Export Premium, Productivity, Trade Openness and Wage Inequality in China: Empirical Evidence from Firm-Level Data

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Contents

Abstract

This thesis uses Chinese firm-level data to investigate the relationships between the export premium, firm productivity and wage inequality. Using Chinese annual survey data for all state-owned firms and other non-state-owned firms with sales on mainland China over 5 million RMB, the author finds that there is a series of premiums for exporters compared with non-exporters and on average, exporters are more productive (based on 1999-2003 data). Firms with relatively high export values will also be relatively more productive. Quantile results show that the premium decreases with the increase of the quantile. In addition, the export premium declines over time and across the industries, provinces and ownership types, and the higher the export intensity, the lower the export premium.

The thesis further investigates the question: what determines the export premium – the selection effect or learning-by-exporting effect? First, the author uses the Olley and Pakes (1996) method to control both selection and simultaneity bias to estimate the reliable firm productivity. Then the author tests the self-selection and learning-by-exporting effects both parametrically and non-parametrically. The author finds both strong self-selection and learning-by-exporting effects at the aggregate level. The higher the productivity the firm has today, the easier for the firm to export tomorrow. The learning-by-exporting effect is the most significant in the second year after exporting. However, at the more disaggregated level, no significant learning effect is found within sectors and within middle and western provinces. A significant

learning effect is found in eastern provinces. The learning-by-exporting effect across different ownership types is not robust to different testing methods.

In addition, the author uses Chinese privately-owned firm-level survey data to investigate the heterogeneous export premium associated with different levels of trade. Firms engaged in international trade have higher premiums than firms which trade only across province borders. Firms which trade across province borders have higher premiums than firms that only trade within their province. Furthermore, export premium deviation between international trade and interprovincial trade is much smaller compared with the export premium deviation between interprovincial trade and inter-county trade. This finding implies that compared with the inter-county premium, the premium at interprovincial level is similar to the premium at the international level (though the former is actually less than the latter). The export premium caused by the self-selection effect can reflect the trade cost and it tells that trading goods across provincial borders within China is as onerous as crossing national borders.

The next question to consider is whether engaging in international trade causes the wage inequality between firms to increase? To find out the answer, the author adopts an estimation strategy to study the effect of international trade on wage inequality in two steps. First the Chinese annual survey firm-level data is used to calculate the wage inequality indexes—Gini and Theil of each province; as well as two dimensions of trade openness—intensive margin and extensive margin of each province. Thereafter the panel data is used to study the impacts of trade margins on

wage inequality between provinces. The results show that the variation of trade openness itself can explain nearly 70 percent of variation of wage inequality across China's provinces and the extensive margin has a larger impact on increasing wage inequality than the intensive margin. Instrumental variable (IV) regression results imply that with one unit of increase in trade openness, the intensive margin increases wage inequality by nearly one unit and the extensive margin increases wage inequality by 1.2 to 1.3 units.

Key words: Export premium, productivity, self-selection effect, learning-by-exporting effect, matching, intensive margin, extensive margin, wage inequality

JEL Classification: D24, F10, F14, F16, J31, L1

Declaration

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Chapter 1: Introduction

1.1 Background

Before the late 1970s, the economic performance of the People's Republic of China (PRC) was poor and the economy suffered with huge inefficiencies and poorly targeted investments. In the late 1970s, China began a programme of economic reforms called "socialism with Chinese characteristics" led by Deng Xiaoping (Deng, 1984).

These economic reforms took advantage of market principles and were carried out in two stages (Tisdell, 2009; Morrison, 2011). The first stage, in the late 1970s and early 1980s, involved the de-collectivization of agriculture, the opening up of the country to foreign investment, and permission for entrepreneurs to start up their own businesses though most business across various industries remained state-owned. The second stage of reform, in the 1980s and 1990s, involved the massive privatization and contracting out much of the state-owned enterprises and the lifting of price controls, protectionist policies, and regulations, although state monopolies in sectors such as banking and petroleum remained. The private sector grew remarkably, and by 2005, it had already accounted for as much as 70 percent of China's gross domestic product (GDP), a figure larger than in many Western nations (Engardio, 2005).

From 1978 to 2010, unprecedented growth occurred, with the economy measured by GDP expanding by 9.5 percent a year. China, from a negligible player in the world economy, has become one of the world's most powerful economies. In 2011, China's economy became the second largest (in GDP) after the United States

(World Bank, 2011). The success of China's economic policies and the manner of their implementation has resulted in immense changes in Chinese society.

International trade has played an important role in the success of China's economy since the reforms were initiated in 1978. Even during the early reform era, protectionist policies were often circumvented by smuggling. Throughout the reform period, the government reduced tariffs and other non-tariff barriers, with the overall tariff rate falling from 56 percent to 15 percent. According to Branstetter and Lardy (2008), by 2001, less than 40 percent of imports were subject to tariffs and only 9 percent of imports were subject to licensing and import quotas.

When China joined the World Trade Organization (WTO) in 2001, it agreed to considerably harsher conditions than other developing countries. Trade has increased from under 10 percent of GDP to 64 percent of GDP between 1978 and 2010. According to Bransetter and Lardy (2008), China is considered to be the openest large country in the world; by 2005, China's average applied tariff on industrial products was 8.9 percent. For Argentina, Brazil, India and Indonesia, the respective percentage figures are 30.9, 27.0, 32.4, and 36.9 percent. China's exports approximately doubled every four years since the opening up policy and by 2009, China had become the world's largest exporter. China's so-called export miracle provides a natural experiment and the opportunity to study the benefits and problems of China's strategy.

In addition to international trade, the process of decentralization resulted in lots of great changes in the agricultural, manufacturing and services sectors in terms of ownership and organization. Productivity in agriculture largely increased, which allowed workers to be released for work in manufacturing and services, and simultaneously increasing agricultural production. For manufacturing, China has become the world's biggest producer of concrete, steel, ships and textiles, and has the

world's largest automobile market. Chinese steel output quadrupled between 1980 and 2000, and from 2000 to 2006 rose from 128.5 million tons to 418.8 million tonnes, one-third of global production (World Steel Association, 2006). Labour productivity at some Chinese steel firms exceeds the Western counterparts.

For services, in the 1990s, the financial sector was liberalized. After China joined the WTO, the rest of the service sector was liberalized greatly and foreign investment was allowed. For example, restrictions on ownership in the retail, wholesale and distribution sectors were ended. Banking, financial services, insurance and telecommunications were opened up to foreign investment. Reforms also took place in the government financial systems such as how they raise and spend funds.

Despite rapid economic growth during the reform period, which has virtually eliminated poverty in urban China and rural regions and the living standards in China have drastically increased in comparison to the pre-reform era, income inequality has increased dramatically within China, as reflected by the Gini coefficient of China being estimated to be above 0.45, comparable to many South American countries (Benjamin et al., 2008). The increasing inequality is attributed to the disappearance of the welfare state, for example, the interior provinces, are being burdened by a larger state sector when comparing with richer coastal provinces.

China's trade success, especially in exporting, is greatly beneficial for the Chinese economy. At the same time, exports have continued to be a major component supporting China's rapid economic growth. Exports of goods and services constituted 39.7 percent of its GDP in 2011. China's major exports are from labour-intensive products, which help to increase employment. These sectors are mainly office machines and data processing equipment; telecommunications equipment; electrical machinery; and apparel and clothing.

Based on the background of China's economic and trade success, this thesis uses Chinese firm-level data to study the benefits of exporting at the micro-level, in particular at how the exporters are better than non-exporters from the perspective of productivity and whether exporting will increase firms' productivity. It will also look into the issue of heterogeneous export premiums doing different levels of trade. Since there is an income inequality issue in China, it will also investigate the question of whether trade openness will cause income inequality to increase from the perspective of wage inequality between firms.

1.2 Broad literature

What determines the types of goods traded internationally? Theoretically, the traditional Heckscher-Ohlin (HO) model predicts that China should export labour-intensive goods since China is a labour abundant country; however, China's export structure seems to be capital intensive and technology intensive, thus there is a debate about China's export structure.[1] Krugman's new trade theory predicts that scale economy should have some effect and China's big home market should stimulate the country to export goods with economies of scale.

What goods China should export based on the HO framework or Krugman trade theory is not the main task of this thesis. Comparative advantage theory and new trade theory focus on the consumer side, and the benefit of trading is that consumers can consume more in the variety of goods (extensive margin) and also in the quantity of the existing goods via lower prices (intensive margin), thus increasing their utility. However, the 'new-new' trade theory based on firm heterogeneity developed by

[1] See Rodrik (2006), Wang and Wei (2008), Xu (2007, 2010), Schott (2008) and Yao (2009) (among many others) for more detail.

Melitz (2003) and others identifies a new welfare gain from the production side, that is, exporting can increase the productivity of exporting firms and thus increase productivity of an industry and even a country.

The Melitz (2003) firm heterogeneity model did not try to predict what kind of goods China should export. It explained that exposure to trade in an industry (labour intensive or capital intensive) will lead to additional inter-firm resource allocations towards more productive firms. Thus the growth of aggregate industry productivity or the productivity in a country can be achieved by the reallocations generated by trade, which is a new welfare gain not previously mentioned in trade theory. Based on this productivity gain at firm level, the thesis uses Chinese firm-level data to study the benefits from exporting from the perspective of productivity based on the latest development of new-new trade theory with firm heterogeneity.

A longstanding interest in trade theory is the impact of trade on the distribution of income. The HO model predicts that developing countries with an abundance of unskilled labour should see a decrease in wage inequality with international trade, according to the Stolper-Samuelson theorem, however, according to Harrison et al. (2010, 2011), a rise in wage inequality has been observed in the developing world including Mexico, Colombia, Argentina, Brazil, Chile, India and China (Attanasio et al., 2004; Goldberg and Pavcnik, 2007; Topalova, 2007; Menezes-Filho et al., 2008, etc).

Based on the firm heterogeneity models, trade economists combine firm heterogeneity and labour market frictions (Davis and Harrigan, 2011; Egger and Kreickemeier, 2009, 2012; Helpman et al., 2010; Bustos, forthcoming). This line of literature shows that trade openness can cause wage inequality to increase at firm level. Therefore, the author wants to look at whether trade openness will cause

income inequality between firms to increase in China from the perspective of wage inequality.

There are a large number of empirical studies of various countries looking at exports and productivity at the firm level, and a detailed review is given in Chapter 2. The findings in the literature are basically as follows: exporters are more productive than non-exporters. Trade economists provide two hypothesises, one is self-selection, that is, more productive firms become exporters because of the cost barrier to sell internationally. The other is the role of learning-by-exporting; knowledge flows in the international market improve the post-entry performance of export starters.

In the literature, the other findings are as follows: the self-selection effect is quite robust and significant. For developed countries, exporting does not increase the productivity of exporting firms while for some developing countries, a significant learning-by-exporting effect is found. Therefore, since the evidence is mixed, the question of whether exporting is good for firms is still not resolved.

1.3 Research questions

Given China's export miracle and the relatively little literature using China's firm-level data, from the perspective of policy, the author asks the following questions: Is there a productivity export premium in China? If there is an export premium, what contributes to the premium? Is the export premium identical between firms that trade internationally, between provinces or between counties?

Besides focusing on the export premium and productivity, this thesis also looks into at the relationship between trade openness and wage inequality in China. As introduced in section 1.1, with the economic growth and trade expansion, income

inequality has increased dramatically within China, and this raises the question about the quality of economic growth in China. This is the first motivation for studying the question. The second motivation comes from the literature, since wage inequality has been observed to increase with international trade, which contradicts the classical trade theory, so the author will investigate this research question, based on the latest development in the literature of trade openness and wage inequality at the firm level.

1.4 Outline

Chapter 2 provides a review of the most relevant literature in addressing the above research questions. Chapters 3 and 4 address the issue about whether exporting is good for Chinese firms and why. Chapter 3 focuses on the investigation of the export premium in China using a large firm-level survey dataset from 1999 to 2003 to see whether exporters are better performers than non-exporters. It also considers the export premium at a disaggregated data level, by year, province, industry, and different ownership types and includes an export dummy and export values in the investigation. Evidence relating to the export premium at different quantiles is presented. The general finding is that in China, exporters are larger and more productive than non-exporters. In the disaggregate analysis, the more export intensive is the firm the smaller is the premium.

Chapter 4 investigates why exporters are more productive than non-exporters, looking at the self-selection effect and the learning-by-exporting effect. These two effects are quite different but important from a policy perspective. If the results show that exporting is good for firms in terms of improving productivity, the policy implication is quite different from the finding that exporters are good just because

certain firms have self-selected to export. Parametric, semi-parametric and non-parametric econometric techniques are used to do the tests. The general finding is that the self-selection and learning-by-exporting effects are significant at the aggregate level and the learning effect is found to be of different significance levels in a disaggregated analysis.

Chapter 5 investigates the heterogeneity of the export premium at three levels of trade: international trade, interprovincial trade and inter-county trade in China using a unique private firm-level survey dataset for the year 2000. Previous literature has assumed that the export premium is identical for each level of trade. This study uses both parametric and non-parametric methods to study the heterogeneous export premium. The general finding is that the premium increases with trade costs. The export premium therefore reflects trade costs and this information can be used to examine trade costs within a country. Trade costs are found to be as highest for goods crossing national borders and slightly lower for goods crossing provincial borders within China. The costs associated with inter-county trade are much lower, as reflected in the much lower export premium.

In Chapter 6, the author asks the question: What are the relationships between international trade and wage inequality in developing countries like China? The focus is on whether international trade will cause wage inequality to rise, providing the evidence from China. The study focuses on the relationship between wage inequality and international trade using the same firm-level data in two steps.

First, in order to capture the trade openness characteristics, the two dimensions of international trade are calculated: intensive margin and extensive margin, in each province based on the large sample of firm-level data. The Gini and Theil wage inequality indexes are computed in each province with firm-level data. Then the wage

inequality indexes are regressed on extensive margin and intensive margin controlling for province and year fixed effects. The author also considers the possible endogeneity issues of trade openness and proposes an instrument variable (IV) regression. The general results show that international trade is important in explaining wage inequality.

Chapter 2: Literature review

2.1 Literature relating to exports and productivity at the firm level

The relationship between openness and growth has always been highly debated in international economics from a policy perspective, and papers about how openness to trade affects growth, in particular productivity are ubiquitous in economic journals. Prior to 1995, trade economists discussed this linkage using aggregate data at the country level or industry level. Bernard and Jensen (1995) are the first scholars to use rich micro panel data at the firm-level to look at how exporters outperform the non-exporters in various dimensions of firm performance, including productivity.

