 4 why I chose export volume rather than value as my indicator. The other two indicators were not available due to me not having information on total sales and output.

intermediary exporters in the ability to create spillovers, which indicates that information externalities are likely to be more important than technology transfers are.

The remainder of this chapter is structured as follows. Section 2 presents a brief review of the relevant literature. Section 3 describes the data and explains the measurements of variables used in this study. Section 4 discusses the econometric specification and estimation method. The results are reported in Section 5. Robustness checks are performed in Section 6. Section 7 summarises and concludes.

4.2 Literature review

4.2.1 Spillover effects from exporters

There are many channels through which the different spillovers are theorised to affect exports. Geographical proximity to other exporters can produce spillovers that bring benefits in terms of lower costs (Aitken, Hanson, & Harrison, 1997) and increased knowledge about foreign markets and consumers (Kneller & Pisu, 2007). Locational concentration of exporters can make it feasible to build specialised transportation infrastructure, such as roads, railways, ports, airports and storage facilities (Duranton & Puga, 2004). Proximity to foreign firms is likely to result in imitation by indigenous firms, therefore promoting skill upgrade and research and development (R&D) activities (Greenaway et al., 2004). In summary, spillovers can affect a firm's export performance through cost-sharing or information sharing mechanisms (Koenig, 2009).

There are different ways to quantify the activity that is a potential source of spillovers. The most commonly used variables count the value of exports or the number of firms partaking in exporting. An example of the former is Aitken et al. (1997) who use a variable that measures a state's share in total industry exports as a ratio of its share in overall manufacturing exports to see if there are local export spillovers[8]. De Rosa (2006) uses the export share in the value of output in a given industry and region to measure agglomeration of manufacturing exporters. Lawless (2009) uses total value of exports in an industry to control for spillovers. Kemme, Nikolsko‐Rzhevskyy, and Mukherjee (2014) employ the share of MNE exports in the total exports of the region to capture FDI export spillovers within the region.

Amongst studies that use the number of exporters instead of the value of exports, Bernard and Jensen (2004) use the share of exporting firms in a given SIC4 industry in the total number of firms outside the SIC4 industry in a given state to capture region-specific spillovers. Silvente and Giménez (2007) count the number of domestic plants operating in the same province and industry and exporting to the same destination country to build a measure of localisation economies. Greenaway and Kneller (2008) use the number of exporting firms in various combinations of regions and industries to construct agglomeration effects. Koenig et al. (2010) calculate the number of other exporting firms to capture general, destination-specific, product-specific and product and destination-specific spillovers, respectively. Cassey and Schmeiser (2013) employ

[8] Local export concentration = $\frac{State-industry\ share\ of\ national\ industry\ exports}{State\ share\ of\ national\ manufacturing\ exports}$

the number of firms in the region exporting to the same country to measure agglomeration.

Other approaches used to capture spillover effects do not count either the exports or the number of exporting firms. For instance, Ruane and Sutherland (2005) use total MNE employment in a sector to measure industry-specific FDI spillovers. Buck, Liu, Wei, and Liu (2007) compute the ratio of intangible assets owned by foreign firms in fixed assets in an industry to capture R&D spillovers. Last, Özler, Taymaz, and Yilmaz (2009) employ the share of outputs by exporters in the same industry to capture export spillovers.

Empirical studies predominantly find that firms involving in exports are more efficient than their counterparts only serving the domestic market (Bernard & Jensen, 1999; Bernard, Jensen, & Lawrence, 1995; Clerides, Lach, & Tybout, 1998). One view is that exporters have an advantage in acquiring knowledge of new production technologies and product designs from their contacts with international trade markets. Then, apart from the self-selection process of more productive firms entering export market, firms can further benefit from learning by exporting after becoming exporters (Aw, Chung, & Roberts, 1998). If exports can facilitate technology transfers abroad, does the rest of the economy gain from these exporters?

A large number of research articles have explored whether exporters can generate spillovers to either the extensive margin or the intensive margin of an exporter. The extensive margin includes decisions to start exporting, to start exporting to a new

destination market and to start exporting a new product to a country. The intensive margin, on the other hand, relates to the decision to grow the value of exports, which can happen either through an increase in price or an increase in export volume.

There is no consensus in the findings in the literature, however - while some studies provide supportive evidence of positive spillover effects from exporters on other firms' export participation, others report weak external impact. For instance, among studies that examine the external margin, Aitken et al. (1997) examine whether localised spillovers associated with exporters affect the export propensity of Mexican manufacturing plants. They find positive effects from the export activity of multinational enterprises specifically but no spillovers when all exporters are included. Clerides et al. (1998) demonstrate that the foreign market participation decision of firms in Colombia, Mexico and Morocco is positively affected by the agglomeration of nearby exporters. Firms in an export-intensive region or industry can benefit from the externality of exporters but these externalities do not improve the firm's productive efficiency. Mañez, Rochina, and Sanchis (2004) consider three different spillover types generated by exporting firms - region-specific, industry-specific and region and industry-specific spillovers - and find that regional and local spillovers have a positive influence on a firm's export probability in Spanish manufacturing industry. Also, Koenig (2009) reports a positive relationship between the agglomeration of exporters and the decision to start exporting for French firms when the local firms are exporting to the same destination market. Similar supportive evidence can also be found in

Belgium (Dumont, Merlevede, Piette, & Rayp, 2010), Poland (Cieślik & Hagemejer, 2014), Denmark (Choquette & Meinen, 2015) and Hungary (Harasztosi, 2016) amongst other countries.

However, Bernard and Jensen (2004) find no evidence that U.S. manufacturing firms drew support from export spillovers to increase the probability of exporting. Silvente and Giménez (2007) find support for spillover effects from domestic firms operating in the same region, same industry and exporting to the same destination when studying the extensive margin of Spanish small and medium sized enterprises (SMEs), but find no evidence of externality from MNEs operating in the same region, same industry and exporting to the same destination, or other firms in the same region and exporting to the same destination.

While research on the effects of spillovers from exporters on the decision to enter a new export market, or the extensive margin, does not come to a unified set of conclusions, the empirical evidence of the relationship between export spillovers and the intensive export margin is also mixed. Malmberg, Malmberg, and Lundequist (2000) find that the export value of Swedish manufacturing firms in 1994 is positively affected by the agglomeration of exporting firms. Chevassus-Lozza and Galliano (2003) study the impact of local exporting firms operating in the same industry on the export share of other firms and find positive export spillovers in the French food industry in 1995. Similarly, De Rosa (2006) find that Russian manufacturing firms' export share over 1998-2001 was positively related to the agglomeration of other exporters in the same

region and sector. Similar supportive evidence on the role of export spillovers on the intensive margin has also been found for Indonesia (Rodríguez-Pose, Tselios, Winkler, & Farole, 2013) and Italy (Bannò, Giuliani, & Zaninotto, 2015).

However, Barrios, Görg, and Strobl (2003) find little evidence to demonstrate that Spanish manufacturing firms increased their export intensity with the intra-sector spillovers from other exporters over the period 1990-1998. Ruane and Sutherland (2005) even report a negative relationship between MNEs' exporting activities and the export intensity of manufacturers in Ireland between 1991 and 1998. Investigating both the extensive and intensive margins, Koenig et al. (2010) demonstrate that the presence of externalities generated by local exporters promotes more French manufacturers to start to export but not the export volume of incumbent exporters, thus finding support for the extensive margin but not the intensive margin. Similarly, studying the exports of Indian IT firms between 2000 and 2006, Kemme et al. (2014) find no role for the local MNEs' export activities in increasing the volume of exports of other firms.

When it comes to studies about China, Ma (2006) uses Chinese provincial data from 1993 to 2000 to examine the impact of export spillovers associated with MNEs on the probability of exporting by domestic firms. Sun (2010) uses firm-level annual survey data over the period 2000-2003 to study the relationship between domestic Chinese firms' export decision and export intensity and industry-specific FDI spillovers. Chen, Sheng, and Findlay (2013) use the same dataset to study how the FDI spillovers sourced from horizontal and vertical industries affect Chinese manufacturing firms'

export participation decision and export value. Sun and Anwar (2017) focus on Chinese firms in textile manufacturing industry and estimate the effect of FDI spillover in the same 4-digit industry on firms' domestic and export market revenue. While these studies investigate the impact of manufacturing activity or export activity of MNEs on Chinese firms' export performance, my study focuses on the spillovers specifically sourced from export activity of intermediary firms, as well as comparing the spillover effects from manufacturing firms and intermediary firms.

4.2.2 The role of intermediaries

It is commonly assumed in the theory of international economics that trade occurs between producers and final consumers. While most major trade models hold this view of exchange, how goods are actually traded is far from being this simple. The greatly successful role that Japanese trading companies played in helping domestic manufacturers to penetrate foreign markets drew trade policy makers' attention to trading companies. It stimulated the imitation of the Japanese trading company model in many countries, including Brazil (da Costa Pinto, 1983) and South Korea (Cho, 1984) and the formation of related export-stimulation programs in the U.S (Golden Jr & Kolb, 1982).

Many policy makers believe that domestic manufacturers can benefit from managerial assistance or assistance with placing export orders from these export-trade-service companies, and eventually, with enough experience of exporting with the help

of an intermediary, the firms may be ready to begin exporting directly (Bilkey, 1978). However, early studies pay more attention to the theory of the role that intermediaries play and its potential benefits to manufacturers, and there is still very little if any empirical evidence to about this link.