2.1.1 Theory, hypothesis and empirics

In two influential works, Bernard and Jensen (1995, 1999) show that this heterogeneity is systematically related to trade participation. Within an industry, some firms export while many others do not and, even among exporters, the fraction of shipments exported is often small. Exporters are larger, more productive, and pay higher wages than other firms within the same industry. Additionally, exporters are observed in both net exporting and net importing industries, although the fraction of exporting firms and the fraction of exported output vary across industries with correlates of comparative advantage.

Bernard and Jensen's work changes the research direction in theory. Theoretical work about exports and productivity has been developed by (among many others) Bernard et al. (2003), Melitz (2003), Helpman et al. (2004), Bernard et al. (2007) and Melitz and Ottaviano (2008). Bernard et al. (2003) extend the Ricardian model to accommodate many countries, geographic barriers, and imperfect competition and the model captures qualitatively basic facts about Bernard and Jensen's empirical findings.

Melitz (2003) marks a milestone in the theory literature with respect of firm heterogeneity, which addresses Bernard and Jensen's empirical challenges by combining a model of industry equilibrium featuring heterogeneous firm productivity. Later there are developments based on the Melitz (2003) model, for example, Helpman et al. (2004) extend the model to foreign direct investment; Bernard et al. (2007) embed the Melitz model within the standard framework of general equilibrium trade theory using the concept of integrated equilibrium, as used in Dixit and Norman (1980) and Helpman and Krugman (1985); and Melitz and Ottaviano (2008) feature the relationship between trade and market size.

Bernard and Jensen's work also changed the research direction in empirical studies, with a subsequent increase in firm-level studies. One of the important empirical findings in this line of literature is that there is a productivity premium for exporters compared with those solely serving the domestic market. The cause of productivity differentials between exporters and non-exporters is one of the core issues addressed in the literature.

Trade economists provide two hypotheses; one is self-selection, that is, more productive firms become exporters because of the cost barrier to sell internationally.

The other is the role of learning-by-exporting; knowledge flows in the international market improve the post-entry performance of export starters.[2]

The ex ante productivity advantage of exporters suggests self-selection: exporters are more productive, not as a result of exporting, but because only the most productive firms are able to overcome the costs of entering export markets. Therefore the first possible explanation for self-selection is the existence of trade costs, especially sunk costs (Lopez, 2005). The costs of entering export markets include all costs incurred in getting a good to the final user other than the marginal cost of producing the good itself: transportation costs (both freight costs and time costs), policy barriers such as tariffs and non-tariff barriers, information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs, like wholesale and retail (Anderson and van Wincoop, 2004). Some studies have found that previous export experience increases the probability of exporting (e.g. Roberts and Tybout, 1997; Bernard and Jensen, 2004), which has been interpreted as evidence that entry costs are important.

According to Lopez (2005), the second explanation for self-selection is the conscious self-selection: firms making conscious decisions to increase productivity with the international markets in mind for importing technology and increasing research and development (R&D) or just the initial export orientation strategy. For example, Alvarez (2001) uses a survey of technological innovation for Chilean manufacturing firms and finds that about 60 percent of the firms that were exporting invested in R&D, while only 20 percent of the non-exporters invested in R&D; Hallward-Driemeier et al. (2002) argue that the initial orientation of the firm, whether

[2] For example, some economists argue that the mechanisms like new technical expertise from buyers, increasing competition and economies of scale will affect the exporters' productivity (Evenson and Westphal, 1995; Grossman and Helpman, 1991; Levinsohn, 1993; Harrison, 1994). See the following literature review of learning-by-exporting mechanisms for more detail.

it decides to be an exporter or a domestic-oriented firm, is exogenous to the productivity level of the firm; Pamukcu (2003) uses plant-level data from Turkey and shows that exporters use more imported capital goods and are more likely to innovate than non-exporters.

The literature focuses on the identification and investigation of the learning-by-exporting effect, because this is the welfare gain from exporting. The question behind the learning-by-exporting is the mechanism. For example, if exporting improves productivity via technology transfer from international buyers, what are the mechanisms by which this learning from exporting occurs? Or which role is played by different target countries of exports for higher productivity as a precondition or result of exporting? Blalock and Gertler (2004) report some anecdotal evidence from interviews with Indonesian exporting factory managers on this. For answering these questions, it is necessary to review the possible theoretical mechanisms for learning by exporting.

Krugman (1979) and Jovanovic and Lach (1991) have modelled the productivity gains from exporting for exporters as being caused by learning and adopting international best practice of production and distribution methods, receiving feedback from international customers, suppliers, and competitors, and other knowledge spillovers. In addition, various studies in the endogenous growth literature argue that exports enhance productivity through innovation (Grossman and Helpman, 1991; Rivera-Batiz and Romer, 1991), technology transfer and adoption from leading nations (Barro and Sala-i-Martin, 1995; Parente and Prescott, 1994), and learning-by-doing gains (Lucas 1988; Clerides et al., 1998).[3] Economies of scale from operating in

[3] The innovation argument is where firms are forced to continually improve technology and product standards to compete in the international market. The technological and learning-by-doing gains arise because of the exposure of exporting firms to cutting-edge technology and managerial skills from their international counterparts.

several international markets are also often cited as one other explanation for the learning-by-exporting hypothesis. The mechanism behind the type of learning-by-exporting effect described above can be further conceptualized using Rosenberg's (1982) "learning-by-using" hypothesis. Rosenberg defines learning-by-using as knowledge that can only be acquired after a product or process has been used. In the exporting context, this refers to learning acquired after being in the export market continuously over time (Yasar et al., 2006).

Since Bernard and Jensen's work, there has emerged a large amount of empirical literature documenting the topic of exports and productivity at the firm level. For example, Bernard and Wagner (1997) and Wagner (2002) for the case of Germany; Aw et al. (2000) for the case of Taiwan and Korea; Clerides et al. (1998) for the case of Colombia, Mexico and Morocco; Girma et al. (2003, 2004) for the case of the United Kingdom; van Biesebroeck (2005) for sub-Saharan African countries; Yasar et al. (2006) for Turkey; and De Loecker (2007) for Slovenia.

A significant share of studies has not found evidence for the learning-by-exporting hypothesis. In a survey article on international trade and technology diffusion, Keller (2004) concludes that "The analysis has shown that there is no econometric evidence for a strong learning-from-exporting effect", but goes on to say that "... it is puzzling that the econometric evidence is so strongly at odds with the case study evidence". Keller (2009) does provide more evidence in favour of learning from exporting and discusses outstanding issues related to measuring the exact channels.

Generally, Wagner (2007) notes, in 54 micro-econometric studies with data from 34 countries that were published between 1995 and 2006, details aside; the self-selection hypothesis has been confirmed by various authors, while the learning-by-

exporting hypothesis is somewhat mixed. However, a significant positive effect of export experience on a firm's productivity has been found in several studies for developing and transition countries such as Aw et al. (2000) for Korea, van Biesebroeck (2005) for nine sub-Saharan African countries, and De Loecker (2007) for Slovenia.

Take De Loecker (2007) for Slovenia for example, the author uses matched sampling techniques to analyse whether firms that start exporting become more productive, controlling for the self-selection into export markets. Micro data of Slovenian manufacturing firms operating in the period 1994-2000 are used. Overall he found that export entrants become more productive once they start exporting. The productivity gap between exporters and their domestic counterparts increases further over time. These results also hold at the industry level and are robust to other controls that may be associated with increased productivity, such as private ownership.

Harrison and Rodriguez (2010) explain this by concluding that the first generation evidence was drawn from high and upper middle income countries, so they found significant self-selection effects but minimal learning-by-exporting effects, owing to the fact that firms in developed countries are likely to be as efficient as those in their trading partners (Blalock and Gertler, 2004), but the second wave of empirical studies focused on developing countries and found strong learning-by-exporting effects. Despite ongoing controversies regarding the importance of learning by exporting, it could be safe to conclude that more productive firms find it easier to become exporters; both self-selection and learning by exporting affect firm productivity; and learning from exporting is more apparent among those less productive firms in technologically backward countries.

Another issue regarding the learning-by-exporting effect is the identification issue. According to De Loecker (2010), in theory, most models of international trade with heterogeneous firms, as introduced by Melitz (2003), rely on exogenous productivity shocks coupled with a fixed cost of exporting to generate the result that exporters are more productive. These models therefore provide no insight into the potential role of export promotion policies often pursued by developing countries. In empirical studies, learning-by-exporting evidence tends to point to the importance of learning from foreign markets through buyer-seller relationships where exporters can learn from foreign customers and rivals about improving product quality, shipment size, or even more directly by specific investment requirements. All of the abovementioned potential mechanisms are, however, never observed or modelled in our empirical models. De Loecker (2010) focuses on the role of exporting in shaping a firm's future productivity and argues that even when we only observe a firm's export status, learning by exporting can be detected by explicitly allowing the evolution of productivity to depend on previous export experience.

2.1.2 Methodology issues

In practice, most of the studies use labour productivity or total factor productivity (TFP) and researchers typically rely on a residual of a production function as a measure of productivity and test whether this increases post export entry. Therefore, the measurement of productivity becomes an issue. Earlier studies like Bernard and Jensen (1995) and many others usually use labour productivity, i.e. output per worker, value added per worker, wage per worker, etc. as the firm productivity measure.

Later the literature began to use TFP as the firm productivity measure, but many existing works on measuring TFP show that the traditional ordinary least squares (OLS) method is imprecise and biased and suggest using the Olley-Pakes (1996) (OP) approach (Amiti and Konings, 2007; De Loecker, 2007; etc). OLS estimates may suffer from simultaneity and selection biases. Simultaneity arises owing to the fact that firms will increase the inputs as the result of positive productivity shocks, because the true productivity is known to firms but not to an econometrician (Marschak and Andrews, 1944), in other words, the simultaneity bias is due to neglecting the unobserved productivity shocks.

Other approaches like instrumental variable (IV) and fixed effect (FE) of panel data methods are applied to control this simultaneity problem. However it is difficult to find reliable instruments and FE will solve the simultaneity problem only if the unobserved productivity shock is firm specific and time invariant. Selection bias arises from the relationship between productivity shocks and the probability of exit from the market, usually the negative correlation between capital stock and probability of exit for a given productivity shock will cause the coefficient on the capital variable to be biased downward (Mahmut et al, 2008). Olley and Pakes (1996) introduce a three stage semi-parametric approach that controls both biases instead of instruments, thus allowing us to estimate the productivity consistently and reliably.

Some others choose to use the Levinsohn and Petrin (2003) (LP) method to estimate the firm productivity, which is a modification of the OP approach to address the problem of simultaneity bias. Petrin et al. (2004) suggest using third-degree polynomials in LP, and Levinsohn and Petrin (2003) also note that such a choice leads to estimated parameters that are very similar to more complicated locally weighted estimation in LP. However, since the LP does not address the selection bias, in this

thesis, OP method is used to estimate the firm productivity by controlling both simultaneity and selection biases. In a more recent paper, De Loecker (2011) proposes a method to estimate firm productivity by considering the price effect since all empirical work relies on value not the physical output to estimate the production function. However, their results are much closer to OP methods.

For testing methodology, the earlier literature has mostly used OLS and panel data approaches. Wagner (2002), Girma et al. (2004), Alvarez and López (2005), and De Loecker (2007) begin to use the matching method to search for causal effects of starting or stopping to export on changes in productivity. In addition, Blundel and Costa Dias (2000) mention that a combination of matching and difference-in-difference (DID) is likely to improve the quality of the estimation of non-experimental evaluation studies.

The matching method aims to control for endogeneity of export status by creating control groups based on average treatment models as suggested by Heckman et al. (1997). The aim of this approach is to evaluate the causal effect of exporting on productivity and productivity growth by matching those export starters with non-exporters. The literature on matching econometrics is now well established, cf., Moffitt (2004), Cameron and Trivedi (2005), Lee (2005), and Abadie and Imbens (2006). This method exists in constructing a counterfactual which allows us to analyse how productivity of a firm would have evolved if it had not started exporting.

Besides matching, Yasar et al. (2006) use quantile regression to investigate the relationship between levels of exports and productivity at different quantiles. When observations are not identically distributed OLS estimates will be inefficient, and if there are long tails, extreme observations will have a significant influence on estimated coefficients. Quantile regression estimates are considered robust relative to

least squares estimates. In contrast to the least squares estimator, the quantile regression estimates place less weight on outliers and are found to be robust to departures from normality. The econometrics literature for quantile regression is illustrated in Koenker and Bassett (1978) and Buchinsky (1998).

2.2 Literature relating to heterogeneous export premium at different export destinations

The existence of an export premium is a well-established empirical finding in export and firm performance literature. Exporters are generally found to be larger and more productive than non-exporters, *ceteris paribus*. Melitz (2003) and other economists explain this stylized fact from the theoretical point of view: when there is the trade cost, the effects of competition and economies of scale make the exporters more productive and ultimately larger than non-exporters.

Though the export premium exists extensively, the next question is whether there is any heterogeneity in the export premium according to different export categories. For example, do firms engaging in inter-county trade, interprovincial trade and international trade have the same premium? According to the firm heterogeneity theory, the answer is both yes and no, because trade costs differ according to different export destinations.

Trading in goods across country borders is more complex than across province borders within a country, which is the border effect, characterized by McCallum (1995). Even for countries signing free trade agreements like the US and Canada,

interprovincial trade between Canadian provinces is much higher than international trade between Canadian provinces and US states.[4]

Similarly, trading across province borders is more complex than across county borders within a province, and this is especially true in China. The underdeveloped infrastructure and informal trade barriers usually make interprovincial trade in China very costly (Li, 2007; Amiti and Javorcik, 2008). In addition, the local governments in China are erecting provincial trade barriers to protect industries from competition (Kumar, 1994; Young, 2000). The export premium associated with the self-selection effect can help to identify the relative cost of doing different levels of trade.

Hence, we should observe the heterogeneity in the export premium between exporters undertaking the various levels of trade. Unfortunately, because of the unavailability of the data about firms undertaking different levels of trade, few studies have tried to address this question and previous literature has usually assumed a homogeneous export premium. There are few papers which directly address the heterogeneous learning-by-exporting effect. De Loecker (2007) first investigates and find that the productivity gains are higher for Slovenian manufacturing firms exporting towards higher income regions in the world, using data from 1994-2000. De Loecker (2007, p.84) writes that "to my knowledge this is the first paper that looks at productivity gains from entering export markets by distinguishing between various destinations".

Actually before De Loecker (2007), Damijan et al. (2004) considered heterogeneity and reported that in Slovenia the productivity difference between future export starters and non-exporters is higher for firms that start to export to more advanced markets. Later Silva et al. (2010) also consider the heterogeneous learning-

[4] Anderson and van Wincoop (2003) tried to solve this border effect puzzle. Using their approach, while the border effect decreases, it still exists quantitatively.

by-exporting effect and report no learning effects for firms that export to non-developed countries only but fast effects for exporters only to EU countries. Some others consider the heterogeneous ex ante productivity levels of exporters to different destinations (selection effect) (Wagner, 2012).

2.3 Literature relating to wage inequality and trade openness at the firm level

According to Harrison et al. (2010, 2011), in the literature, until the 1990s, the leading framework for understanding the possible link between trade and inequality was the HO model. The simple model predicts that countries export goods that use intensively the factor with which they are most abundantly. One implication of the model is that trade increases the real return to the factor that is relatively abundant in each country and lowers the real return to the other factor – known as the Stolper-Samuelson Theorem. This implies that developing countries, with an abundance of unskilled labour, should observe an increase of wages of unskilled workers relative to skilled workers and wage inequality should decrease after trade liberalization.

However, as stated in the introduction, a number of case studies of developing world dealt a serious challenge to this theory by documenting an increase in wage inequality in the developing countries which experienced major trade liberalization reforms (Harrison et al., 2010; 2011). Countries exhibiting this trend include Mexico, Colombia, Argentina, Brazil, Chile, India and China (Attanasio et al., 2004; Goldberg and Pavcnik, 2007; Topalova, 2007; Menezes-Filho et al., 2008, etc.). Economists have used mechanisms like skill biased technology change to explain this finding, however, most labour and trade economists were sceptical of assigning too great an

importance to trade-based explanations for the increase in inequality (Harrison et al., 2010; 2011).

The well-documented models to explain the wage inequality in developing countries before the line of firm heterogeneity models come from Feenstra and Hanson (1996), Davidson et al. (1999) as well as Dinopoulos and Segerstrom (1999). Feenstra and Hanson's (1996) task model shows that there is a range of tasks that are moved from the skill-rich country to the skill-poor country and the unskilled tasks in the skill-rich country are still relatively more skill intensive than in the skill-poor country, thus trade causes wage inequality to increase. Davidson et al. (1999) incorporate worker search frictions and unemployment into a standard trade model and demonstrate that such frictions can lead to a substantive revision of the distributional effects of trade, like wage inequality. Dinopoulos and Segerstrom's (1999) trade and innovation model shows that innovation can be an important channel for wage inequality to increase because through innovation trade affects income distribution in ways that are very different from a comparative advantage approach.

More recently, new theoretical predictions about the relationship between international trade and wage inequality between exporters and non-exporters have been established. This stream of theory focuses on heterogeneous firms with bargaining and labour market friction (Davis and Harrigan, 2011; Egger and Kreickemeier, 2009, 2012; Helpman et al., 2010; Bustos, forthcoming).

Davis and Harrigan (2011) adapt efficiency-wage theory to the Melitz model and showed that international trade can either increase or reduce wage inequality. Egger and Kreickemeier (2009) explore a Melitz-type model with a significant form of labour market friction, i.e. workers care about receiving a 'fair wage', and they showed that trade will increase wage inequality. Egger and Kreickemeier (2012) again

introduce the fair wage into the heterogeneous workers framework and show that income inequality between exporters and non-exporters can increase after trade openness.

The Helpman et al. (2010) framework adds more elements: searching frictions, bargaining between workers and employers, idiosyncratic match quality and employer testing to identify which worker will be the most productive. They demonstrated that when the fraction of exporting firms in a country is sufficiently small, an increase in the fraction of exporting firms, which is the increase of extensive margin of trade openness, will increase wage inequality in that country.

Bustos (forthcoming) presents a model where trade and capital account liberalization increase the profitability of skill-biased new technologies in all sectors, but there is cross-firm heterogeneity in technology adoption due to differences in productivity, fixed costs of adoption and credit constraints. Liberalization drives the adoption of new technologies in developing countries by increasing market size, eliminating restrictions on technology transfers and reducing interest rates. Only the most productive firms enter export markets, and thus make enough profits to cover the fixed cost of technology adoption. Foreign-owned firms are less subject to credit constraints, and hence are also more likely to be able to finance investment in technology. The model predicts that the level of technology spending and skill intensity after liberalization is discretely higher for exporters and foreign-owned firms, thus trade openness can increase wage inequality from the channel of skill-biased technical change.

The model developed by Melitz (2003) explains the export premium and the phenomenon that only the most productive firms can profitably export. Many empirical studies seem to confirm the wage premium of exporters compared with non-

exporters and the stylized fact that only a small fraction of firms can export and make a profit (for example, Bernard and Jensen, 1995; van Biesebroeck, 2005; De Loecker, 2007; etc.). Therefore, an increase of trade openness should increase the wage inequality between exporting firms and non-exporters within the country. On the empirical side at firm level, there are some empirical studies trying to identify the mechanisms of how trade increases wage inequality.

Menezes-Filho and Muendler (2011) use economy-wide linked employer-employee micro data and investigate resource reallocation directly, by following workers across employers and industries before and after a major trade reform in Brazil. They find that Brazil's trade liberalization triggers worker displacements, particularly from more protected industries, as trade theory predicts. However, neither exporting firms nor comparative-advantage industries absorb trade-displaced workers for several years. In fact, exporters hire significantly fewer workers than the average employer after trade liberalization. This finding implies that there are clear trade-related worker flows, but more productive firms fail to expand employment after trade liberalization so that sales shift to more productive firms while labour moves in the reverse direction or remains unallocated, thus causing wage inequality between exporters and non-exporters to increase.

Frias et al. (2009) use matched employer-employee micro data from Mexico to examine the wage premium paid by exporters and find that approximately two-thirds of the higher level of wages in larger, more productive plants is explained by higher levels of the wage premium, and that nearly all of the differential within-industry wage change due to export shocks is explained by changes in the wage premium. Amiti and Davis (2012) use Indonesian manufacturing data to study the effects of trade liberalization (tariff reduction) on firm workers' wages and find that a fall in

output tariffs lowers wages at import-competing firms, but boosts wages at exporting firms, thus increasing wage inequality.

Bustos (forthcoming) use Argentinean firm-level data to examine the interaction between trade and technology in the early 1990s when trade and capital account liberalization in Argentina took place, and find that the increase in the relative demand for skilled labour does not come from labour reallocation across sectors, nor across firms, but from upgrading skills within firms, thus increasing wage inequality. Firms that upgrade technology faster also upgrade skill levels faster. The results are robust after controlling for sector, initial productivity and size effects.

Helpman et al. (2012) extend the heterogeneous-firm model of trade and inequality from Helpman et al. (2010) and structurally estimate it with Brazilian matched employer-employee data. They show that the estimated model fits the data well, both in terms of some key moments as well as in terms of the overall distributions of wages and employment, and international trade is important for this fit. In the estimated model, reduction in trade costs has a sizeable effect on the measures of wage inequality.

2.4 Summary

Just as Hayakawa et al. (2009) point out, although many papers exist in the export and productivity literature, there are few papers on East Asian developing countries. It would be invaluable to replicate previous studies by using those countries' own micro data which have been studied before, since economic linkages are quite strong in East Asia, especially China compared with other regions. One might obtain empirically different results from those in previous studies looking at developed

countries or developing countries in other regions. China's export miracle suggests the significance of the relationship between productivity and the level of exports, which is particularly important from a policy perspective because China is still a labour abundant and technologically backward developing country. If exporting yields significant productivity benefits, the policy implications are quite different compared to exporting being advantageous because it selects the more efficient firms to compete internationally.

Similar questions have already been expressed by Yang and Mallick (2010), who argue that, drawing on matched Chinese firms during 2000 to 2002, a significant learning effect is found once the firm has entered the export market, especially during the second year after entry. This thesis, however, differentiates from Yang and Mallick (2010) in at least three ways: first, they use a much smaller dataset than in this study. Their dataset is derived from the World Bank investment climate survey that contains 2,340 firms from 2000 to 2002. Second, they use balanced panel data, taking no consideration of the impacts of firm exit and re-entry activities on estimating firms' productivity. Third, they only examine the question at aggregate level, lacking disaggregated data-level analyses. Luong (2011) also studies the learning-by-exporting effect using data from the Chinese automobile industry between 1998 and 2007 and finds no evidence of learning by exporting in the automobile sector.

In this thesis, the author aims to identify whether the learning-by-exporting effect exists at both aggregate data level and the disaggregated data level within different sectors, regions and ownership types. Methodologically, in the thesis, the author will use the augmented OP approach to gauge the firms' TFP, thus overcoming the possible simultaneity bias and selection bias. Such biases are important for an

emerging economy like China where the least productive firms exit the market and are replaced by new more productive firms owing to various shocks.[5] This study also uses quantile techniques to study the export premium and matching econometrics to investigate the learning-by-exporting effect.

Since there are few studies addressing the heterogeneous export premium, the study in this thesis, attempts to provide further evidence to the literature about the heterogeneity of the export premium for firms which export to different destinations. It is related to the work of Eaton and Kortum (2004, 2005) where export destination is used to understand the importance of fixed cost in entering export markets and to which extent they are market (country) specific. This study uses a unique private firm-level survey dataset and analyses the mixed export premium of firm performance at three levels of trade: inter-county, interprovincial and international. To the author's best knowledge, this is the first paper using export premium information to indirectly identify the internal trade cost between China's provinces.

The study in this thesis uses Chinese firm-level data to test the general predictions of the models that trade openness will increase wage inequality between firms when the fraction of exporting firms is small, given the reality of firm heterogeneity. Using sub-national data, there is no need to consider the labour market characteristics in the models because the labour market features (legal systems and institutions) are very similar within a country, which especially fits China's centralized policy orientation fact.

The purpose of the thesis is not to sort through the different theories to identify which specific theory is the most consistent with the data or which mechanism causes wage inequality to increase, but to estimate the general prediction that international

[5] For more information about firm exit and re-entry activity, refer to Manova and Zhang (2009), where they express the exit and re-entry of firms in detail. It can be seen from Table 6 in Chapter 3 that there are extensive entry and exit activities to the market throughout the period from 1999 to 2003.

trade will increase wage inequality. To the author's best knowledge, the contribution of this study is that it is the first to use Chinese firm-level data to demonstrate the impact of trade openness on wage inequality between firms in China.

It should be highlighted that we investigate the research questions in this thesis based on the firm-level data, and an extensive micro econometric analysis is done. Such research questions can also be analysed from other perspectives but little attention is given in this thesis due to the unavailability of the relevant data at the firm level, for example, product fragmentation trade in China. Lots of works deal explicitly with various aspects of China's role in production networks, for example, extensive margin and intensive margin, trade openness and wage inequality, which may be consistent with the growing product fragmentation trade, domestic consumption expansion in electronics, and South-South trade increasing.[6] These are aspects worth investigating but can only be done after giving product fragmentation a more explicit role in the analysis and the author leaves this to future research agenda, for example, by matching the firm level data with China's Customs data.

[6] See the works in this regard by Athukorala (2009, 2011, 2012), Athukorala and Yamashita (2009), Athukorala et al. (2009), Athukorala and Menon (2010), Baldwin (2006a, 2006b, 2010, 2011), Elek (2008), Feenstra (1998, 2008), and Freenstra et al. (1999).

Chapter 3: The Export Premium in China: An Empirical Investigation Using Firm-Level Data

3.1 Introduction

In the late 1970s, China began to adopt economic reform and more than three decades from 1978 to now have witnessed an unprecedented expansion in Chinese exports. These drastic changes in trade orientation provide a good opportunity to investigate the nature of the export premium in China's export miracle. If there is a strong export premium, China will continue to be directed to deeper integration with other countries, and support firms to go abroad.

In this chapter, the author uses a large Chinese firm-level dataset to investigate the export premium. Both an export dummy and export values are used to examine the average premium between exporters and non-exporters as well as the export premium between exporters with different export densities. The export premium is also examined at the disaggregated data level, i.e. across the years, sectors, provinces and different ownership types, owing to the well-known fact that China's exports come mostly from coastal provinces, foreign-invested firms and some key sectors like machinery and electronics.[7] In order to illustrate this uneven distribution, the largest 10 firms in terms of export volume in 2007 are shown in Table 3.1, and it can be seen

[7] Xu (2007, 2010) pointed out that in 2004, exports from 11 coastal provinces of Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan, accounted for 92% of exports from China as a whole. The machinery and electronics industry accounted for 18 percent of China's ordinary exports and 63 percent of China's processing exports, and nearly 60 percent of China's exports (processing exporting dominated). Exports of foreign-invested enterprises accounted for 28 percent for ordinary exports and 84 percent for processing exports in China - see Feenstra and Wei (2010) for more detail. Other findings imply that the high processing-intensive machinery and electronics industry by foreign-invested enterprises had less than 20 percent of domestic value added (Koopmans et al., forthcoming).

that all the firms were in coastal provinces, i.e. Guangdong, Jiangsu, Shanghai and Beijing, and most are foreign-invested companies, especially, Hongkong, Macao and Taiwan (HMT)-invested companies, and in the machinery and electronics sectors.

Table 3.1: The largest 10 exporters in 2007

Source: China Customs Statistical Yearbook (2007)
Note: The unit for export volume is US $ thousands. The full names for the firms are as follows: 1.Shenzhen Hongfujin Precision Industry Co. Ltd., 2. Dongguan External Processing and Assembling Service Co., 3. Maintek Computer (Suzhou) Co. Ltd., 4. Dagong (Shanghai) Electric Appliance Co., Ltd., 5. Tech-front (Shanghai) Computer Co. Ltd, 6. Nokia Telecommunications Ltd. (NTL), 7. Shenzhen Baoan District Foreign Economic Development General Co., 8. Compal Computer (Kunshan) Co. Ltd, 9. Yingshunda Technology Co. Ltd. and 10. Huawei Technology Co. Ltd. Foreign means that the firms are owned by other foreign except HMT companies. The ratio is the firm exports ratio over the exports at the national level.

An extensive search reveals that based on the firm-level data during the period from 1999 to 2003, China had strong export premiums in various specifications. In addition, using the TFP estimated with FE approach as a rough measure for productivity, the author finds that exporting firms were on average 2.54 percent more productive. The author also finds that firms with higher export values will be more productive. In addition, using quantile regression techniques in export dummy and export values specifications, the author finds that the export premium decreased with the higher quantile, which means that the larger the firms, the lower the premium.

The author finds that the export premium decreased over time and across industries and provinces as more firms engaged in exporting. Also, domestic firms

had a higher export premium than foreign-invested firms, which implies that when international trade costs are low, more firms can export, so the export premium will be lower.[8]

The chapter is organized as follows. In section 3.2 the author discusses the dataset and the features of Chinese firms. Section 3.3 talks about the export premium in China with aggregate data. Section 3.4 refers to the uneven export premium at the disaggregated levels—across the years, industries, provinces and ownership types. The last section concludes the chapter.