Intermediaries are specialist-service firms connecting domestic manufacturers and foreign consumers (Oviatt & McDougall, 1994). Due to the lack of resources and knowledge about foreign markets, SMEs in particular have difficulty with participating in trade markets directly, but using intermediary firms can be an effective way to help them indirectly reach foreign buyers.

From the perspective of transaction cost, Peng and Ilinitch (1998) put forward some propositions on why manufacturers select intermediaries as their export channel. Producers may be more likely to depend on intermediary firms to enter more distant and unfamiliar markets where search costs associated with export market research are higher. Additionally, the decision whether or not to use an intermediary firm depends negatively on the presence of monitoring and enforcement costs in the particular industry. Specifically, in the case of exporting, industries with higher value-added and more differentiated content are involved in more monitoring and enforcement costs and are therefore less likely to use intermediaries than industries that produce low-value-added and/or homogeneous products. Feenstra and Hanson (2004) also support the hypothesis that reducing information costs is the main incentive for buyers and sellers to trade through intermediaries. Furthermore, intermediaries can help exporters save

transportation costs, lower the risks associated with long-distance travel and employ entrepôts to process goods when necessary.

Other research on intermediary firms provides theoretical and empirical evidence to explain the mechanisms behind intermediated trade. Felbermayr and Jung (2008) develop an export choice model to explain how producers export to foreign markets. They find that the choice of intermediation technology depends on firm characteristics, such as productivity, perceived quality of products, variable production costs and marketability of goods, as these may affect contractual frictions. Additionally, they predict no correlation between prevalence of trade intermediation and destination country's distance, market size or wage rates.

Akerman (2010) builds a theoretical model to allow for the existence of an intermediary sector and use Swedish wholesalers as an example to analyses the role of intermediaries in productivity sorting. He finds that the most productive firms export directly, while the firms of intermediate productivity levels export through international wholesalers. Similarly, Ahn et al. (2011) demonstrate the pattern of intermediated trade in China in 2005. They provide supportive evidence for the role of intermediaries in productivity sorting. Furthermore, they find a positive relationship between intermediary export shares and destination country's distance, tariffs and a measure of fixed costs and a negative relationship between intermediary export shares and destination GDP and an inverse measure of information barriers.

Empirical studies on intermediaries focus on their impact on the intensive margin as well. Abel - Koch (2013) finds empirical evidence that supports the recent theories predicting intermediated trade pattern. Producers introducing new products to foreign markets, or producing low quality goods, are more likely to draw support from trade intermediaries in Turkey in 2005. Using Italian firm-level trade data over 2000-2007, Bernard, Grazzi, and Tomasi (2015) document how export volumes are shaped by intermediaries and manufacturers across products and countries and suggest that wholesalers, a subset of export intermediaries, have an advantage in countries with higher destination-specific fixed costs. Furthermore, compared to direct manufacturing exporters, wholesalers have larger sunk entry costs and are thus less responsive to exogenous shocks. Additionally, Ahn et al. (2011) give supportive evidence that intermediaries can promote the extensive margin of direct trade, that is starting to export directly after using intermediaries. However, to the best of my knowledge, the effect of intermediation on the intensive trade margin of incumbent manufacturers that are directly exporting to foreign markets is yet to be studied.

4.3 Data and variables

I use firm-level trade data over the 2000-2005 period, collected by China's General Administration of Customs (GAC). The dataset records Chinese firms that were involved in international trade and reports rich and detailed trade information for each firm-product-partner transaction associated with export activities of the firms. Products are classified at the HS-6-digit level, and the dataset includes trade values (in US dollar),

quantities and prices for each firm-product-partner pair. The dataset also includes the firm's name as well as a unique 10-digit identifier, making it possible to conduct comparisons across time periods. Furthermore, the dataset includes the destination country of each transaction. The dataset also reports the geographical information where a firm is located, including 22 provinces, 5 autonomous regions and 4 municipalities but excluding Hong Kong, Macau and Taiwan.

I construct five different measurements of export-related activity that I use to test the presence of spillover effects in my empirical study, which I call spillover variables. All of the measurements are based on the number of exporting firms, instead of the value of exports, and use the information I have on an exporter's location, product and trading partners. According to the findings in my meta-analysis chapter, the number of exporters is the most commonly used measure in the empirical spillover studies - about 35% of the observations I collected use this measurement. Thus, following the existing literature (Greenaway & Kneller, 2008; Koenig et al., 2010), I use the number of exporters instead of the value of the exporters' exports.

For each of the firm-year pairs in the dataset, I construct five spillover variables to measure different potential sources of spillover. Furthermore, each of the spillover variables is expressed separately for all exporters, direct exporters and intermediaries, respectively. This gives me 15 different measurements for each firm-year pair, which allows me to test more accurately whether spillovers are product-specific, region-

specific, destination specific or a combination thereof as well as if the size of the spillover depends on whether or not the exporter is a direct exporter or an intermediary.

The first spillover variable, **region-specific** (*sp_reg*), counts the number of exporting firms located in the same province as the observed firm. The second spillover variable, **product-specific** (*sp_p*), counts the number of firms exporting the same HS6 product as the observed firm. The third spillover variable, **regional product-specific** (*sp_rp*), counts the number of firms located in the same province and exporting the same HS6 product as the observed firm. The fourth spillover variable, **regional destination-specific** (*sp_rc*), counts the number of firms located in the same province and exporting to the same destination market as the observed firm. The fifth spillover variable, **regional product-destination-specific** (*sp_rpc*), is defined as the number of firms located in the same province and exporting the same HS6 product to the same destination market as the observed firm. All of these spillover variables are expressed in logged values in the empirical study.

A key interest for my empirical study is to find out if and where intermediary firms create spillovers. A firm is classified as an intermediary firm if it acts as an agent that buys from suppliers to sell to final consumers or if it acts as an intermediary that helps connect buyers and sellers, such as looking for suppliers, finding and stimulating buyers, choosing buy and sell prices, deciding the terms and conditions of transactions, managing payments or holding inventories (Spulber, 1996). Intermediaries can include

wholesalers, retailers, agents or brokers, and an intermediary may or may not take ownership of the product, service or property that they help to intermediate.

However, the dataset I use does not make clear the exact nature of a firm's business, including whether or not it can be classified as an intermediary. Therefore, following Ahn et al. (2011), I use a method that identifies a firm as an intermediary firm if its name includes a term that translates into "importer", "exporter" and/or "trading". This allows me to categorize exporting firms into direct exporters and intermediary firms to study if the spillover effects are different depending on whether the other firms in the industry are intermediaries or direct exporters.

Accordingly, the first five of my spillover variables count the number of exporters to capture spillovers from all firms (*sp_reg*, *sp_p*, *sp_rp*, *sp_rc* and *sp_rpc*), the next five spillovers count the number of manufacturing exporters to capture spillovers from the firms directly involved in trade (*sp_reg_d*, *sp_p_d*, *sp_rp_d*, *sp_rc_d* and *sp_rpc_d*) and the last five of my spillover variables count the number of intermediary firms to capture spillovers sourced from intermediation (*sp_reg_i*, *sp_p_i*, *sp_rp_i*, *sp_rc_i* and *sp_rpc_i*).

I use two gravity variables as control variables - *GDP* as an indicator of destination country's market size and *Distance* to measure the geographical distance between China and the firm's trading partner. The exact definitions of these variables as well as the spillover variables are given in Table 4.1.

Table 4.2 reports summary statistics on the number of all Chinese exporters, direct exporters and intermediaries from 2000 to 2005. All of the three exporter types - all exporters, direct exporters and intermediaries, witnessed an increase in number during the study period. The number of all exporters grew by 129%, from 62,771 in 2000 to 144,030 in 2005. Out of the total exporters, the number of direct exporters grew 123%, from 54,739 in 2000 to 121,931 in 2005, and the number of intermediary firms grew 175%, from 8,032 in 2000 to 22,099 in 2005.

It is clear that intermediary firms became more important in China's international trade during my study period. The share of intermediary firms in total exporters accounted for 12.8% in 2000, climbed to 16.6% in 2004 and then slightly declined to 15.3% in 2005. Although the average share of intermediaries in all exporters is only 14.45%, they can still play a significant role in international trade.

Furthermore, according to Ahn et al. (2011), the method I use to identify intermediation technology may underestimate the number of intermediary firms involved in exporting as identification solely relies on the firm having a specific word in its name. Also, direct exporters may draw support from foreign intermediary partners, which will not be evident in my dataset. Therefore, it is likely that there are more intermediaries in export market than I can observe in my data.

Table 4.3 describes summary statistics for the five different export spillover variables used in the estimation. Not surprisingly, the table shows that the number of exporters decreases as the spillover variables become more specific. The average

number of firms potentially generating region-specific spillovers in each province is 19,713 out of which 15,379 (78%) are direct exporters and 4,334 (22%) are intermediary firms. When it comes to product-specific spillovers, the mean number of firms exporting the same HS6 product is 2,000 out of which 1,123 (56.2%) are direct exporters and 877 (43.9%) are intermediary firms. In terms of regional product-specific spillovers, there are on average 582 firms exporting the same product in the same province, out of which 341 (58.6%) are direct exporters and 241 (41.4%) are intermediary firms.

When I put constraints on the destination, the average number of firms exporting to the same destination in the same province is 5,169, among which 4,084 (79%) are direct exporters and 1,085 (21%) are intermediary firms. Last, on average 129 firms in the same province export the same product to the same destination, potentially generating regional product-destination-specific spillovers to other exporters, out of which 80 (62%) are direct exporters and 49 (38%) are intermediary firms.

I can observe from these statistics that product-specific spillover variables are associated with a higher share of intermediary firms than spillover variables that are region or destination specific only. This observation is probably due to the findings that intermediaries export more products than direct exporters (Ahn et al., 2011; Akerman, 2010). Intermediary firms do not produce goods by themselves and can pool the trade costs across more than one good, therefore possessing a wider product scope than manufacturers.

Figure 4.1 further presents the histograms for all the spillover variables. It shows the similar distribution among all exporters, direct exporters and intermediaries within the same group of spillovers. Also, it displays the heterogeneity in the distribution across different groups of spillover variables.

4.4 Econometric Specification and Estimation methods

The main purpose of this chapter is to identify the existence and magnitude of export spillovers on the export internal margin of Chinese exporters. I want to understand what type of agglomeration is most likely to generate spillovers – whether it is region, product or destination specific or a combination thereof. I also want to compare the spillover effects between direct exporters and intermediary exporters to shed some light on whether spillovers stem from technology transfers or knowledge transfers.

To measure the intensive margin of trade, I use export volume following Lutz and Talavera (2004), Lutz, Talavera, Park, and Trade (2008), Koenig et al. (2010) and Hu and Tan (2016). Crozet, Head, and Mayer (2011) demonstrate that quality can raise firm-level prices and export values, which indicates that high-quality firms exporting more is likely due to them being able to charge a higher price rather than exporting a larger quantity. Therefore, in order to avoid the issues that are associated with using export values, such as firm-level quality sorting and price issues, I chose export volume as a proxy for the intensive margin of trade.

In order to examine the spillover effects on the intensive margin of exports, I use the following empirical model:

$$lnExport_{irjpt} = \alpha lnSpillovers + \mu_{ijp} + \gamma_t + \varepsilon_{ijpt}, \quad (1)$$

where subscript i refers to firm, r to region, j to country, p to product, t to year. $Export_{irjpt}$ is the export quantity of firm located in province r at the country-HS6 product level. $Spillovers$ includes one of the spillover variables calculated for all exporters, direct exporters and intermediaries, respectively. These include the region-specific spillover variables (*sp_reg*, *sp_reg_d* and *sp_reg_i*), product-specific spillover variables (*sp_p*, *sp_p_d* and *sp_p_i*), regional product-specific spillover variables (*sp_rp*, *sp_rp_d* and *sp_rp_i*), regional destination-specific spillover variables (*sp_rc*, *sp_rc_d* and *sp_rc_i*) and regional product-destination-specific spillover variables (*sp_rpc*, *sp_rpc_d* and *sp_rpc_i*). μ_{ijp} is the firm-product-country fixed effect and γ_t is the year fixed effect. I use ordinary least squares method of estimation, controlling for the firm-product-country fixed effects and the year fixed effects.

It is worth to mention the importance of addressing the estimation issues that might cause endogeneity. Firstly, the existence of omitted variables should be solved. In the literature studying firms' export performance, firm characteristics, such as productivity, size, wage, capital intensity and R&D intensity, are found to be important in explaining why and how much firm exports (Barrios et al., 2003; Bernard & Jensen, 2004). Ideally, my empirical model is supposed to control as many of these firm characteristics as possible. However, due to the unavailability of the information on firm characteristics,

I am unable to include these variables in this study. Similarly, any characteristics common to the industry and the destination country are likely to affect the relationship between export and spillover variables. In addition, it is necessary to control for the shocks that might affect the export-spillover coefficient. Therefore, I include the firm-product-country fixed effects and the year fixed effects to control for the time-invariant unobserved variables.

Secondly, in estimating the effect of various spillover variables on firm's export quantity, simultaneity needs to be considered. Reverse causality could lead to the estimation bias. Instrumental-Variable (IV) techniques are commonly employed to address this issue. To find out effective IV, it would need an explanatory variable that is highly correlated with the spillover variable, but uncorrelated with the error term. Unfortunately, such good instruments are difficult to find and not available in the key dataset I use – China Customs Data.

By including the firm-product-country fixed effects and the year fixed effects, I believe that I have, to some extent, addressed the endogeneity issues. Also, I cluster all regressions at the level of a country to avoid bias in the estimation of standard errors.

4.5 Results

4.5.1 Region-specific spillover effects

Table 4.4 reports the impacts of region-specific spillovers on firms' intensive margin of exports. After controlling for firm-product-country fixed effects and year

fixed effects, all spillover variables from exporters in the same province show positive and statistically significant effect on the observed firm's export volume. A 10% increase in the number of all exporters in the province enhances a firm's export volume in a country-HS6 product pair by 0.77%. The coefficient of region-specific spillovers from direct exporters in the same province indicates that a 10% increase in the number of neighbouring firms directly exporting to foreign markets promotes a 0.67% increase in the firm-product-country export quantity. Analogously, a 10% increase in the number of nearby intermediary firms increases the firm's export volume by 0.69%.

It is surprising to find such a small spillover effect sourced from other exporting firms located in the same province. Despite being the most commonly examined spillover variable, I find that region-specific export spillovers are small in magnitude for the incumbent Chinese exporters.

4.5.2 Product-specific spillover effects

Table 4.5 shows the regression results for export volume controlling for product-specific spillovers from all exporters, direct exporters and intermediary firms, respectively. An increase of 10% in a number of exporting firms in a particular industry increases the export quantity of a firm in that industry by roughly 2.2%. This shows that product-specific spillovers are more important than just region-specific spillovers. I find that direct exporters have a larger product-specific spillover effect than

intermediaries (0.228 vs. 0.166) suggesting that product-specific spillovers may be more likely to be generated by technology transfers than knowledge transfers.

4.5.3 Regional product-specific spillover effects

The estimates of regional product-specific spillovers on intensive margin of exports are given in Table 4.6. The result for all exporters demonstrates positive and statistically significant spillover effects on export volume. A 10% increase in the number of all exporters operating in the same province and exporting the same product enhances the firm's export quantity by 0.8%, while the equivalent estimates for direct exporters and intermediaries are 0.73% and 0.67%, respectively.

My initial hypothesis was that the spillovers get stronger the closer the firms are to the exporter studied in terms of product exported. However, I find that the spillovers from nearby exporters within the same industry (0.8%) are not much larger than those from nearby exporters in all industries (0.77%). This can be explained by the congestion costs associated with agglomeration (Farole & Winkler, 2013) and over-competition effect of over-agglomeration (Bao, Ye, & Song, 2016). Spatial proximity to other firms may increase production costs by raising the demand for and thus prices of key sector-specific factors of production that may include land, capital and labour with specific skills. Spatial proximity can also increase transportation and transaction costs by extending waiting times. Over-agglomeration of exporters may lead to increased

competition between the firms and thus reduced mark-ups, generating negative external effects.

4.5.4 Regional destination-specific spillover effects

Table 4.7 presents the results for the regional destination-specific export spillovers. Geographical proximity to exporters exporting to the same destination market is found to transfer positive and statistically significant spillovers to the observed firm's export volume. The coefficient of regional destination-specific spillovers from all exporters indicates that a 10% increase in the number of neighbouring firms serving the same foreign market leads to a 5.79% increase in the firm-product-country export quantity, while the equivalent estimates for direct exporters and intermediary firms are 5.35% and 6.41%, respectively. These results are significantly larger than what I found for the spillovers that did not control for the destination. This demonstrates that exporting requires specialized knowledge of foreign markets, which can contribute to spatial concentration (Lovely, Rosenthal, & Sharma, 2005). My finding shows that spatial proximity to firms exporting to a particular destination country can be greatly beneficial to exporters regardless of the industry of the other exporters. Furthermore, my finding that intermediaries have a larger spillover effect than direct exporters supports the hypothesis that the destination-specific spillovers are knowledge-based.

4.5.5 Regional product-destination-specific spillover effects

The estimation results of the most specific spillovers – regional product-destination-specific spillovers - are reported in Table 4.8. I find highly positive and statistically significant coefficients of regional product-destination-specific spillovers from all categories of exporters. A 10% increase in the number of exporters entering in a particular province and trading a particular product to a particular country stimulates 5.82% increase in the observed firm's export volume. while the equivalent estimates for direct exporters and intermediary firms are 5.82% and 5.09%, respectively. Compared to purely region-specific spillovers and product-specific spillovers, product-destination-specific agglomeration results in much larger externalities. However, similar to the comparison between regional spillovers and regional product-specific spillovers, the difference between regional destination-specific spillovers and regional product-destination-specific spillovers are insignificant. It seems again that firms suffer negative effects of competition that outweighs any further positive information spillovers that one could assume is present when the firm is in the same industry. Harasztosi (2016) finds that the externality from firms in the same region that export the same good to the same country is stronger than either product or product-specific alone, mirroring my results.

In summary, all spillover types sourced from all exporters, direct exporters and intermediary firms show positive and statistically significant impacts on firms' intensive export margin. Agglomeration of firms that export to the same destination

country has by far the largest impact on a firm's intensive margin, whether or not those firms operate in the same industry or are direct exporters or intermediaries. Perhaps counterintuitively, the additional benefit of the firms exporting the same good is small. This suggests that the knowledge spillovers from the exporters that know the firm's micro market the best are outweighed by the negative effects of these firms also being in direct competition with our exporter. It could also suggest that when in direct competition with others, firms take measures to prevent knowledge spillovers to their competitors from occurring.