3.2 Data description and firms' characteristics

The sample of data used in this chapter comes from a rich firm-level unbalanced panel dataset covering more than 150,000 firms per year over the period 1999 to 2003. Such data are collected by China's National Bureau of Statistics annual survey focusing on the manufacturing industry, with more than 100 financial variables listed in the main accounting sheets of all firms, including gross product output, capital input, labour input, export sales value, etc., which is a rich source for the analysis of differences between exporters and non-exporters.[9] These firms include all the state-owned firms and others whose sales in mainland China are more than 5 million RMB (about US$600,000) per year and they cover more than 90 percent of China's industrial output value.[10]

[8] One example of this is the processing trade in China, for which the government at various levels will give favoured policy packages to support.
[9] The unit for the financial variables is thousands of RMB.
[10] Indeed, aggregated data of the industrial sector in China's Statistical Yearbook by the National Bureau of Statistics (NBS) are compiled from such a dataset.

Although this dataset contains unusually rich information, a few samples in the dataset are noisy and misleading due, in large part, to the mis-reporting by those firms (see Holz, 2004, for a discussion about possible problems of using China's data). [11] Following Jefferson et al. (2008) and Yu (2008), the author therefore drops the observations if the number of employees hired for a firm is less than eight people, since most of the improbable values are associated with smaller firms that usually do not have reliable accounting systems. [12]

Furthermore, observations with any of the following problems are dropped: (a) the firm started business after 2003; (b) the capital input equals to zero; (c) any of the following are not bigger than zero: the gross value, value added, wage, fixed capital, intermediate materials; (d) exports are negative or the sales are negative. Finally, after cleaning, this gives an unbalanced panel of 238,208 firms for the period 1999 to 2003 with 606,591 observations owing to the fact that some firms will leave the survey, some firms will re-enter the survey and there are some new entries.

Table 3.2 presents the basic information of the firm-level data. It can be seen that the exports in the sample covered more than 70 percent of national exports of manufactures, [13] which reflects that the sample includes most exporters in China. In 1999, 29,645 firms were exporting out of 110,993 firms, or about 26.7 percent, and in 2003, 43,069 firms out of 137,436 were exporting, which is about 31.3 percent, and in line with previous studies, exporting firms covered a small proportion of firms. However, the ratio of exporting firms increased from 26.7 percent to 31.3 percent

[11] For example, some firms report negative export volume and zero employment, and some firms are surveyed twice in the same year.

[12] In their paper, they also dropped those firms where the ratio of value-added relative to sales was less than zero or higher than one, because in our dataset, the 2001 survey did not report the value-added data, so this study ignores this. In China, if the number of employed workers is more than eight, it will not be treated as a small firm and actually in the earlier stage of China's economic reform from 1977 to the earlier 1980s, private firms could only hire a maximum of eight employees and this rule remained in place for about 10 years. See Chapter 5 for more about this.

[13] De Loecker (2007) used all Slovenian firms but the export volume from the firm-level data only accounted for between 82 and 89 percent of total national exports in the period 1994-2000.

from 1999 to 2003, which implies an increase in the extensive margin in China's exports.

Table 3.2: Basic information of Chinese firm-level data

Year	1999	2000	2001	2002	2003
Raw observations	162033	162883	169031	181557	196222
Manufacturing(14-43)	118835	119145	125274	133678	142636
Filtering observations	110993	111577	120706	125879	137436
Exporters	29645	31688	35212	38442	43069
Ratio (%)	26.71	28.40	29.17	30.54	31.34
Exports of firms	121.98	155.80	172.71	214.98	288.65
Manufacturing exports in China	174.99	223.74	239.76	297.06	403.42
Ratio	0.70	0.70	0.72	0.72	0.72

Note: The unit for export value is US$ billion. The author uses the yearly average exchange rate to transfer RMB to US$, and in fact, from 1999 to 2003, the average rate was 8.28 each year. The national manufacturing export data come from China Statistical Yearbook (1999 to 2003).

To capture the trade openness of extensive and intensive margins relating to China's firms' exports in more detail, following Alessandria and Choi (2010), the author introduces the ratio of exports to total sales and decomposes the ratio into three components:

$$\frac{Exports}{Total\ sales} = \frac{\sum_{i=1}^{n} ex_i}{\sum_{i=1}^{N} sales_i} = \left(\frac{\sum_{i=1}^{n} ex_i / n}{\sum_{i=1}^{n} sales_i / n}\right)\left(\frac{\sum_{i=1}^{n} sale_i / n}{\sum_{i=1}^{N} sales_i / N}\right)\left(\frac{n}{N}\right) \tag{3.1}$$

Where n is the number of exporters and N is the number of total firms, then the change of export share can be decomposed into intensive margin, sales premium and extensive margin:

$$\overbrace{\Delta ex}^{Export\ share} = \overbrace{\Delta(ex / sales^X)}^{Intensive\ margin} + \overbrace{\Delta(sales^X / sales)}^{Sales\ premium} + \overbrace{\Delta(n / N)}^{Extensive\ margin} \tag{3.2}$$

Here, sales premium is the ratio of the change in sales of exporters to total sales. This is similar to the meaning of 'export premium' in the title and 'export premium' in this thesis means compared to non-exporters, exporters are better. X indicates exporting firms. Table 3.3 shows the three components and their percentile change from 1999 to 2003.

From Table 3.3, it can be seen that with the increase of export share, both intensive margin and extensive margin increase, but the ratio of average sales of exporters to average sales of all firms decreases (see the similar findings in the export premium at disaggregated level analysis across the years in section 3.4 for more detail).

Table 3.3: Margin characteristics of Chinese firms

Components/Year	1999	2000	2001	2002	2003
Export share	0.19	0.21	0.21	0.23	0.24
Change (%)	--	10.53	0.00	9.52	4.35
Intensive margin	0.35	0.37	0.38	0.39	0.40
Change (%)	--	5.71	2.70	2.63	2.56
Export premium	2.06	2.03	1.94	1.91	1.90
Change (%)	--	-1.46	-4.43	-1.55	-0.52
Extensive margin	0.27	0.28	0.29	0.31	0.31
Change (%)	--	3.70	3.57	6.90	0.00

Tables 3.4 to 3.6 show the number of firms involved in the dataset distributed by every industry, province and ownership type respectively, with the industry distributed at the SIC (Standard Industrial Classification) two-digit industrial code.[14] As the case described in the introduction for exporting firms, the firms including both exporting and non-exporting firms also distribute strongly unevenly across industries,

[14]Here state-owned firms include domestic state-owned firms, state-owned joint venture enterprises, state-owned and collective joint venture enterprises and state-owned limited corporations. Foreign-invested firms include foreign-invested joint-stock corporations, foreign-invested joint venture enterprises, fully foreign-invested enterprise and foreign-invested limited corporations. Other types have similar sub-classifications so there is overlapping within each ownership type.

provinces and ownership types. The industries of textiles, clothing, chemical products, and manufacture of non-metallic mineral products, machinery and electronics dominate the dataset, and there are also a high proportion of firms from coastal provinces in China and over half firms are privately owned enterprises.

Table 3.4: Firms in various industries

Industry	Numbers	Ratio
Manufacture of foods (14)	7,786	2.90
Manufacture of beverages (15)	5,267	1.97
Manufacture of tobacco (16)	409	0.15
Manufacture of textile (17)	21,705	8.10
Clothing and other fibre products manufacturing (18)	14,646	5.46
Manufacture of leather, fur, and feather (19)	6,656	2.48
Processing of timber, manufacture of wood, bamboo, rattan, palm and straw products (20)	5,407	2.02
Manufacture of furniture (21)	2,981	1.11
Manufacture of paper and paper products (22)	8,164	3.05
Printing, reproduction of recording media (23)	5,953	2.22
Manufacture of articles for culture, education and sport activities (24)	3,834	1.43
Processing of petroleum, coking (25)	1,883	0.70
Manufacture of raw chemical materials and chemical products (26)	19,891	7.42
Manufacture of medicines (27)	5,390	2.01
Manufacture of chemical fibres (28)	1,574	0.59
Manufacture of rubber (29)	3,170	1.18
Manufacture of plastics (30)	12,517	4.67
Manufacture of non-metallic mineral products (31)	23,989	8.95
Smelting and pressing of ferrous metals (32)	6,101	2.28
Smelting and pressing of non-ferrous metals (33)	4,904	1.83
Manufacture of metal products (34)	16,726	6.24
Manufacture of general purpose machinery (35)	18,352	6.85
Manufacture of special purpose machinery (36)	11,657	4.35
Manufacture of transport equipment (37)	11,786	4.40
Arms and ammunition manufacturing (39)	8,543	3.19
Electrical machinery and equipment manufacturing industry (40)	17,012	6.35
Electronic and communication equipment manufacturing industry (41)	8,757	3.27
Instrumentation and computers, office machinery manufacturing (42)	6,420	2.40
Other manufactures (43)	6,548	2.44

Table 3.5: Firms in each province

Province	Number	Province	Number
Beijing(11)	5,742	Shandong(37)	18,124
Tianjin(12)	6,683	Henan(41)	9,691
Hebei(13)	9,369	Hubei(42)	8,523
Shanxi[1](14)	3,348	Hunan(43)	7,469
Inner Mongolia(15)	1,389	Hainan(46)	489
Liaoning(21)	8,334	Chongqing(50)	2,676
Jilin(22)	2,901	Sichuan(51)	5,718
Heilongjiang(23)	2,987	Guizhou(52)	1,996
Shanghai(31)	13,528	Yunnan(53)	2,004
Jiangsu(32)	33,604	Tibet(54)	291
Zhejiang(33)	33,018	Shanxi[2](61)	2,582
Anhui(34)	5,291	Gansu(62)	2,743
Fujian(35)	9,687	Qinghai(63)	382
Jiangxi(36)	3,984	Ningxia(64)	535
		Xinjiang(65)	1,427

Note: province code in parentheses, 11, 12, 13, 21, 31, 32, 33, 35, 37 and 44 are typical east coastal provinces.1 denotes the capital of the province is Taiyuan and 2 denote the capital of the province is Xi'an. The pronunciation of the two provinces is the same.

Table 3.6: Firms in each ownership type

Ownership	Number	Ratio
State-owned	52,906	22.21
Collectively-owned	78,943	33.14
Private-owned	132,065	55.44
HMT-owned	32,581	13.68
Foreign-owned	28,481	11.96

Note: Some firms are joint ventures; hence the sum of the ratio does not equal 100 percent. Foreign-owned means that the firms are owned by other foreign except HMT companies.

Table 3.7 shows the number of firms with specific features like continuing to exist, continuing to export and no exporting, etc. The table shows large exit and entry activity in every year. Most of the firms had a short life - 75 percent of firms had a life span of 1-3 years,[15] in which 33.4 percent just lasted for one year. In addition, most of

[15] Here, firm's life does not just mean that the firm dies but means that the firm exits from the survey and there are several reasons causing this: for state-owned firms, changing ownership to other styles

the active firms continued to exist during the period under analysis. Only less than 7 percent of firms exist discontinuously.[16]

This chapter looks at the effect of export market entry on a firm's performance and Table 3.7 also presents the information on how much export entry took place during the sample window. First, the export market entry rate was low. The majority of the active firms were non-exporters, for example, of firms existing for one year, the number of non-exporters was nearly four times that of the exporters. For those existing for more than one year continuously, the number of non-exporting firms continued to dominate. Second, export market entry took place occasionally for some firms. It was found that approximately 7.32 percent of firms would export discontinuously during their life span. Third, once firms started to export, most would tend to continue exporting. For those firms existing for five, four, three and two years, firms that continued to export for four, three and two years represented 62.8, 59.4, 63.3 and 73.9 percent of the all the possible exporting firms, respectively.

and the sales on mainland China is less than 5 million RMB; for other ownership, the sales on mainland China drop to less than 5 million RMB or ceased altogether.

[16] Firms existing discontinuously during their life span only account for a small proportion (less than 7 percent) of the total. The number of exporters in this group is not counted since the number should be negligible and makes little effect on the export market entry information.

Table 3.7: Basic features of Chinese firms

Features	Number	Ratio
Continuing to exist for 5 years	39,252	16.48
Continuing to export for 5 years	11,294	4.74
Exporting for 1 to 4 years	6,691	2.81
Non-exporting for 5 years	21,267	8.93
Continuing to exist for 4 years	20,382	8.56
Continuing to export for 4years	4,388	1.84
Exporting for 1 to 3years	3,005	1.26
Non-exporting for 4 years	12,989	5.45
Continuing to exist for 3 years	33,938	14.25
Continuing to export for 3 years	7,299	3.06
Exporting for 1 to 2 years	4,240	1.78
Non-exporting for 3 years	22,399	9.40
Continuing to exist for 2 years	48,832	20.50
Continuing to export for 2 years	9,882	4.15
Exporting for 1 years	3,497	1.47
Non-exporting for 2years	35,453	14.88
Existing for 1 year	79,472	33.36
Exporting	16,909	7.10
Non-exporting	62,563	26.26
Existing discontinuously	16,332	6.86

Table 3.8 shows the mean descriptive statistics of the main variables for each year.[17] The results show that all of the characteristics of log of output per labour, log of value added per unit of labour, log of sales per unit of labour and log of wage per unit of labour consistently increased during the period, but log of capital per unit of labour and log of employment moved in the opposite direction. This is an interesting finding, indicating that the employment of both labour and capital inputs fell but output increased, that is to say, the firm's productivity significantly increased.

[17] Here, the value added in 2001 is missing (not included in the survey), which implies that in the following analysis about export premium with value added, the observations should drop the year of 2001. In addition, in estimating the production function in Chapter 4, output is used, not value added, as the dependent variable.

Table 3.8: Mean statistics

	1999	2000	2001	2002	2003
Output pw	4.51	4.65	4.76	4.89	5.04
Value added pw	3.12	3.26	n.a.	3.51	3.67
Wage bill pw	1.82	1.92	2.02	2.10	2.20
Sales pw	4.45	4.60	4.71	4.85	5.01
Capital pw	3.40	3.43	3.44	3.46	3.40
Employment	5.05	5.01	4.94	4.91	4.88
Observations	110,993	111,577	120,706	125,879	137,436

Note: pw denotes per worker and all variables are in the logarithmic form.

3.3 Export premium in China

Are exporters larger than non-exporters? Figure 3.1 shows the export participation ratio plotted against firms' employment scale for the period 1999 to 2003. The ratio clearly increased with the employment scale; from nearly 20 percent of firms with less than 100 employees being exporters to 70 percent of firms with more than 2,500 employees being exporters. From the above information, the straightforward finding is that exporters are larger than non-exporters.