In all of my regressions, I generally find that the spillovers from intermediaries are equivalent in size to the spillovers from direct exporters. Given that intermediaries are only involved in knowledge transfer while direct exporters can be involved in either knowledge or technology transfer, these findings suggest that knowledge spillovers are likely to be behind most of the positive impact caused by agglomeration. Additionally, I find a higher spillover effect from direct exporters than intermediary firms in all product-related spillovers, which might indicate that product-specific spillovers are more likely to be driven by technology transfers than non-product specific spillovers. Last, my finding that destination-specific spillovers are larger for intermediaries than direct exporters suggest that destination-specific spillovers are more likely to be driven by knowledge transfers than non-destination specific spillovers.

4.6 Robustness checks

As one of the most successful empirical models in economics, gravity model is widely used to explain trade flows between countries as well as firms' export behaviour. Destination market's economic size and the distance between trading partners are highly associated with fixed and variable trade costs, thus affecting a firm's decision to export to a particular market as well as the volume of trade. So far I have not attempted to control for variables that might affect the export volume outside of my spillover variables, but in this section I follow the gravity literature and add as control variables the destination country's GDP and the distance between China and the trading country to ensure that my results are robust. A similar specification can be found in Koenig et al. (2010), Mayneris and Poncet (2015) and Choquette and Meinen (2015). My empirical equation for robustness checks is:

$$lnExport_{irjpt} = \alpha lnSpillovers + \beta_1 lnGDP_j + \beta_2 lnDistance_j + \mu_{ijp} + \gamma_t + \varepsilon_{ijpt}, \quad (2)$$

where, as in (1), subscript i refers to firm, r to region, j to country, p to product, t to year. GDP_j is thus the GDP of the destination country j and $Distance_j$ is the distance between the exporter's home country and the destination market j. Other variables are as in (1).

Tables 4.9-4.13 provide the results of the robustness checks for my five spillover variables. In each table, I find positive and significant coefficients for *GDP*, which is consistent with the prediction of gravity model that larger destination economic size

can contribute to more exports to this market. With regard to *Distance*, Tables 4.9-4.11 that cover the non-destination-specific spillovers display negative estimates, while Tables 4.12-4.13 that cover the destination-specific spillovers report positive estimates. However, none of the coefficients are significant, suggesting that distance per se does not affect the internal margin of trade. Others have found a significant negative effect of distance on exports but these studies, unlike me, do not control for country fixed effects at the same time (see for example Bannò et al., 2015; Harasztosi, 2016; Koenig, 2009).

After introducing *GDP* and *Distance* variables and continuing to control for firm-product-country fixed effects and year effects, I can see from Tables 4.9-4.11 that the coefficient sizes of region-specific, product-specific and regional product-specific spillovers of all types of exporters change only slightly from the equivalent coefficients in Tables 4.4-4.6 that do not control for these gravity variables. When looking at all the exporters located in the same region, the coefficient for other exporters located in the same region reduces from 0.077 to 0.072, the coefficient for all other firms exporting the same product increases from 0.220 to 0.238, while the coefficient for all other nearby exporters in the same industry increases from 0.080 to 0.083. I get similar results when I study the subsamples of direct exporters and intermediary firms - slight increases or decreases in the coefficients. This demonstrates that my previous results are robust. Again, I do not find large difference in the spillover effects between direct

exporters and intermediary firms, which might indicate the information spillovers dominate technology spillovers.

While I find that the region-specific, product-specific and regional product-specific spillovers are not affected significantly by the addition of the gravity variables, my results in Tables 4.12-4.13 show that the destination-related spillover coefficients decrease in size when I add in the trading country's characteristics compared to the equivalent tables 4.7-4.8 that do not control for these characteristics. Comparing Table 4.7 to Table 4.12 shows that the coefficient for all other nearby firms exporting to the same destination country falls from 0.579 to 0.342, while the coefficient for other direct exporters decreases from 0.535 to 0.318 and the coefficient for intermediary firms decreases from 0.641 to 0.320. Similarly, comparing Table 4.8 to Table 4.13 shows that the coefficient for all other firms operated in the same province and exporting the same product to the same foreign market decreases from 0.582 to 0.422, while the coefficient for other direct exporters falls from 0.582 to 0.414 and the coefficient for intermediary firms falls from 0.509 to 0.369. This is likely to be because *GDP* correlates with the number of firms that are a potential source of destination-specific spillovers – when the market is more lucrative, there are likely to be more firms serving the market. Thus, the *GDP* variable takes out some of the explanatory power of the spillover variables in these regressions while it is significant but does not affect the coefficient sizes in the regressions that do not control for destination. However, these results still support my previous conclusions that destination-specific spillovers are the strongest and thus that

agglomeration of firms exporting to the same destination market has the largest effect on another firm's extensive margin of exports.

In conclusion, my previous findings are robust to new specifications that add destination country's GDP and the distance between China and the trading country as control variables. I still find positive and statistically significant coefficients for all spillover variables from other exporters, regardless of the exporters' classification as a direct exporter or an intermediary firm. Generally, as I do not find large differences in the effects between direct exporters and intermediary firms, I believe that export spillovers on an exporter's intensive trade margin are more likely be driven by knowledge spillovers than technology spillovers given that both direct exporters and intermediaries can theoretically be a source of knowledge-based spillovers while technology spillovers are exclusive to direct exporters. However, technology transfers are more likely to be the source of product-specific spillovers than non-product-specific spillovers due to the larger size of the spillovers from direct exporters relative to intermediaries for product-specific spillovers. Furthermore, knowledge spillovers are likely to be relatively more important for destination-specific spillovers than non-destination specific spillovers due to the relatively larger size of the intermediary spillovers to spillovers from manufacturing exporters for destination-specific spillovers.

4.7 Conclusion

In this chapter, I quantify export spillovers from incumbent Chinese exporters to the intensive margin of other exporters in China. I study whether the spillovers are

related to locational agglomeration within China, if they are industry-specific or more general and if they are destination-specific. I also allow the spillovers from intermediary exporters to differ from direct exporters to test if the spillovers are more knowledge-based or technology based.

My main results are as follows. I find that regional agglomeration of firms that export to the same destination market has the highest potential to generate spillovers. The impact is about the same whether or not the other exporters are in the same industry, so it appears that the knowledge about the destination country itself is more important than knowledge about the specific industry within the destination country. I also find that intermediary firms and direct exporters have close to the same ability to generate spillovers. The fact that spillovers from intermediary exporters are positive and significant suggests that spillovers are knowledge-based, while the positive significant spillovers from manufacturing exporters suggest that they are either knowledge or technology-based. This then leads me to conclude that knowledge transfers are a more likely source for the export spillovers than technology transfers.

When studying spillovers from firms in the same industry, I find that they get smaller when the firms are located in the same province. It is possible that competition between firms exporting the same good reduces the export performance thus cancelling out any additional spillovers that might exist from firms that are the closest to our exporter in terms of specific knowledge and technology.

To conclude, I find support for the existence of positive spillovers from exporters that are regionally agglomerated, produce the same good and/or export to the same country. By further distinguishing the effects from direct exporters and intermediary firms, I find that knowledge spillovers play an important role in promoting incumbent exporters' intensive margin of trade while I cannot rule out technological spillovers. My findings supplement the literature that discusses the role intermediary firms play in facilitating trade. I find that they do not only help less productive manufacturers to indirectly participate in international trade market but that they also help incumbent exporters to become more successful through a transfer of information spillovers.

4.8 References

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Table 4.1 Description of variables

Variable	Definition
Export volume	Firm's export quantity at the country-HS6 product level
sp_reg	The number of all exporters located in the same province as the observed firm
sp_reg_d	The number of direct exporters located in the same province as the observed firm
sp_reg_i	The number of intermediary firms located in the same province as the observed firm
sp_p	The number of all exporters exporting the same HS6 product as the observed firm
sp_p_d	The number of direct exporters exporting the same HS6 product as the observed firm
sp_p_i	The number of intermediary firms exporting the same HS6 product as the observed firm
sp_rp	The number of all exporters located in the same province and exporting the same HS6 product as the observed firm
sp_rp_d	The number of direct exporters located in the same province and exporting the same HS6 product as the observed firm
sp_rp_i	The number of intermediary firms located in the same province and exporting the same HS6 product as the observed firm
sp_rc	The number of all exporters located in the same province and exporting to the same destination market as the observed firm
sp_rc_d	The number of direct exporters located in the same province and exporting to the same destination market as the observed firm
sp_rc_i	The number of intermediary firms located in the same province and exporting to the same destination market as the observed firm
sp_rpc	The number of all exporters located in the same province and exporting the same HS6 product to the same destination market as the observed firm
sp_rpc_d	The number of direct exporters located in the same province and exporting the same HS6 product to the same destination market as the observed firm
sp_rpc_i	The number of intermediary firms located in the same province and exporting the same HS6 product to the same destination market as the observed firm

Variable	Definition
GDP	Gross domestic product
Distance	Air distance in nautical miles between the trading country pairs

Table 4.2 Summary statistics for the number of exporting firms

Year	All exporters	Direct exporters	Intermediary firms	Intermediary share (%)
2000	62,771	54,739	8,032	12.8
2001	68,072	59,112	8,960	13.2
2002	78,612	67,915	10,697	13.6
2003	95,629	81,048	14,581	15.2
2004	120,589	100,592	19,997	16.6
2005	144,030	121,931	22,099	15.3