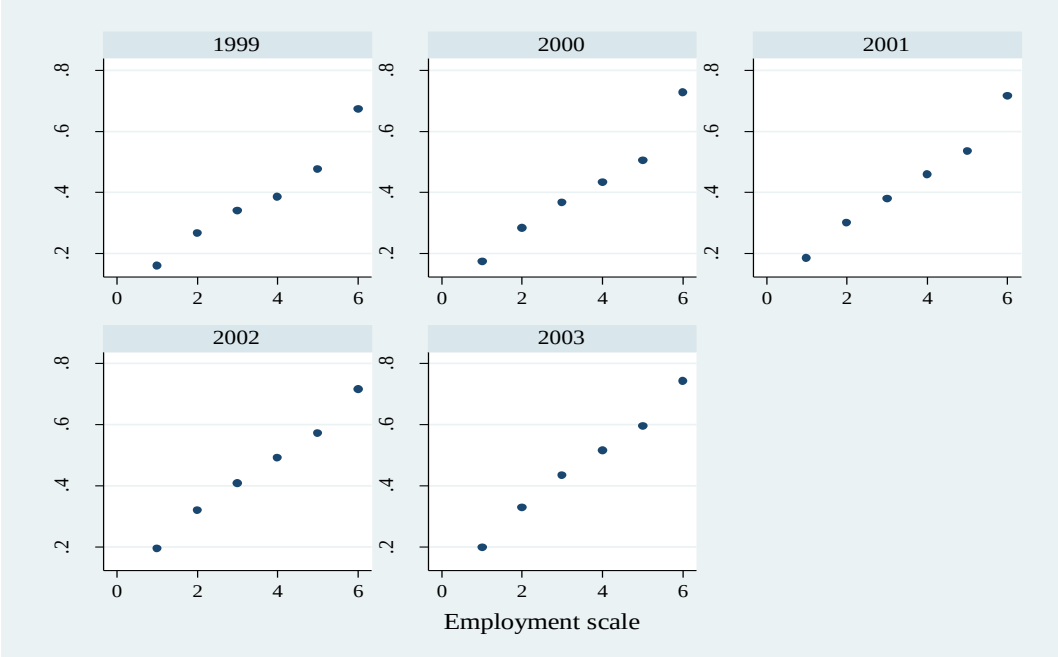

Figure 3.1: Export participation ratio and employment scale

Note: 1 means employment less than or equal to 100; 2 means employment between 101 and 250 inclusive; 3 means employment between 251 and 500 inclusive; 4 means employment between 501 and 1000 inclusive; 5 means employment between 1,001 and 2,500 inclusive; 6 means employment more than 2,500.

A comprehensive analysis is performed to show whether the findings in the literature – that exporting firms have different characteristics compared with non-exporting firms – also hold for a transition economy like China. Following Bernard and Jensen (1999), De Loecker (2007) and many others, the following regression (3.3) is run using pooled OLS and FE methods.[18] More importantly, the author controls the effects of industry, province and ownership owing to the fact that different ownership types and sectors behave very differently and the economic gap between west and east is very large.[19]

[18] Random effect analysis on the unbalanced panel requires much stronger assumptions (Wooldridge, 2002, Ch17). We also use random effect to run the regressions and the results are very similar.

[19] State-owned companies have more financial support from governments, and foreign-owned companies can get investment easily from abroad, which means the credit constraint is different across different ownerships. See: Manova (2008) studies the relationship between credit constraint and international trade; Li and Yu (2009) analyse the issue of credit constraint on export and productivity in China; Feenstra et al. (2011) study the relationship between export and credit constraint under incomplete information. In foreign-invested firms, behaviour varies according to country of origin.

$$x_{ikrvt} = \alpha_i + \beta Ex_{ikrvt} + \delta l_{ikrvt} + \phi Age_{ikrvt} + \sum_t \varphi_t Time_{it} + \sum_k \eta_k Indus_{it} + \sum_r \lambda_r Region_{it} + \sum_v \theta_v Owner_{it} + \varepsilon_{ikrvt} \quad (3.3)$$

where x_{ikrvt} refers to the firm characteristics of firm i at period t active in industry k and region r with ownership type v; Ex is an export status dummy, equal to one when the firm is an exporter and zero otherwise, l is the log of the number of employees of firm i, controlling for the scale of the firm, and Age is the firm i's age. The author controls for year, industry, region and ownership effects, where subscripts t, k, r and v refer to the effect of years ($Time$), industries ($Indus$), regions ($Region$) and ownership types ($Owner$), respectively.[20]

Coefficient β tells how the exporting firms are different from non-exporting firms in various dimensions, and more importantly, it can reflect the percentage differential between exporters and those who sell only to the domestic market (for log value of firm characteristics). Table 3.9 reports the results of the pooled OLS method and Table 3.10 shows the results of coefficient β estimated using the FE approach. From the tables, it is clear that the exporters are significantly different from the non-exporters.

HMT-invested firms are more export-oriented than other foreign firms. Most of the HMT affiliates are labour-intensive industries and the affiliates of western countries are technology-intensive, so firms from HMT and from western countries differ greatly, in terms of their ownership advantages, firms from HMT are export-oriented by processing with cheap labour costs in mainland China while firms from other counties like the US, EU and Japan focus on the domestic market of China (Huang, 2004; Branstetter and Foley, 2010).

[20] Here, for industry, the author distributes the industry at the SIC two-digit industrial level, and there are 29 industries with 28 dummies, with other manufacturing industry as the benchmark; for regions, the author uses the province code, 31 provinces with 30 dummies, and Tibet as the benchmark; for ownership, there are five categories – state owned, collectively owned, privately owned, HMT-invested, and other foreign-invested, with collectively owned as the benchmark.

Table 3.9: Firm characteristics differentials between exporters and non-exporters (OLS)

Firm characteristic(X)	β	Robust standard errors	R^2
Wage pw	0.0940***	(0.00214)	0.262
Value added pw	0.193***	(0.00387)	0.208
Output pw	0.0514***	(0.00316)	0.282
Sales pw	0.0611***	(0.00318)	0.285
Employment	0.705***	(0.00362)	0.170
Observations		606,591 (485,885)	

Note: Firm characteristic differentials between exporters and non-exporters. pw = per worker and all variables take the logarithmic form. Observations refer to the sum of firms and time products. Due to the missing data for value added in 2001, the number in brackets for the observations term is for value added pw regression. *** p<0.01

Table 3.10: Firm characteristics differentials between exporters and non-exporters (FE)

Firm characteristic(X)	β	Robust standard errors	R^2
Wage pw	0.0672***	(0.00397)	0.102
Value added pw	0.113***	(0.00670)	0.105
Output pw	0.115***	(0.00431)	0.183
Sales pw	0.121***	(0.00435)	0.183
Employment	0.0949***	(0.00358)	0.010
Capital pw	0.0621***	(0.00473)	0.200
TFP(FE)	0.0254***	(0.00209)	0.015
Observations/Firms		606,591/238,208 (485,885/230,329)	

Note: Firm characteristic differentials between exporters and non-exporters. pw = per worker and all variables except TFP take the logarithmic form. Observations refer to the sum of firms and time products, and firms refer to the number of cross-section firms. Due to the missing data for value added in 2001, the number in brackets for the observations/firms term is for value added pw regression. *** p<0.01.

From the pooled OLS method results $(100(Exp(\beta)-1)\%)$, it can be seen that exporters on average paid higher wages (10%), produced more (5.3%), sold more (6.3%), added more value (21.3%), operated on a larger scale and employed more workers (100%). For the FE approach, exporters paid on average higher wages (7%), produced more (12.2%), sold more (13%), added more value (12%), operated on a larger scale and employed more people (10%) and were more capital intensive (6.4%). Using TFP estimated with FE approach as a rough measure for productivity, exporting firms were on average 2.54 percent more productive.

In general, these results are in line with the findings of Bernard and Jensen (1995) for the US; Bernard and Wagner (1997) for Germany; Isgut (2001) for Columbia; van Biesebroeck (2005) for nine sub-Saharan African countries; and De Loecker (2007) for Slovenia. Furthermore, the results are consistent with the Alvarez and Lopez (2005) conclusion that exporting firms in developing countries with abundant labour are more capital intensive.[21]

Thus far, it is safe to conclude that in China there is a strong export premium; on average exporters outperform non-exporters in various characteristics. In order to test the related question of whether a firm with more exports will display a higher export premium, another regression (3.4) is run which controls the scale of the firm and the fixed effects relating to time, industry, province and ownership as follows:

$$x_{ikrvt} = \alpha_i + \beta ex_{ikrvt} + \delta l_{ikrvt} + \phi Age_{ikrvt} + \sum_t \varphi_t Time_{it} + \sum_k \eta_k Indus_{it} + \sum_r \lambda_r Region_{it} + \sum_v \theta_v Owner_{it} + \varepsilon_{ikrvt} \quad (3.4)$$

All the variables except ex have the same meaning as regression (3.3), and here ex is the log value of export volume of the firm. The pooled OLS and FE approach are used to run the regression. The coefficient of interest is β which can tell how the exporting firms are different from each other with different export volumes in various dimensions, and more importantly, it can reflect the elasticity change with a 1 percent increase in export value (for log value of firm characteristics). Tables 3.11 and 3.12 report the coefficient estimates of both methods.

[21] Previous studies find even more significant differences in transitional economies, like De Loecker (2007) for Slovenia, finding that exporters paid on average higher wages (16.14%), sold more (58.63%) and were more capital intensive (36%). This is because this study's dataset does not have those small and non-export firms; however, the firm-level export represents over 70 percent of total manufacturing export, and this will not affect our analysis about the export premium.

Table 3.11: Export premium between exporters (OLS)

Firm characteristic(X)	β	Robust standard errors	R^2
Wage pw	0.060***	(0.00113)	0.251
Value added pw	0.251***	(0.00232)	0.291
Output pw	0.298***	(0.00200)	0.411
Sales pw	0.304***	(0.00202)	0.419
Employment	0.312***	(0.00174)	0.350
Capital pw	0.0931***	(0.00217)	0.256
TFP(OLS)	0.0185***	(0.000484)	0.047
Observations		178,056 (142,844)	

Note: Firm characteristic differentials between exporters. pw = per worker and all variables except TFP take the logarithmic form. Observations refer to the sum of firms and time products. Due to the missing data for value added in 2001, the number in brackets for the observations term is for value added pw regression. *** p<0.01.

Table 3.12: Export premium between exporters (FE)

Firm characteristic(X)	β	Robust standard errors	R^2
Wage pw	0.0834***	(0.00238)	0.118
Value added pw	0.239***	(0.00457)	0.173
Output pw	0.256***	(0.00348)	0.381
Sales pw	0.269***	(0.00358)	0.399
Employment	0.115***	(0.00211)	0.075
Capital pw	0.0554***	(0.00240)	0.217
TFP(FE)	0.0644***	(0.00129)	0.073
Observations/ Firms		178,056/72,135(142,844/69,169)	

Note: Firm characteristic differentials between exporters and non-exporters. pw = per worker and all variables except TFP take the logarithmic form. Observations refer to the sum of firms and time products, and firms refer to the number of cross-section firms. Due to the missing data for value added in 2001, the number in brackets for the observations/firms term is for value added pw regression. *** p<0.01.

From Table 3.11, it can be seen that with every 1 percent increase in export value, the exporting firm on average will pay higher wages (0.06%), produce more (0.30%), sell more (0.30%), add more value (0.25%), operate on a larger scale and employ more workers (0.31%), be more capital intensive (0.093%), and using the OLS method TFP as the productivity level, will be 0.02 percent more productive. The FE approach results obtain similar findings, with every 1 percent increase in export value, a firm on average will pay higher wages (0.08%), produce more (0.26%), sell more (0.27%), add more value (0.24%), operate on a larger scale and employ more people (0.12%), be more capital intensive (0.06%), and using the fixed-effect method

TFP as the productivity level, will be 0.06 percent more productive. These results confirm that firms with more exports will have a much higher export premium.

In addition, the export premium at different points of the conditional distribution is examined. Both the export dummy and export volume are used in the specifications (3.3) and (3.4) to find the premium between exporters and non-exporters and the premium between exporters at three quantile levels, 0.25, 0.50 and 0.75. Tables 3.13 and 3.14 report the results. From the results, generally it is found that with the increase in the quantile, the premium decreases, which implies that the export premium falls with the firm's scale.

Table 3.13 shows that the employment increases with each quantile, which captures the firms' scales. However, other firm characteristics of per capita variables including the TFP show the decreasing trend of the export premium between exporters and non-exporters with the increase of firm scale. All firm characteristics including employment scale and TFP in Table 3.14 present the declining trend of the export values premium as the firm scale rises. Therefore, it is safe to conclude that with the increase in quantile, the premium decreases. These results differ from previous findings by Yasar et al. (2006), who analyse Turkish manufacturing firms and find that the productivity effect of exporting increases as one moves from the lower tail to the upper tail of the distribution.

Table 3.13: Quantile export premium between exporters and non-exporters

Firm characteristic (X)	0.25 Quantile	0.50 Quantile	0.75 Quantile
Wage pw	0.0877***	0.0646***	0.0542***
	(0.00223)	(0.00175)	(0.00198)
Output pw	0.0386***	0.0300***	0.0231***
	(0.00370)	(0.00358)	(0.00427)
Sales pw	0.0487***	0.0385***	0.0309***
	(0.00374)	(0.00362)	(0.00429)
Employment	0.563***	0.642***	0.715***
	(0.00398)	(0.00382)	(0.00455)
TFP (FE)	0.0112***	0.00587***	0.00174
	(0.000939)	(0.000970)	(0.00118)

Note: pw: per worker and all variables except TFP (FE) take the logarithmic form.*** p<0.01

Table 3.14: Quantile export premium between exporters

Firm characteristic (X)	0.25 Quantile	0.50 Quantile	0.75 Quantile
Wage pw	0.0597***	0.0483***	0.0465***
	(0.000919)	(0.000840)	(0.00107)
Value added pw	0.379***	0.280***	0.219***
	(0.00139)	(0.00182)	(0.00286)
Output pw	0.597***	0.359***	0.264***
	(0.000766)	(0.00146)	(0.00249)
Sales pw	0.635***	0.372***	0.269***
	(0.000702)	(0.00142)	(0.00235)
Employment	0.344***	0.333***	0.313***
	(0.00145)	(0.00155)	(0.00220)
Capital pw	0.0916***	0.0832***	0.0796***
	(0.00243)	(0.00230)	(0.00279)
TFP (FE)	0.111***	0.0759***	0.0573***
	(0.000270)	(0.000397)	(0.000646)

Note: pw: per worker and all variables except TFP (FE) take the logarithmic form.
*** p<0.01

From the above analysis, it is clear that in line with previous literature documenting the topic of exports and productivity at the firm level, China shows a strong export premium, that is, Chinese exporting firms are better in terms of various dimensions of firm characteristics than those firms which only serve the domestic market. In addition, as the scale effect in the Melitz (2003) model predicts, firms which have much higher productivity will export more and our results show that firms with more exports have a much higher export premium in various dimensions

including productivity measured by TFP. The quantile regression results show that across exporters and non-exporters, the larger the firms (higher quantile), the lower the premium. As has been mentioned above, in China, the export distribution is also strongly uneven across industries, regions and ownership types, so it is important to study the export premium at these disaggregated levels, and this is the task of the next section.