Table 4.3 Summary statistics for spillover variables

Variable	Mean	Std. dev.	Min	Max
sp_reg	19,713	11260.9	43	38,536
sp_reg_d	15,379	9337.9	21	31,156
sp_reg_i	4,334	2076.6	8	7,380
sp_p	2,000	2357.8	1	18,102
sp_p_d	1,123	1481.7	1	12,236
sp_p_i	877	906.0	0	5,866
sp_rp	582	866.0	1	6,858
sp_rp_d	341	558.2	1	4,896
sp_rp_i	241	322.8	0	1,988
sp_rc	5,169	6566.2	1	25,364
sp_rc_d	4,084	5583.1	1	21,505
sp_rc_i	1,085	1024.6	0	3,859
sp_rpc	129	349.4	1	4,381
sp_rpc_d	80	230.8	1	3,220
sp_rpc_i	49	123.8	0	1,285

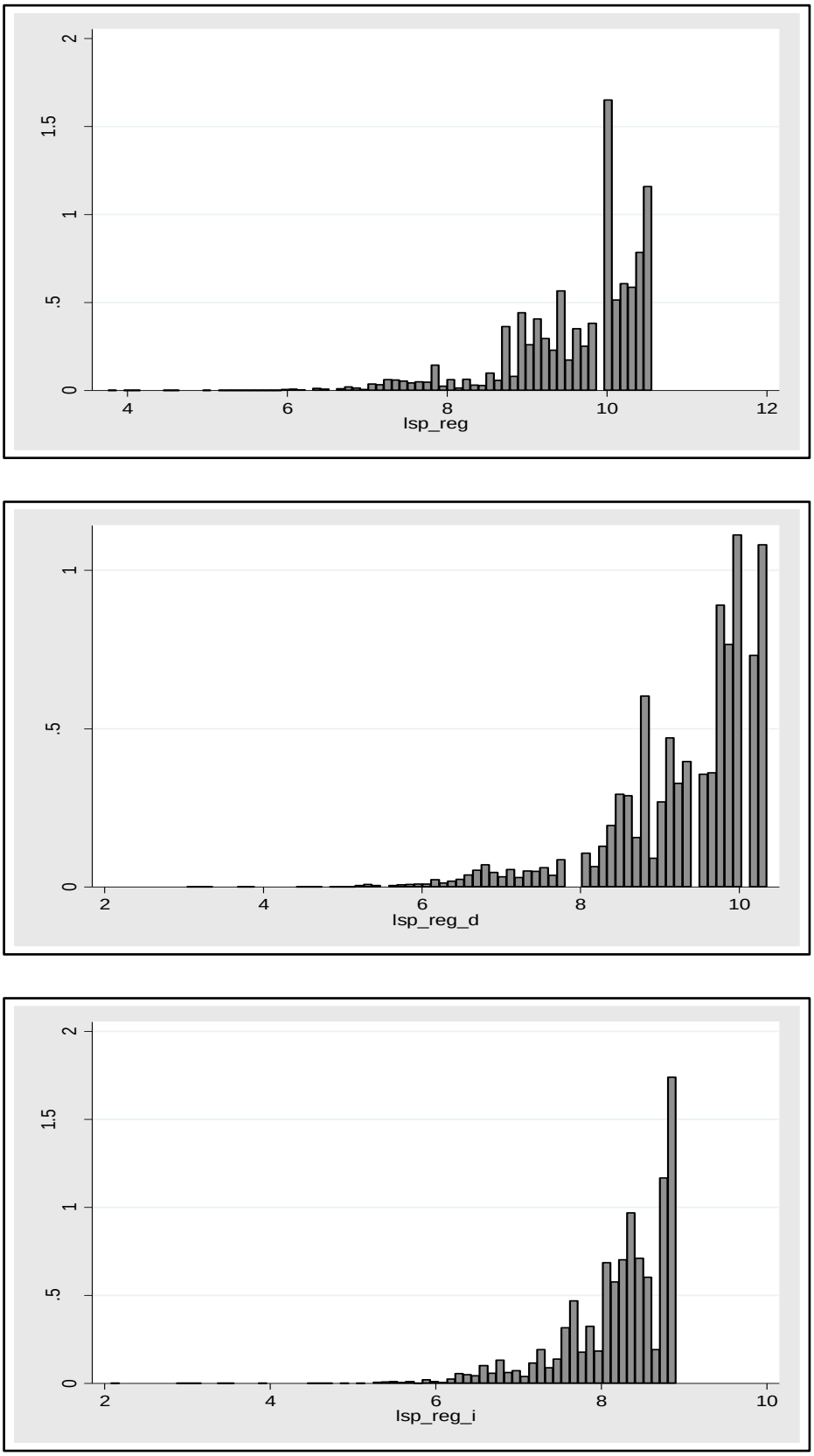


Figure 4.1 Histograms of spillover variables

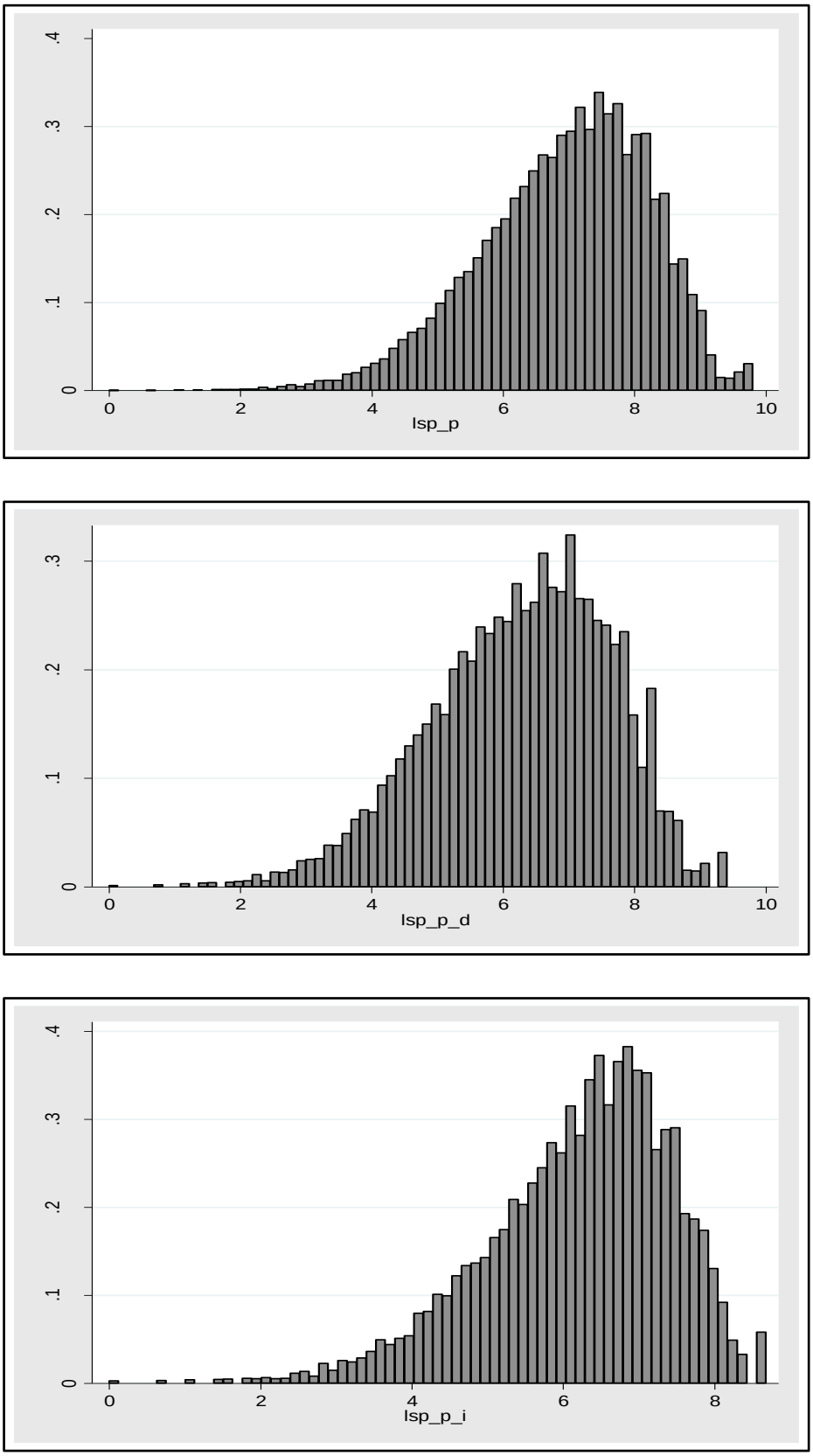


Figure 4.1 Histograms of spillover variables

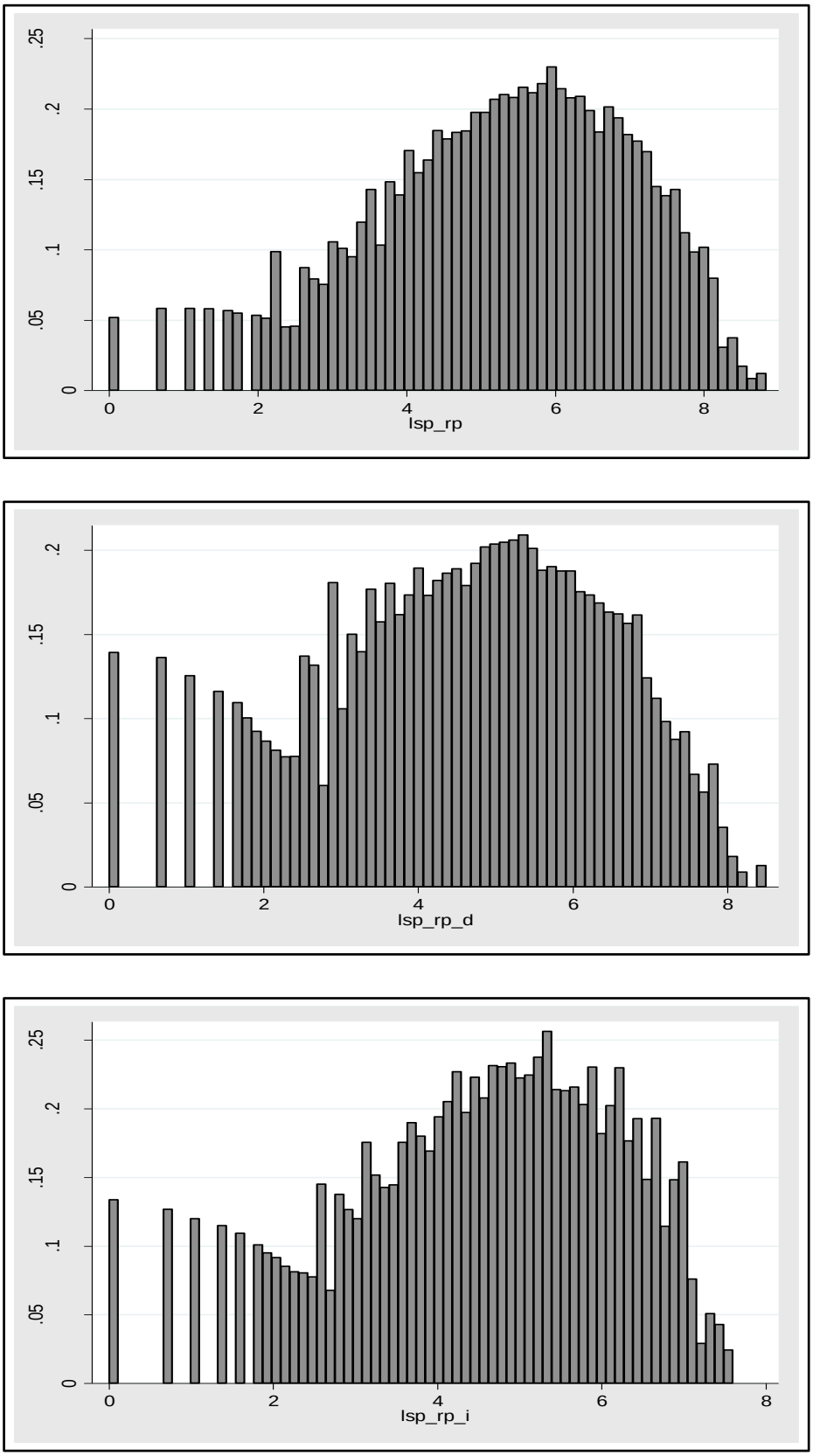


Figure 4.1 Histograms of spillover variables

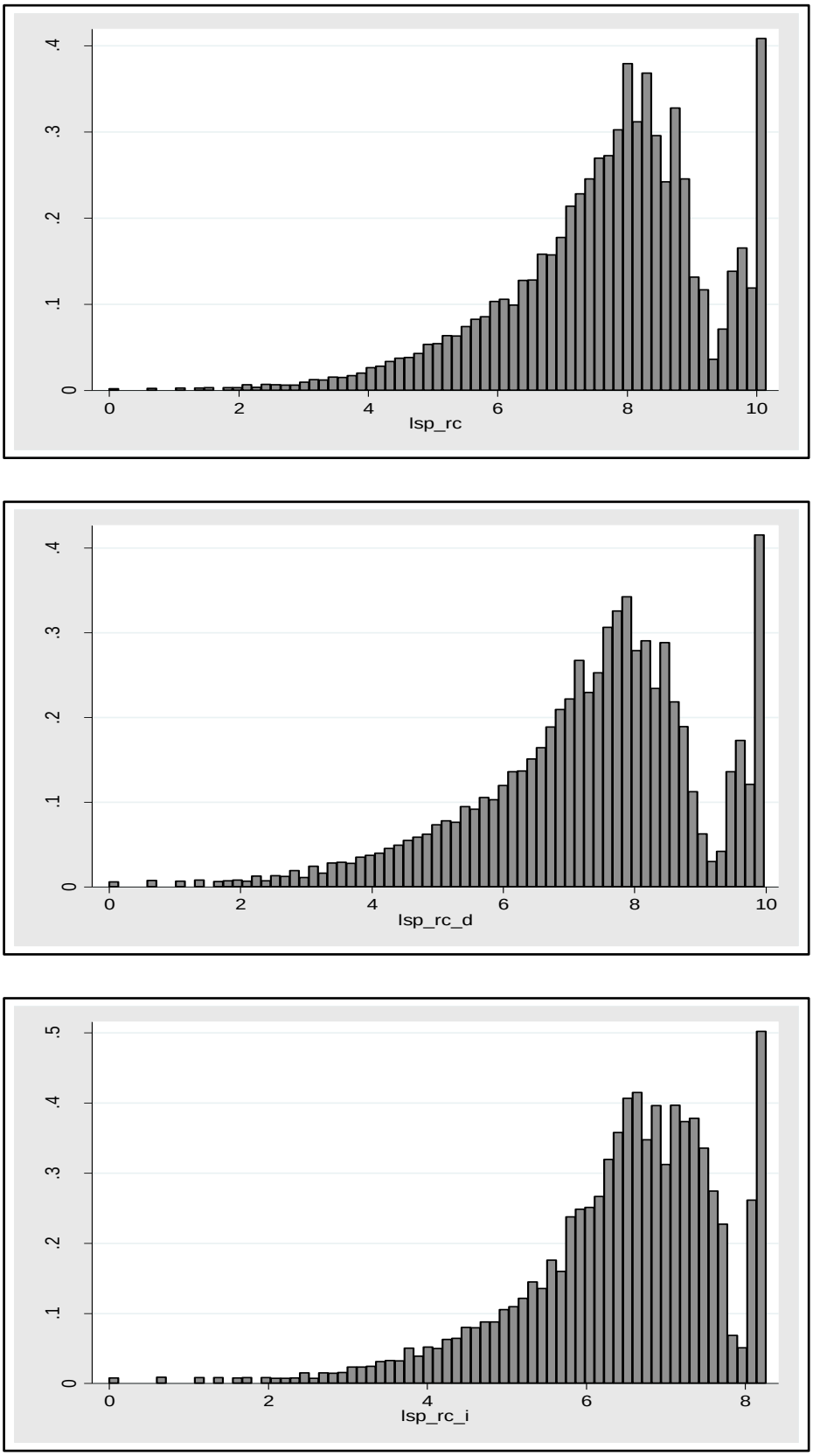
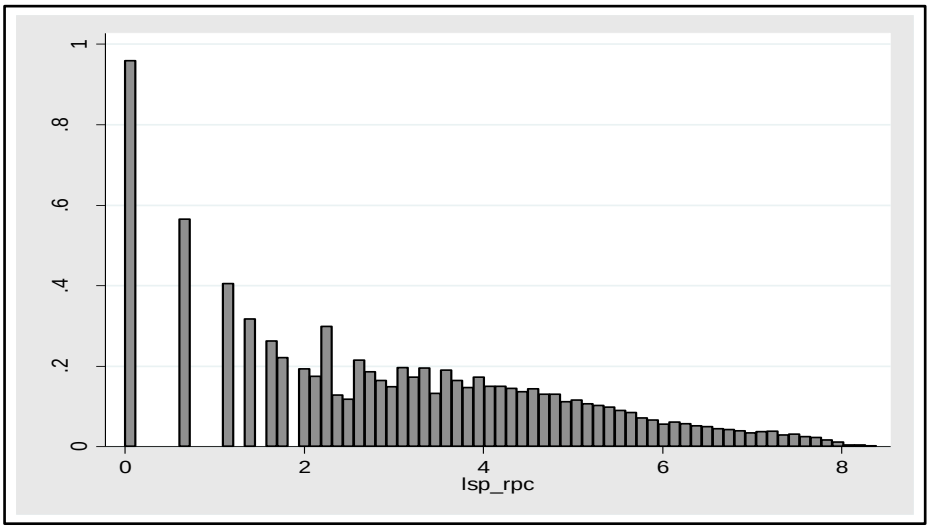
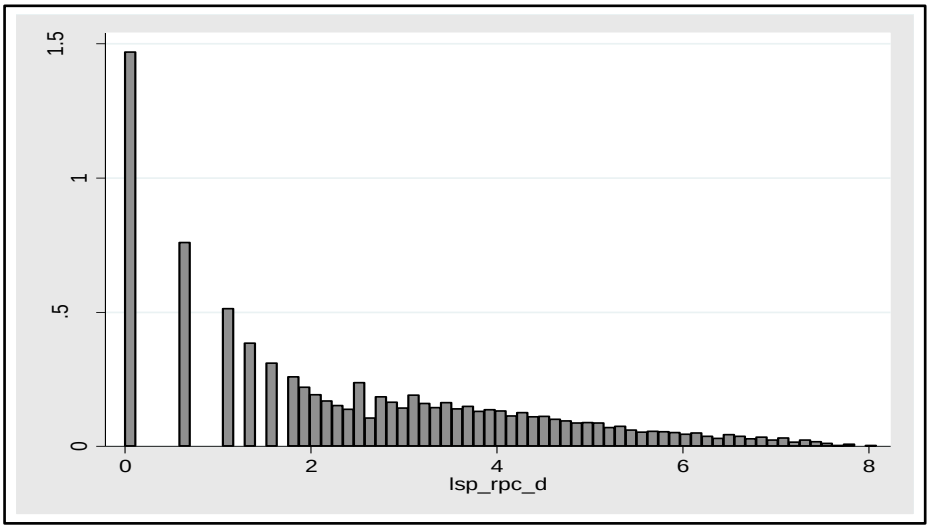