3.4 Export premium at the disaggregated data level

In order to study the export premium at the disaggregated data level, the labour productivity (the output per capita) is the firm characteristic used to run the regression (3.3) in every year, for each industry, each province and each ownership type, dropping the specific dummies, respectively. The author uses the OLS method for regression on every year and FE for the others. Tables 3.15 and 3.16 report the estimation results for the export premium of labour productivity in China for each year and each ownership type, respectively. The export premium in each industry and each province is presented in Figures 3.2 and 3.3.[22] Generally, this shows a significant export premium in the various regression analyses, which confirms the finding about the export premium in China.

[22] In Figures 3.2 and 3.3, the author drops the insignificant estimate results (though all are positive values).

Table 3.15: Firm yearly output differentials between exporters and non-exporters (OLS)

Output pw	β	Robust standard errors	R^2	HMT
1999	0.0995***	(0.00765)	0.305	8,746
2000	0.0813***	(0.00755)	0.290	9,336
2001	0.0356***	(0.00717)	0.266	10,385
2002	0.0422***	(0.00675)	0.245	10,289
2003	0.0313***	(0.00636)	0.238	11,851
Obs (min./max.)				110,993/137,436

Note: Firm output per capita differentials between exporters and non-exporters. pw = per worker and output take the logarithmic form. HMT denotes the number of HM- invested firms. *** p<0.01

Table 3.16: Firm output differentials between exporters and non-exporters in each ownership type (FE)

Output pw	β	Robust standard errors	R^2
State owned	0.200***	(0.0108)	0.155
Collectively owned	0.100***	(0.00719)	0.198
Privately owned	0.103***	(0.00508)	0.210
HMT owned	0.0731***	(0.00745)	0.163
Foreign owned	0.0910***	(0.00810)	0.144
Obs (min./max.)			68,927/275,727
Firms (min./max.)			28,481/132,065

Note: Firm output per capita differentials between exporters and non-exporters. pw = per worker and output take the logarithmic form. Observations refer to the sum of firms and time products, and firms refer to the number of cross-section firms. *** p<0.01.

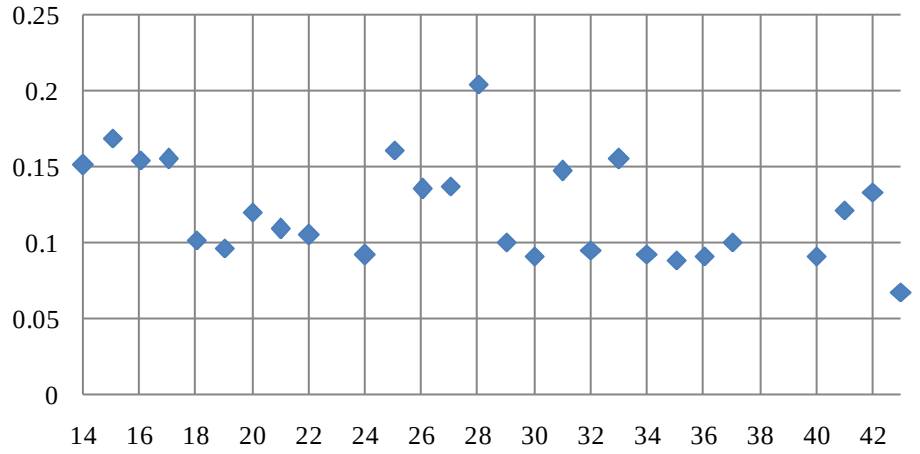

Figure 3.2: Export premium in each industry

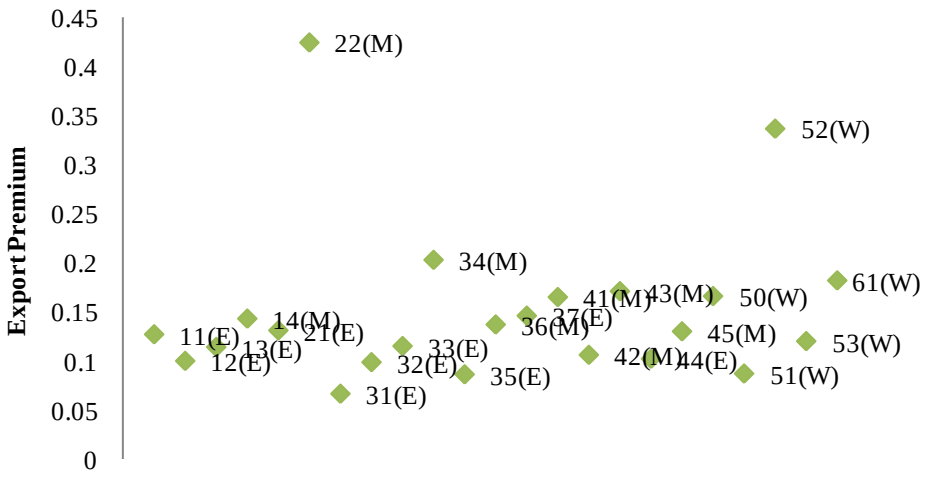

Figure 3.3: Export premium in each province

Table 3.15 shows that the export premium significantly declined from 1999 to 2003. In section 3.2, it was also found that the sales premium – average sales of exporters to average sales to all firms declined from 1999 to 2003. With the process of globalization, the barriers to enter international markets will fall, and more firms can enter the export market, thus causing the premium to come down.[23]

It is a well-known fact that China's exports are dominated by foreign-invested enterprises, in the machinery and electronics industry and by coastal provinces.[24] From Figures 3.2 and 3.3, it is also clear to see that the export premium of those exporting-intensive machinery and electronics industries and coastal provinces was smaller than for other industries and provinces. Table 3.16 shows that the export premiums for HMT-invested firms were the smallest, at 0.0731. For domestic firms, the export premium was much higher, at 0.2 for state-owned companies and about 0.1 for collectively owned and privately owned firms.

[23] See Tables 3.2 and 3.3 about the increase of the number of exporting firms and the increase of the extensive margin during the period from 1999 to 2003.
[24] See footnote 7 for more information.

The export of processed goods is the most important feature in China's trade, especially the processing by HMT-invested firms.[25] The most important motivation of HMT-invested enterprises to operate in mainland China is to make use of China's cheap labour and favoured treatment policy by various governments, like reduced taxes to process exporting.[26] The processing exporters have already built the stable distribution channel in foreign markets, thus greatly reducing the cost of international trade. Therefore, more firms can survive in the export market, and the export premium will decrease and that is why those export-intensive industries, provinces and ownership types have a smaller export premium.

In this section, the author tests the export premium by year, industry, province, and ownership type. While the export premium is confirmed in these regressions, it is decreasing over time and across industries, provinces and ownership types, and the more export-intensive the firms, the lower the export premium. The reason for this is the heterogeneity of trade costs, and with decreasing trade costs, more firms can become exporters, especially for Chinese HMT-invested processing exporters, and the export premium decreases.

3.5 Concluding remarks

In this chapter, a large firm-level panel dataset of China's manufacturing sector has been used to investigate whether the export premium exists in a developing and transitional economy like China. The data cover more than 150,000 firms per year

[25] Processing exports account for 55 percent or more of China's exports and processing is predominantly by foreign-invested enterprises (especially HMT-invested enterprises), and the ratio of foreign processing over the process exporting increased from 67 percent in 1999 to nearly 80 percent in 2003 (see Feenstra and Wei, 2010). Also see footnote 19 for different ownership advantages.

[26] Before 1 January 2008, the Corporate Income Tax rate for foreign-invested enterprises in China was 15 percent, compared to 25 percent for domestic firms. After 1 January 2008, the Corporate Income Tax was the same for foreign-invested firms and domestic firms, at 25 percent.

and cover more than 70 percent of China's manufacturing exports. An extensive investigation shows consistent findings with previous studies about the export premium at the firm level.

The features of the Chinese firm-level data are outlined as follows: first, exporting firms cover a small fraction of firms at about 30 percent; second, most of the firms have a short life span, with 33.4 percent firms having a life span of one year; third, when firms begin to export, most will keep exporting, and those firms existing for five, four, three and two years, tend to keep exporting for four, three and two years (accounting for 62.8, 59.4, 63.3 and 73.9 percent of the exporting firms), respectively; fourth, both intensive margin and extensive margin of firms' exports increases over time.

Various firm characteristics and both an export dummy and export values are used to test the export premium in China and find that there is a strong export premium. On average, during the period studied from 1999 to 2003, taking the FE approach estimated coefficients, for example, exporters paid higher wages (7%), produced more (12.2%), sold more (13%), added more value (12%), operated on a larger scale and employed more workers (10%) and were more capital intensive (6.4%). Using the TFP estimated with the FE method as a rough measure for productivity, exporting firms were on average 2.54 percent more productive.

It was also found that firms with more export values had a higher export premium. Taking the FE approach estimated coefficients, for example, on average with every 1 percent increase in export value, a firm paid higher wages (0.08%), produced more (0.26%), sold more (0.27%), added more value (0.24%), operated on a larger scale and employed more people (0.12%), and were more capital intensive (0.06%). Using the TFP estimated by the FE approach as the productivity level, a firm

was 0.06 percent more productive with a 1 percent increase in export value. Quantile regression results show that the higher the quantile, the lower the premium.

Finally, the export premium was tested across the years, industries, provinces and ownership types. The export premium was found to be decreasing over time, and the more export-intensive an industry, province or ownership type, the lower the export premium, because when there are low trade costs, more firms can become exporters, especially the processing exporters, so the export premium decreases.

Chapter 4: Exporting and Productivity in China: Self-Selection and Learning by Exporting

4.1 Introduction

The existence of the export premium is one of the important empirical findings in export and productivity literature at the firm level. The cause of productivity differentials between exporters and non-exporters is the core issue economists want to investigate and the related literature has been reviewed in Chapter 2. Generally, two hypotheses are suggested. One is self-selection – only the more productive firms choose to become exporters and can succeed in the export market – less productive firms are prevented from entering the export market because of the international cost barrier. The other is the role of learning by exporting – knowledge flows on the international market improve the post-entry performance of export starters.

In Chapter 3, the author found a significant export premium in China related to various firm characteristics. Using TFP estimated by the FE approach as a rough measure for productivity, it was found that exporting firms were on average 2.54 percent more productive, based on 1999-2003 data. This chapter disentangles this stable correlation between export status and productivity. In addition, the author analyses the relationship between exporting and productivity across industries, regions and ownership types. The dataset used is the same as in Chapter 3 and from the descriptive statistics of the data in Table 3.8 of Chapter 3, it can be seen that all the characteristics of log of output per capita, log of value-added per capita, log of sales per capita and log of wage per capita increased during the period, but log of

capital per capita and log of employment moved in the opposite direction, indicating that the employment of inputs falls but output increases. This finding implies that the firm's productivity has greatly increased, which supports the value of this research.

The structure of the chapter is as follows: the next section presents the estimation strategy to obtain a reliable measurement for TFP, taking account of the export status of a firm; section 4.3 talks about the parametric method to test the self-selection effect and the robustness check; section 4.4 presents the results of the learning-by-exporting effect both parametrically and non-parametrically; section 4.5 is the conclusion.

4.2 Estimating firm productivity

In this section the author discusses the estimation strategy for identifying firm productivity. Productivity is often estimated as the deviation between observed output and output predicted by a Cobb-Douglas production function. Usually, the production function is estimated by OLS. OLS estimates may suffer from simultaneity and selection biases. Simultaneity arises owning to the fact that firms will increase the inputs as the result of positive productivity shocks, because the true productivity is known to firms but not to the econometrician (Marschak and Andrews, 1944).

OLS estimation will be biased because of neglecting the unobserved productivity shocks. Other approaches like IV and FE of the panel data method are applied to control this problem. It is difficult to find reliable instruments and FE will solve the simultaneity problem only if the unobserved productivity shock is firm specific and time invariant. Selection bias arises from the relationship between productivity shocks and the probability of exit from the market, usually the negative

correlation between capital stock and probability of exit for a given productivity shock will cause the coefficient on the capital variable to be biased downward (Mahmut et al., 2008). Olley and Pakes (1996) introduce a three stage semi-parametric approach that controls both biases instead of instruments, thus allowing us to estimate the productivity consistently and reliably.[27]

The author extends the Olley and Pakes (1996) framework by allowing export status effect in the model. Following Mahmut et al. (2008) and others, the production form is as follows:

$$Y_{it} = F(L_{it}, M_{it}, K_{it}, a_{it}, \Omega_{it}) \tag{4.1}$$

For estimation purposes, Cobb-Douglas technology is assumed

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_m m_{it} + \beta_k k_{it} + \beta_a a_{it} + \mu_{it} \tag{4.2}$$

$$\mu_{it} = \Omega_{it} + \eta_{it} \tag{4.3}$$

where y_{it} is log output for firm i in period t; l_{it}, m_{it} k_{it} are the log values of labour, intermediate materials and capital inputs; a_{it} is the age of the firm; and Ω_{it} is the productivity shock that is observed by the firm. The productivity shock is dependent on capital input, investment, firm age and export status of the firm. η_{it} is the unexpected productivity shock, assumed to have no effect on the firm's decisions.

Standard estimation methods such as OLS treat μ_{it} as white noise. Running the regression gets the TFP as:

$$TFP^{ols} = y_{it} - \hat{y}_{it} \tag{4.4}$$

First, the investment decision rule is introduced to control for the correlation between the error term and the inputs. This is based on the assumption that any future

[27] This method has been used to analyse the impact of trade liberalization on plant productivity in Chile by Pavcnik (2002), and the effect of exporting on firm productivity in Slovenia (De Loecker, 2007).

productivity shock will have an effect on a firm's investment decisions. Following previous works such as van Biesebroeck (2005) and Amiti and Konings (2007), the author revises the OP approach by adding the firm's export decision as an extra argument of the investment function since most of firms' export decisions are determined in the previous period (Tybout, 2003).