Figure 4.1 Histograms of spillover variables





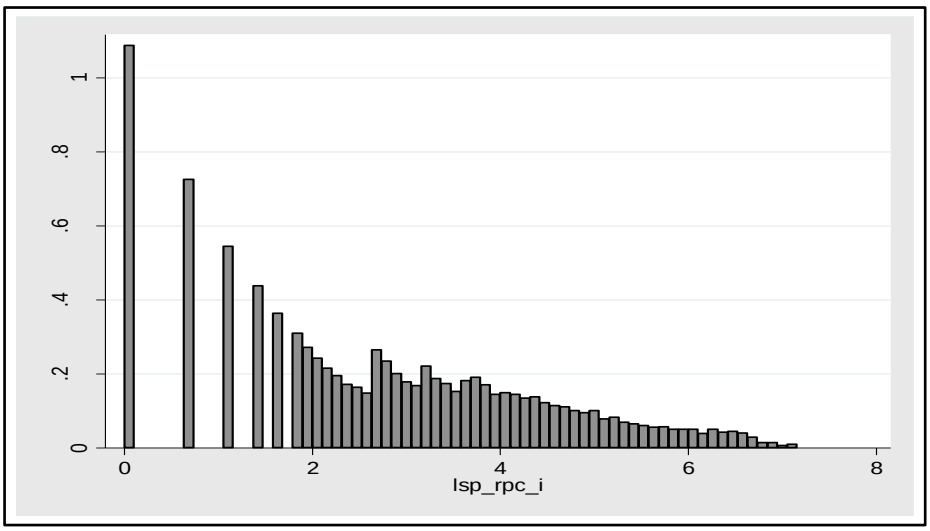


Figure 4.1 Histograms of spillover variables

Table 4.4 Effect of region-specific export spillovers on export volume

Spillovers	***All exporters*** ***(1)***	***Direct exporters*** ***(2)***	***Intermediaries*** ***(3)***
lsp_reg	0.077*** *(3.28)*		
lsp_reg_d		0.067*** *(3.22)*	
lsp_reg_i			0.069*** *(2.91)*
Firm-Product-Country Fes	YES	YES	YES
Year Fes	YES	YES	YES
R-squared	0.8367	0.8367	0.8367
Observations	1,809,295	1,809,295	1,809,295

NOTE: Table regresses firm's log export quantity (at the country-HS6 product level) on spillovers from all exporters, direct exporters or intermediary firms located in the same province over 2000-2005. All explanatory variables are expressed in logs. The constant in each regression is not reported. Standard errors are clustered by country. Significance: * 10%; ** 5%; *** 1%.

Table 4.5 Effect of product-specific export spillovers on export volume

Spillovers	***All exporters*** ***(1)***	***Direct exporters*** ***(2)***	***Intermediaries*** ***(3)***
lsp_p	0.220*** *(6.50)*		
lsp_p_d		0.228*** *(7.28)*	
lsp_p_i			0.166*** *(5.41)*
Firm-Product-Country FEs	YES	YES	YES
Year FEs	YES	YES	YES
R-squared	0.8367	0.8367	0.8366
Observations	1,809,295	1,809,295	1,808,936

NOTE: Table regresses firm's log export quantity (at the country-HS6 product level) on spillovers from all exporters/direct exporters/intermediary firms exporting the same HS6 product over 2000-2005. All explanatory variables are expressed in logs. The constant in each regression is not reported. Standard errors are clustered by country. Significance: * 10%; ** 5%; *** 1%.

Table 4.6 Effect of regional product-specific export spillovers on export volume

Spillovers	***All exporters*** ***(1)***	***Direct exporters*** ***(2)***	***Intermediaries*** ***(3)***
lsp_rp	0.080*** *(5.77)*		
lsp_rp_d		0.073*** *(5.80)*	
lsp_rp_i			0.067*** *(5.27)*
Firm-Product-Country FEs	YES	YES	YES
Year FEs	YES	YES	YES
R-squared	0.8367	0.8367	0.8350
Observations	1,809,295	1,809,295	1,777,820

NOTE: Table regresses firm's log export quantity (at the country-HS6 product level) on spillovers from all exporters/direct exporters/intermediary firms located in the same province and exporting the same HS6 product over 2000-2005. All explanatory variables are expressed in logs. The constant in each regression is not reported. Standard errors are clustered by country. Significance: * 10%; ** 5%; *** 1%.

Table 4.7 Effect of regional destination-specific export spillovers on export volume

Spillovers	***All exporters*** ***(1)***	***Direct exporters*** ***(2)***	***Intermediaries*** ***(3)***
lsp_rc	0.579*** *(13.35)*		
lsp_rc_d		0.535*** *(13.58)*	
lsp_rc_i			0.641*** *(11.95)*
Firm-Product-Country FEs	YES	YES	YES
Year FEs	YES	YES	YES
R-squared	0.8449	0.8450	0.8437
Observations	1,809,295	1,809,295	1,807,228

NOTE: Table regresses firm's log export quantity (at the country-HS6 product level) on spillovers from all exporters/direct exporters/intermediary firms located in the same province and exporting to the same destination market over 2000-2005. All explanatory variables are expressed in logs. The constant in each regression is not reported. Standard errors are clustered by country. Significance: * 10%; ** 5%; *** 1%.

Table 4.8 Effect of regional product-destination-specific export spillovers on export volume

Spillovers	***All exporters*** ***(1)***	***Direct exporters*** ***(2)***	***Intermediaries*** ***(3)***
lsp_rpc	0.582*** *(13.72)*		
lsp_rpc_d		0.582*** *(13.36)*	
lsp_rpc_i			0.509*** *(11.14)*
Firm-Product-Country FEs	YES	YES	YES
Year FEs	YES	YES	YES
R-squared	0.8464	0.8458	0.8350
Observations	1,809,295	1,809,295	1,345,647

NOTE: Table regresses firm's log export quantity (at the country-HS6 product level) on spillovers from all exporters/direct exporters/intermediary firms located in the same province and exporting the same HS6 product to the same destination market over 2000-2005. All explanatory variables are expressed in logs. The constant in each regression is not reported. Standard errors are clustered by country. Significance: * 10%; ** 5%; *** 1%.

Table 4.9 Effect of region-specific export spillovers on export volume

Spillovers	***All exporters*** ***(1)***	***Direct exporters*** ***(2)***	***Intermediaries*** ***(3)***
lsp_reg	0.072*** *(2.94)*		
lsp_reg_d		0.061*** *(2.79)*	
lsp_reg_i			0.070*** *(3.10)*
lnGDP	0.356*** *(12.71)*	0.356*** *(12.71)*	0.356*** *(12.72)*
lnDistance	-0.011 *(-0.18)*	-0.011 *(-0.18)*	-0.011 *(-0.18)*
Firm-Product-Country FEs	YES	YES	YES
Year FEs	YES	YES	YES
R-squared	0.8423	0.8423	0.8423
Observations	1,701,402	1,701,402	1,701,402

NOTE: Table regresses firm's log export quantity (at the country-HS6 product level) on spillovers from all exporters/direct exporters/intermediary firms located in the same province, GDP of destination country and distance between the two countries over 2000-2005. All explanatory variables are expressed in logs. The constant in each regression is not reported. Standard errors are clustered by country. Significance: * 10%; ** 5%; *** 1%.

Table 4.10 Effect of product-specific export spillovers on export volume

Spillovers	***All exporters*** ***(1)***	***Direct exporters*** ***(2)***	***Intermediaries*** ***(3)***
lsp_p	0.238*** *(6.57)*		
lsp_p_d		0.241*** *(8.03)*	
lsp_p_i			0.183*** *(5.53)*
lnGDP	0.357*** *(12.73)*	0.357*** *(12.73)*	0.357*** *(12.72)*
lnDistance	-0.011 *(-0.19)*	-0.011 *(-0.19)*	-0.011 *(-0.19)*
Firm-Product-Country FEs	YES	YES	YES
Year FEs	YES	YES	YES
R-squared	0.8424	0.8424	0.8423
Observations	1,701,402	1,701,402	1,701,079

NOTE: Table regresses firm's log export quantity (at the country-HS6 product level) on spillovers from all exporters/ direct exporters/intermediary firms exporting the same HS6 product, GDP of destination country and distance between the two countries over 2000-2005. All explanatory variables are expressed in logs. The constant in each regression is not reported. Standard errors are clustered by country. Significance: * 10%; ** 5%; *** 1%.