Provided I_{it} is strictly positive, the inverse function for the unobserved shock, Ω_{it} can be written as,

$$\Omega_{it} = I^{-1}(i_{it}, k_{it}, a_{it}, Ex_{it}) = h(i_{it}, k_{it}, a_{it}, Ex_{it}) \tag{4.5}$$

It is strictly increasing in I_{it}, and this function can be used to control for the simultaneity problem; substituting (4.5) and (4.3) into (4.2) yields:

$$y_{it} = \beta_l l_{it} + \beta_m m_{it} + \phi(i_{it}, k_{it}, a_{it}, Ex_{it}) + \eta_{it} \tag{4.6}$$

where $\phi(i_{it}, k_{it}, a_{it}, Ex_{it}) = \beta_0 + \beta_k k_{it} + \beta_a a_{it} + h(i_{it}, k_{it}, a_{it}, Ex_{it})$

The term $\phi(.)$ is approximated with a second-order polynomial series in age, capital, investment and export dummy. From (4.6) it is possible to estimate the coefficients of labour and intermediate materials by the OLS method. The coefficients will be consistent because $\phi(.)$ controls for the unobserved productivity. However, it is still necessary to estimate the coefficients of capital and firm age.

To correct for the selection bias as mentioned above, the second step is required to estimate survival probabilities. Whether the firm chooses to stay in the export market or exit depends on some threshold productivity level $\overline{\Omega}_{it}$, which depends on capital, age and export status. The probability of survival in period t depends on the productivity level of the last stage and in turn on capital, age and export status at time $t-1$. Here, the probability of survival is estimated by fitting a

probit model $\hat{P}_{it}$ on investment, capital, age and the export dummy at time $t-1$ as well as their squares and cross products.

The third step involves running the following equation by non-linear least squares (Arnold, 2005):

$$y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it} = \beta_k k_{it} + \beta_a a_{it} + g(\hat{\phi}_{t-1} - \beta_k k_{i,t-1} - \beta_a a_{i,t-1} - \lambda Ex_{i,t-1}, \hat{P}_{it}) + \xi_{it} + \eta_{it} \tag{4.7}$$

where the unknown function $g(.)$ is approximated by a second-order polynomial in $\hat{\phi}_{t-1} - \beta_k k_{i,t-1} - \beta_a a_{i,t-1} - \lambda Ex_{i,t-1}$ and $\hat{P}_{it}$.

One of the essential components to calculate the OP-type TFP is to obtain data on investment, which is usually calculated by adopting the perpetual inventory method as follows:

$$I_{it} = K_{it} - (1-\delta)K_{it-1} \tag{4.8}$$

where, I_{it}, K_{it} denotes investment and fixed capital in year t for firm i, respectively. δ denotes a common depreciation rate across firms and years given that China did not change its depreciation rate over the period 1999-2003. Amiti and Konings (2007) adopt 15 percent for developing countries like Indonesia. China indeed may adopt a number up to 16 percent as its depreciation rate in some years in the 1990s (Wang and Yao, 2003), and since the difference is not very significant, in this thesis a rate of 15 percent is adopted for the depreciation just following Amiti and Konings (2007).

Finally, the author obtains the OP-type TFP once the coefficients of $\hat{\beta}_k$ and $\hat{\beta}_a$ are estimated:

$$TFP^{op} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_a a_{it} \tag{4.9}$$

Table 4.1: Production function estimates: OLS, FE and OP (aggregate)

Variables	OLS	FE	OP-EX
Log(labour)	0.0566***	0.122***	0.0516***
	(0.000868)	(0.00118)	(0.00124)
Log(capital)	0.0252***	0.0266***	0.0434***
	(0.000493)	(0.000778)	(0.00221)
Log(materials)	0.898***	0.737***	0.901***
	(0.00145)	(0.000759)	(0.00212)
Firm age	-9.79e-05***	-1.06e-05	-2.78e-05
	(9.71e-06)	(6.61e-06)	(1.86e-05)
Observations	606,591	606,591	356,917
R-square	0.956	0.758	

Note: *** p<0.01 and robust standard errors are in parentheses. OP-EX means controlled export status of firms in the OP method.

Table 4.2: Production function estimates: OLS, FE and OP (disaggregate)

	Labour coefficient			Capital coefficient		
Sectors	OLS	FE	OP-EX	OLS	FE	OP-EX
Food, beverage, tobacco	0.0542	0.103	0.0393	0.0271	0.0115	0.0506
Textile, fibre, leather	0.0664	0.101	0.0585	0.0218	0.0217	0.0217
Wood, straw, furniture	0.0706	0.0963	0.0530	0.0149	0.0157	0.00886
Paper, printing, culture	0.0586	0.107	0.0478	0.0281	0.0290	0.0330
Chemical-related, medicine	0.0532	0.129	0.0346	0.0329	0.0322	0.0628
Metal-related	0.0570	0.131	0.0451	0.0233	0.0245	0.0510
Machinery and electronics	0.0538	0.132	0.0412	0.0229	0.0300	0.0571
Others	0.0693	0.116	0.0666	0.0203	0.0168	0.0206
Regions	OLS	FE	OP-EX	OLS	FE	OP-EX
East	0.0630	0.140	0.0503	0.0309	0.0332	0.0491
Middle	0.0424	0.0835	0.0357	0.0164	0.0152	0.0475
West	0.0457	0.0972	0.0234	0.0127	0.00763	0.0525
	Intermediate material coefficient					
Sectors	OLS		FE		OP-EX	
Food, beverage, tobacco	0.930		0.789		0.937	
Textile, fibre, leather	0.888		0.773		0.893	
Wood, straw, furniture	0.891		0.796		0.919	
Paper, printing, culture	0.901		0.755		0.902	
Chemical-related, medicine	0.886		0.708		0.905	
Metal-related	0.890		0.694		0.898	
Machinery and electronics	0.905		0.742		0.909	
Others	0.892		0.752		0.901	
Regions	OLS		FE		OP-EX	
East	0.885		0.715		0.892	
Middle	0.915		0.770		0.922	
West	0.926		0.800		0.943	

Note: OLS estimates are all significant at the 1 percent level; FE estimates, the capital coefficient of the west region is insignificant, and capital coefficient of food et al. is significant at the 5 percent level, and others all significant at the 1 percent level; OP method estimates, the capital coefficient of wood et al. is insignificant, and capital coefficients of textile et al. and other manufacturing is significant at the 5 percent, and all others are significant at the 1 percent level. OP-EX means controlled export status of firms in the OP method. Since the table contains 33 regressions, for brevity, the author does not report the standard errors and the goodness-of-fit in each regression. The observations for the eight 'big sectors' listed are (in the order shown) 32,048, 41,573, 8,258, 17,599, 43,523, 50,605, 68,314 and 6,548 respectively. The observations for east, middle and west region are 431,987, 112,649 and 61,955 respectively.

Table 4.1 shows the estimated coefficients of variables in the production function (4.2) by the OLS approach, FE and OP approach with aggregate data. From Table 4.1, it can be seen that the firm age variable coefficients are insignificant, so the firm age variable is ignored, and the production function is estimated again with disaggregated data in each industry and region separately. Table 4.2 reports the

coefficients of different inputs estimated with OLS, FE and OP methods in each industry and region.[28]

As can be seen from Table 4.2, most of the capital input coefficients estimated by OLS and FE methods are downward biased compared with the OP method. These estimates of inputs by the OP method are used to construct the firm productivity level, which is then used to do further analysis about the hypothesis tests. If using the TFP estimated by the OP method to run the regression function (3.3) in Chapter 3 by FE, the author finds the productivity premium is 0.4 percent higher for exporters than non-exporters.[29]

4.3 Self-selection and learning by exporting

In Chapter 3, exporters were found to outperform non-exporters in terms of various firm characteristics, like the wage bill, sales levels, output, value added, capital intensity and employment, and when using TFP estimated with the OP approach as the productivity measure, there is still found to be an export premium. This section employs some econometrics to test the self-selection effect and the learning-by-exporting effect.

[28] At the SIC 2-digit industrial level, there are 29 sectors in Table 3.4 of Chapter 3. The author combined similar SIC 2-digit industries to get eight 'big sectors' for the estimation of the production function at sector level and in the following sectoral analysis about the learning-by-exporting effect, the author refers to these 'big sectors'. For the 2-digit industrial level in Table 3.4 of Chapter 3, food, beverage, tobacco is combined by 14-16; textile, fibre, leather is combined by 17-19; wood, straw, furniture is combined by 20-21; paper, printing, culture is combined by 22-24; chemical-related, medicine is combined by 25-30; Metal-related is combined by 31-34; machinery and electronics is combined by 35-42; and others is the same as 43.

[29] The OP-type TFP ranges from -5.52 to 11.71 in our sample, with a mean of 0.59 and standard deviation of 0.33.

4.3.1 Self-selection effect

The first approach to shed light on the empirical validity of the hypothesis mentioned – namely, that the more productive firms go abroad (self-selection effect) is to investigate the pre-entry export market differences in productivity between export starters and non-exporters. If good firms become exporters then it would be expected to find significant differences in productivity between future export starters and non-exporters several years before some of them begin to export. To test whether today's export starters were more productive than today's non-exporters several years back when all of them did not export, all firms that did not export between year t-j and t-1 are selected. The average difference in productivity is estimated in year t-j between those firms which started to export in year t and those who did not. More formally, the following empirical model is estimated as suggested by Wagner (2007):

$$Productivity_{ikrv(t-j)} = \alpha + \beta Ex_{ikrvt} + \delta Sl_{ikrv(t-j)} + \xi Sk_{ikrv(t-j)} + \phi Age_{ikrv(t-j)} + \sum_k \eta_k Indus_{i(t-j)} + \sum_r \lambda_r Region_{i(t-j)} + \sum_v \theta_v Owner_{i(t-j)} + \varepsilon_{ikrvt} \quad (4.10)$$

First let t be the year of 2003 and j=1, 2, 3, 4 and the controlled group are those firms which do not export at all throughout the period from 1999 to 2003.[30] So the pre-entry premium can be computed from the estimated coefficient β, which shows the average difference between exporters in 2003 and the non-exporters one to four years before some of them started to export in 2003. The firm characteristics including firm employment scale (employment), firm age, sector dummies, province dummies and ownership type dummies are controlled in a specific year.

[30] These firms either existed but did not export throughout the period from 1999 to 2002 or in some year they did not exist in the sample. In later cases, the idea is the same.

Second let t=2002, j=1, 2, 3, and choose those firms which do not export at all from 1999 to 2002 as controls. The pre-entry premium is computed between 2002 exporters and the non-exporters one to three years before some of them start to export in the year of 2002, while controlling for the firm characteristics some years before. Third, let t=2001, j=1, 2, and keep those firms which do not export at all from 1999 to 2001, then calculate the pre-entry premium between 2001 exporters and the non-exporters one to two years before some of them start to export in 2001, controlling for the characteristics before. Finally, let t=2000 and j=1. Those firms which do not export in the sample in the year of 1999 are kept as controls and the pre-entry premium is computed between 2000 exporters and the non-exporters one year before starting to export, controlling for the firm characteristics in 1999.

Furthermore, in order to confirm the findings and do the robust test, the probit and logit model are used to test how the pre-entry productivity affects a firm's export status in the later years with the following econometric model.

$$Ex_{ikrvt} = \alpha + \beta Productivity_{ikrv(t-j)} + \delta l_{ikrv(t-j)} + \xi k_{ikrv(t-j)} + \phi Age_{ikrv(t-j)} + \sum_k \eta_k Indus_{i(t-j)} + \sum_r \lambda_r Region_{i(t-j)} + \sum_v \theta_v Owner_{i(t-j)} + \varepsilon_{ikrvt} \quad (4.11)$$

Let t=2003, j=1, 2, 3, 4, and the controlled group consists of those firms which did not export at all throughout the period from 1999 to 2002. The pre-entry productivity effect on a firm's future export status can be computed from the estimated coefficient β, which shows the average effect on increasing the probability of a firm to become an exporter in 2003, controlling for the characteristics including firm employment scale, firm age, sector dummies, province dummies and ownership type dummies some years before.

Similarly, let t=2002, j=1, 2, 3, computing the average probability increasing effect of pre-entry productivity on a firm's exports in 2002; and let t=2001, j=1, 2 computing the average probability increasing effect of pre-entry productivity on a firm's exports in 2001; and finally, let t=2000, j=1, computing the average probability increasing effect of pre-entry productivity on a firm's exports in 2000.

Table 4.3: Self-selection hypothesis test results

Dependent variable	Productivity(1999)		Productivity(2000)		Productivity(2001)		Productivity(2002)	
Export(2003)	0.0115		0.0197**		0.0185***		0.0186***	
Export(2002)	0.0194**		0.0238***		0.0211***			
Export(2001)	0.0273***		0.0260***					
Export(2000)	0.0334***							
Dependent variable	Export(2003)		Export(2002)		Export(2001)		Export(2000)	
	Probit	Logit	Probit	Logit	Probit	Logit	Probit	Logit
Productivity(1999)	0.0548	0.131	0.0943**	0.218***	0.139***	0.311***	0.161***	0.338***
Productivity(2000)	0.107**	0.235**	0.129***	0.272***	0.129***	0.280***		
Productivity(2001)	0.109***	0.237**	0.126***	0.272***				
Productivity(2002)	0.0887***	0.198***						

Notes: the tests control for the firm characteristics including firm scale variables, industry dummies, province dummies and ownership type dummies as appropriate but not reported. The table contains 30 regressions and for brevity, the author does not report the robust standard errors and the goodness-of-fit. The significance levels are denoted as: *** p<0.01, ** p<0.05, * p<0.1. The observations are ranged from 27,470 to 60,549.

Table 4.3 presents the results of the self-selection effect (coefficient β) in various years estimated by equations (4.10) and (4.11). Generally, consistent with the findings in previous literature, the self-selection effect estimated by two specifications is highly significant. Future exporters displayed the productivity premium several years prior to exporting and the higher productivity of the firm today, the easier for the firm to become exporters tomorrow. Furthermore, comparing the magnitude of the estimates in different years, it can be seen that the productivity premium of future exporters was strongly uneven across the years. Specifically, during the period when all the firms were non-exporters, the nearer to the starting exporting point, the premium of ready-to-export firms was more significant, which implies that the

productivity of future exporters increases much faster than for those firms which will never export.

Take the productivity in 1999 for example: on average, the firms that started to export in 2000 were 3.34 percent more productive in 1999 than those firms that did not export at all; the firms that started to export in 2001 were 2.73 percent more productive in 1999 than those firms that did not export at all; and the firms that started to export in 2002 were 1.94 percent more productive in 1999 than firms that did not export at all. Finally, regarding the productivity of firms that started to export in 2003, the premium compared with the non-exporters in 1999 is insignificant.

4.3.2 The learning-by-exporting effect

First, the author plots the trends of average productivity evolution between non-exporters and exporters for the period 1999 to 2003. The measurement of productivity is TFP estimated with the OP method. Exporters are chosen that started to export in 2000, 2001, 2002 and 2003. As shown in Figure 4.1, on the one hand, the productivity of export starters was always higher than for non-exporters; on the other hand, after exporting, there was productivity overshooting. Both features show some evidence of the learning-by-exporting effect at the aggregate level.