Table 4.11 Effect of regional product-specific export spillovers on export volume

Spillovers	***All exporters*** ***(1)***	***Direct exporters*** ***(2)***	***Intermediaries*** ***(3)***
lsp_rp	0.083*** *(6.10)*		
lsp_rp_d		0.071*** *(5.90)*	
lsp_rp_i			0.076*** *(6.32)*
lnGDP	0.356*** *(12.72)*	0.356*** *(12.71)*	0.356*** *(12.67)*
lnDistance	-0.012 *(-0.19)*	-0.012 *(-0.19)*	-0.011 *(-0.18)*
Firm-Product-Country FEs	YES	YES	YES
Year FEs	YES	YES	YES
R-squared	0.8424	0.8423	0.8407
Observations	1,701,402	1,701,402	1,672,473

NOTE: Table regresses firm's log export quantity (at the country-HS6 product level) on spillovers from all exporters/direct exporters/intermediary firms located in the same province and exporting the same HS6 product, GDP of destination country and distance between the two countries over 2000-2005. All explanatory variables are expressed in logs. The constant in each regression is not reported. Standard errors are clustered by country. Significance: * 10%; ** 5%; *** 1%.

Table 4.12 Effect of regional destination-specific export spillovers on export volume

Spillovers	***All exporters*** ***(1)***	***Direct exporters*** ***(2)***	***Intermediaries*** ***(3)***
lsp_rc	0.342*** *(5.78)*		
lsp_rc_d		0.318*** *(5.81)*	
lsp_rc_i			0.320*** *(4.62)*
lnGDP	0.225*** *(6.63)*	0.222*** *(6.38)*	0.258*** *(7.54)*
lnDistance	0.067 *(1.32)*	0.071 *(1.40)*	0.037 *(0.67)*
Firm-Product-Country FEs	YES	YES	YES
Year FEs	YES	YES	YES
R-squared	0.8436	0.8436	0.8431
Observations	1,701,402	1,701,402	1,699,816

NOTE: Table regresses firm's log export quantity (at the country-HS6 product level) on spillovers from all exporters/direct exporters/intermediary firms located in the same province and exporting to the same destination market, GDP of destination country and distance between the two countries over 2000-2005. All explanatory variables are expressed in logs. The constant in each regression is not reported. Standard errors are clustered by country. Significance: * 10%; ** 5%; *** 1%.

Table 4.13 Effect of regional product-destination-specific export spillovers on export volume

Spillovers	***All exporters*** ***(1)***	***Direct exporters*** ***(2)***	***Intermediaries*** ***(3)***
lsp_rpc	0.422*** *(16.54)*		
lsp_rpc_d		0.414*** *(14.21)*	
lsp_rpc_i			0.369*** *(12.82)*
lnGDP	0.231*** *(13.65)*	0.241*** *(13.37)*	0.252*** *(11.96)*
lnDistance	0.062 *(1.73)*	0.067 *(1.83)*	0.064 *(1.56)*
Firm-Product-Country FEs	YES	YES	YES
Year FEs	YES	YES	YES
R-squared	0.8462	0.8459	0.8349
Observations	1,701,402	1,701,402	1,272,075

NOTE: Table regresses firm's log export quantity (at the country-HS6 product level) on spillovers from all exporters/direct exporters/intermediary firms located in the same province and exporting the same HS6 product to the same destination market, GDP of destination country and distance between the two countries over 2000-2005. All explanatory variables are expressed in logs. The constant in each regression is not reported. Standard errors are clustered by country. Significance: * 10%; ** 5%; *** 1%.

Chapter 5. Conclusion

In this thesis, I undertake three studies focusing on the determinants of firm's export performance. My primary objective is to investigate the role played by intermediaries in the export decision of a firm. The main research questions I study are: (i) How do intermediaries facilitate firm-level exports? (ii) What is the average overall effect of spillovers on exports found in the literature? Is the sample of estimated effects in the literature affected by publication bias? Are there data, estimation, and/or study characteristics that can explain the heterogeneity of estimated effects across studies? (iii) Are there spillover effects of exports in the domestic economy and do they vary between intermediaries and direct exporters? (iv) What are the channels of export spillovers? Are they product-specific, region-specific or destination-specific?

Chapter Two of this thesis attempted to respond to the first question by replicating and then extending the work of Ahn et al. [AKW] (2011) that investigate the pattern of intermediated trade. The theoretical model of AKW modifies the Melitz (2003) model to allow for the existence of an intermediary sector and derives three testable hypotheses. First, it explains how less productive firms can lower entry costs by employing an intermediary to indirectly access the export market. The model predicts a "hockey stick" relationship between productivity and direct exports, and an inverted U-shape relationship with indirect exports. Second, the model predicts that the consumer prices of the products exported with the help of an intermediary are higher than those exported directly. Third, as entry costs vary with country characteristics, the

model predicts that exports to countries with higher trade costs or smaller market size have a higher intermediary share of exports.

The replication carried out in this chapter consists of six parts: (a) re-examination of the first hypothesis on the relationship between productivity and export mode using the same dataset as AKW sourced from the World Bank's Enterprise Survey Data from 2002 to 2003; (b) robustness checks of the first hypothesis using more recently available data in 2012; (c) re-examination of the second hypothesis on the relationship between using an intermediary and directly exporting and unit value differentials using the same dataset sourced from China Customs Data in 2005; (d) robustness checks of the second hypothesis using data from earlier years from 2000-2004 and regional subsamples in the same year; (e) re-examination of the third hypothesis on the relationship between intermediary export share and destination market characteristics; (f) robustness checks of the third hypothesis using different data sources for key variables, data from earlier years and regional subsamples.

My replication study generally finds supportive evidence of intermediaries facilitating trade. However, when I examine the AWK hypotheses further, I find that their results are not generally robust. When I use more recently available data to test the first hypothesis, only one of the three productivity proxies support the prediction. When I use subsamples of firms by geographic regions to re-estimate the rest of hypotheses, I find supportive evidence for the AWK hypotheses only for firms in the Eastern China region. When I use data from earlier years, the results are mixed.

Additionally, I identified multiple different versions in the public domain of one of the key variables used in the study - the number of required importing procedures used as a proxy for the fixed cost of entering into a specific market. I get mixed results, depending on which version of the importing procedures I use. My findings suggest that further research needs to be done to better understand the role of intermediaries in international trade markets.

Chapter Three studies how export performance of a firm can be influenced by other exporters in a more indirect way, through spillover effects on exports. To investigate this, I collect 3,025 estimated spillover effects from 98 studies in the literature and conduct a meta-analysis to analyse the spillover effects on exports. The spillover-export hypothesis states that spillovers from (i) agglomeration economies (urbanization and localization), (ii) FDI and (iii) other exporters should affect the probability of a firm's participation decision in the export market (extensive export margin) and its export intensity (intensive export margin). While theoretical models clearly distinguish between the different types of spillovers with different effects on a firm's export performance, it is challenging to distinguish these effects empirically. There is no consensus on whether spillovers have a positive influence on exports, and neither is there a consensus on the primary transmission mechanism. Further, little is known about why different studies obtain different results.

In order to address these questions, I conduct a meta-analysis. As the estimated spillover effects in the literature span a large number of types and measures of both

exports and spillovers, I transform estimates to partial correlation coefficients (PCCs) to make them comparable. I analyse these transformed effects using four different versions of Weighted Least Squares estimators, incorporating both meta-analytic "Fixed Effects" and "Random Effects" regressions. The main findings of this chapter are the following. First, I find that a mean overall effect of spillovers on exports is statistically significant but economically negligible. Second, by using conventional Funnel Asymmetry Tests, I find that there exists a positive publication bias. However, the impact of publication bias is generally small. Third, I use both Bayesian Model Averaging and frequentist WLS estimation to study the effect of the data, estimation and study characteristics on the found spillover effect. I find that some data, estimation and study characteristics have a significant effect in some regressions. However, only a few of these characteristics are robust to all regressions, and the influence is small.

Chapter Four focuses on the spillover effects from intermediaries versus direct exporters on the incumbent exporting manufacturers' intensive margin. I examine the following spillover effects on a firm's export performance: spillovers from geographic proximity to exporters, national concentration of exporters exporting same products, regional agglomeration of exporters exporting the same product, regional concentration of exporters with the same destination market and regional concentration of exporters exporting the same product to the same destination market. I use a firm's export volume as an indicator of the intensive margin. I find positive and statistically significant evidence for all of the above spillover variables affecting the intensive margin of trade,

regardless of their sources from different categories. Furthermore, I do not find a major difference between the spillovers generated by general exporters, direct exporters or intermediary exporters. Given that intermediaries are only involved in knowledge transfer while direct exporters can be involved in either knowledge or technology transfer, I interpret my findings to suggest that knowledge spillovers play a more important role than technology transfers in promoting incumbent exporters' intensive margin of trade.

To conclude, my findings generally suggest that intermediaries play an important role in trade. I find supportive evidence that intermediation technology can help less productive manufacturers participate in the export market; however, as the productivity level of all producers increases over time, the effect of intermediaries on a firm's participation decision may decline. Manufacturers also benefit from gaining information on the export market and from improvements in the local transportation infrastructure. These benefits can be partly accrued by spillovers from other firms. I find that the spillovers from other exporters significantly affect incumbent exporters' intensive margin of trade. Information spillovers can help exporters further overcome the knowledge barriers of foreign markets and export more. By comparing the effects between direct exporters and intermediaries, I find that information externality dominates the spillover effects from exporters. Intermediaries are thus not only useful for those firms looking at entering new markets but they can be of great importance to manufacturers that are already in the export market. My findings suggest that

information barriers greatly affect both non-exporters and exporters. How to help firms overcome these barriers is a question for policy makers to work on.