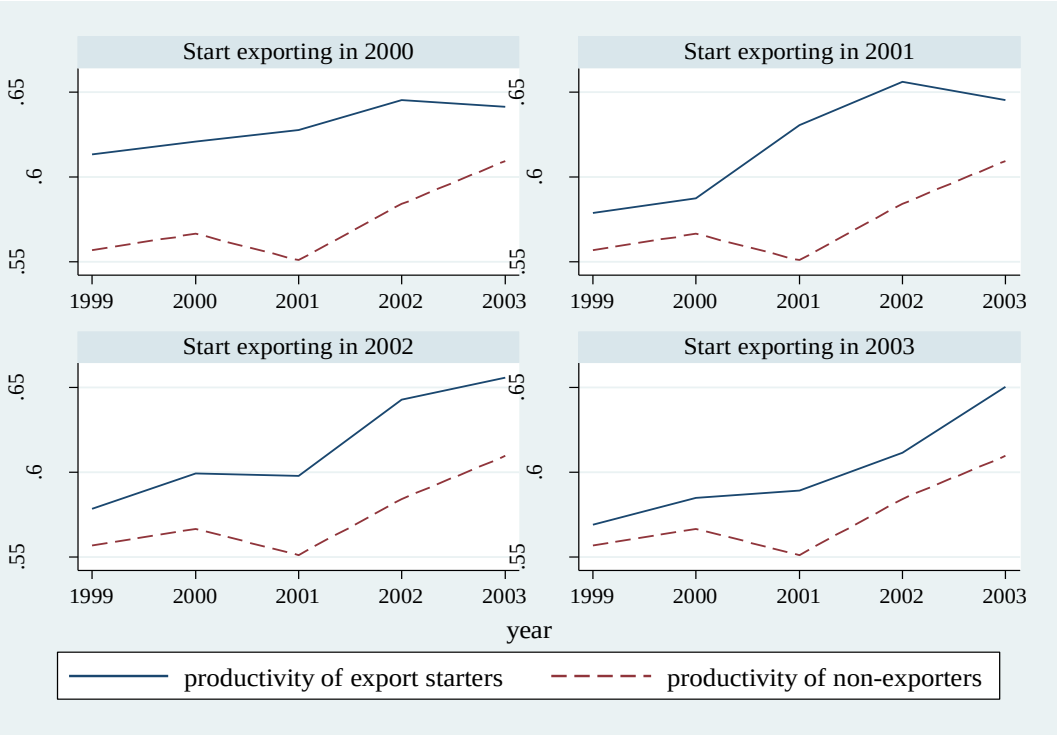

Figure 4.1: Is there a learning-by-exporting effect?

Next a parametric method is used to test the learning-by-exporting effect, choosing firms that start exporting in year *t* and firms that never export, and it is estimated how exporting leads to increased productivity, compared with non-exporters. For comparison purposes, the author does not incorporate firms that were exporters over the entire sample period from 1999 to 2003. The exporters have a significant self-selection effect, i.e. before exporting, their productivity is already higher than the non-exporters. Therefore, after exporting, the author looks into how the exporters' productivity growth outperforms the non-exporters to investigate the learning-by-exporting effect. The following empirical models are estimated:

$$TFP_{i,(t+j)} - TFP_{i,(t+j-1)} = \alpha + \beta^{t}_{lbe} Start_{it} + cControl_{i,(t+j-1)} + \varepsilon_{i,(t+j)} \quad (4.12)$$

$$TFP_{i,(t+j)} - TFP_{i,(t-1)} = \alpha + \beta^{T}_{lbe} Start_{it} + cControl_{i,(t-1)} + \varepsilon_{i,(t+j)} \quad (4.13)$$

Firms are chosen which started exporting in year t and once they began to export, they continued to export until 2003. These continuous exporters are the treated group and the non-exporting firms from 1999 to 2003 are the control group.[31]

Let t be the year of 2000, 2001, 2002 and 2003, and $t + j \leq 2003$. The learning-by-exporting effect can be estimated by the coefficient β. The first coefficient β_{lbe}^{t} shows the average yearly learning effect between export starters and non-exporters every year at 2000, 2001, 2002 and 2003, respectively. The second coefficient β_{lbe}^{T} shows the cumulative learning effect at the year of 2000, 2001, 2002 and 2003, respectively. Both effects will have somewhat different interpretations. Exporting firms should become more productive and grow faster with respect to their pre-export productivity level; however, they need not grow faster every year after entering the export market.

Table 4.4 presents the results of β_{lbe}^{t} and β_{lbe}^{T} at the aggregate data level, other controls including productivity at base year, firm age at base year, industry dummies, province dummies and ownership type dummies are included in the regressions as appropriate but not reported.[32] There are significant learning-by-exporting effects across the years after starting to export, with the learning effect most significant in the second year after exporting. Take the firms that started to export in the year of 2000 for example; the annual productivity growth from 1999 to 2000 was 2 percent more than for non-exporters and the annual productivity growth from 2000 to 2001 was

[31] Chapter 3 showed that after exporting, most firms continued to export (see Table 3.7).

[32] Here, unlike the self-selection test using productivity level as the dependent variable, we use productivity growth as the dependent variable. Therefore, we control the productivity at the base year rather than the firm scale variables in the self-selection test. We do not incorporate firm age in the estimate of firm productivity with the OP method, so do the same with self-selection effect test, and we still control firm age in the learning-by-exporting test. These controls are the same with the following matching test.

3.88 percent more than for non-exporters. The cumulative productivity growth from 1999 to 2001 was 4.34 percent higher for export starters than for non-exporters.

Table 4.4: Learning-by-exporting hypothesis test results (aggregate)

	Productivity growth	1	2	3	4
Start2000	Annual growth	0.0207***	0.0388***	0.0276***	0.00501
		(0.00792)	(0.00451)	(0.00427)	(0.00546)
	Cumulative growth	0.0207***	0.0434***	0.0399***	0.0337***
		(0.00792)	(0.00809)	(0.00870)	(0.00914)
Start2001	Annual growth	0.0226***	0.0422***	0.0114***	
		(0.00722)	(0.00312)	(0.00370)	
	Cumulative growth	0.0226***	0.0401***	0.0265***	
		(0.00722)	(0.00887)	(0.00728)	
Start2002	Annual growth	0.00627	0.0240***		
		(0.00589)	(0.00443)		
	Cumulative growth	0.00627	0.0144		
		(0.00589)	(0.0114)		

Note: Productivity growth is the dependent variable. Firm age at base year, productivity level at base year, province dummies, industry dummies and ownership type dummies are controlled. Each regression is like a cross-section analysis, i.e. for export starters in 2000, when testing the learning-by-exporting effect in 2000, the dependent variable is the productivity growth from 1999 to 2000, and 1999 is the base year. Observations (goodness of fit) for Start2000 (start to export in 2000), annual growth regression from left to right are 54,923 (0.288), 51,501 (0.297), 60,251 (0.284), 60,938 (0.162); cumulative growth regression from left to right: 54,923 (0.288), 40,951 (0.301), 34,019 (0.388), 27,726 (0.304). Similarly, for Start2001, annual growth: 48,538 (0.299), 62,533 (0.284), 63,220(0.164), cumulative growth: 48,538 (0.299), 39,917 (0.367), 32,559 (0.268); for Start2002, annual growth: 58,209 (0.288), 63,707 (0.159), cumulative growth: 58,209 (0.288), 46,677 (0.204). Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Furthermore, those firms which start exporting in 2000 are chosen to see the learning-by-exporting effect at the disaggregated level, owing to the fact that the learning-by-exporting effect for firms starting to export in 2000 offers more estimators than other cases, which can help to identify the trend of learning by exporting over time more clearly. The author investigates the learning-by-exporting effect at industry level, regional level and different ownership types. Table 4.5, 4.6 and 4.7 report the learning effects with different industries, regions and ownership styles.

Table 4.5: Learning-by-exporting hypothesis test results (sectoral)

	Productivity growth	1	2	3	4
Food, beverage, tobacco	Annual growth	-0.0426	0.0137	0.00584	-0.0234
		(0.0290)	(0.0247)	(0.0280)	(0.0182)
	Cumulative growth	-0.0426	-0.0203	-0.0329	-0.0162
		(0.0290)	(0.0306)	(0.0475)	(0.0355)
Textile, fibre, leather	Annual growth	0.00409	0.00818	-0.00522	-0.000201
		(0.0149)	(0.00948)	(0.00800)	(0.00826)
	Cumulative growth	0.00409	0.0155	0.00132	0.0318
		(0.0149)	(0.0177)	(0.0166)	(0.0236)
Wood, straw, furniture	Annual growth	-0.0270	0.0375	-0.00272	0.00431
		(0.0249)	(0.0230)	(0.0194)	(0.0130)
	Cumulative growth	-0.0270	0.00495	0.0130	-0.0141
		(0.0249)	(0.0239)	(0.0248)	(0.0281)
Paper, printing, culture	Annual growth	0.0484	0.0250	-0.0110	0.00454
		(0.0428)	(0.0270)	(0.0123)	(0.0146)
	Cumulative growth	0.0484	0.0435	0.0101	0.00702
		(0.0428)	(0.0315)	(0.0369)	(0.0308)
Chemical-related, medicine	Annual growth	-0.0313*	-0.000185	-0.0136	-0.00660
		(0.0162)	(0.0101)	(0.00947)	(0.0189)
	Cumulative growth	-0.0313*	-0.0253	-0.00959	-0.0492***
		(0.0162)	(0.0159)	(0.0209)	(0.0188)
Metal-related	Annual growth	-0.00679	-0.000219	0.0236	0.00487
		(0.0133)	(0.00902)	(0.0152)	(0.0214)
	Cumulative growth	-0.00679	0.00985	-0.0102	0.00277
		(0.0133)	(0.0137)	(0.0151)	(0.0170)
Machinery and electronics	Annual growth	-0.0305**	-0.0131*	-0.00831	-0.0274***
		(0.0128)	(0.00720)	(0.00723)	(0.00793)
	Cumulative growth	-0.0305**	-0.000101	0.00357	-0.00931
		(0.0128)	(0.0132)	(0.0162)	(0.0129)
Others	Annual growth	-0.0399	0.0301	-0.00169	-0.0125
		(0.0394)	(0.0243)	(0.0138)	(0.0177)
	Cumulative growth	-0.0399	0.0300	-0.0151	0.0324
		(0.0394)	(0.0362)	(0.0338)	(0.0505)

Note: Productivity growth is the dependent variable. Firm age at base year, productivity level at base year, province dummies, and ownership type dummies are controlled. Each regression is like a cross-section analysis, i.e. for export starters in 2000, when the author tests the learning-by-exporting effect in 2000, the dependent variable is the productivity growth from 1999 to 2000, and 1999 is the base year. Observations (goodness of fit) for food et al., annual growth regression from left to right are 4,123 (0.387), 3,351 (0.465), 3,627 (0.516), 3143 (0.217); cumulative growth regression from left to right: 4,123 (0.387), 2,943 (0.415), 2,333 (0.527), 1,684 (0.476). Similarly, for textile et al., annual growth: 5,180 (0.262), 5,543 (0.309), 6,985 (0.418), 6,982 (0.284); cumulative growth: 5,180 (0.262), 3,737 (0.270), 3,054 (0.326), 2,222 (0.374). For wood et al., annual growth: 1,556 (0.428), 1,402 (0.354), 1,713 (0.287), 1,718 (0.491); cumulative growth: 1,556 (0.428), 1,075 (0.553), 820 (0.333), 625 (0.402). For paper et al., annual growth: 4,882 (0.408), 4,581 (0.300), 5,181 (0.399), 5,235 (0.377); cumulative growth: 4,882 (0.408), 3,839 (0.376), 3,206 (0.562), 2,664 (0.466). For chemicals and medicine, annual growth: 10,388 (0.289), 9,755 (0.343), 11,313 (0.341), 11,761 (0.183); cumulative growth: 10,388 (0.289), 7,797 (0.302), 6,568 (0.420), 5,423 (0.290). For metals, annual growth: 13,342 (0.390), 11,813 (0.412), 13,888 (0.283), 14,100 (0.185); cumulative growth: 13,342 (0.390), 9,597 (0.426), 8,103 (0.444), 6,713 (0.275). For machinery and electronics, annual growth: 14,782 (0.359), 14,254 (0.347), 16,629 (0.366), 17,079 (0.182); cumulative growth: 14,782 (0.359), 11,491 (0.369), 9,555 (0.516), 8,070 (0.449). For others, annual growth: 670 (0.382), 802 (0.400), 915 (0.503), 920 (0.251); cumulative growth: 670 (0.382), 472 (0.382), 380 (0.578), 325 (0.537). Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.6: Learning-by-exporting hypothesis test results (regional)

	Productivity growth	1	2	3	4
East	Annual growth	0.0222***	0.0342***	0.0263***	0.00225
		(0.00778)	(0.00479)	(0.00452)	(0.00574)
	Cumulative growth	0.0222***	0.0438***	0.0437***	0.0301***
		(0.00778)	(0.00841)	(0.00926)	(0.00983)
Middle	Annual growth	0.00696	0.0245	0.00841	-0.0202
		(0.0473)	(0.0182)	(0.0205)	(0.0142)
	Cumulative growth	0.00696	0.0457	0.00131	0.00548
		(0.0473)	(0.0317)	(0.0242)	(0.0257)
West	Annual growth	-0.0726	0.0498**	0.00176	0.00995
		(0.0626)	(0.0233)	(0.0167)	(0.0196)
	Cumulative growth	-0.0726	-0.0396	-0.0341	-0.0182
		(0.0626)	(0.0533)	(0.0506)	(0.0478)

Note: Productivity growth is the dependent variable. Firm age at base year, productivity level at base year, sector dummies, and ownership type dummies are controlled. Each regression is like a cross-section analysis, i.e. for export starters in 2000, when the author tests the learning-by-exporting effect in 2000, the dependent variable is the productivity growth from 1999 to 2000, and 1999 is the base year. Observations (goodness of fit) for east region, annual growth regression from left to right are 31,190 (0.251), 31,343 (0.253), 38,884 (0.239), 41,251 (0.101); cumulative growth regression from left to right: 31,190 (0.251), 23,397 (0.261), 19,559 (0.329), 16,632 (0.214). Similarly, for middle region, annual growth: 15,710 (0.285), 12,519 (0.306), 13,545 (0.360), 12,376 (0.258); cumulative growth: 15,710 (0.285), 11,243 (0.312), 9,153 (0.443), 6,829 (0.418). For west region, annual growth: 8,023 (0.350), 7,639 (0.394), 7,822 (0.301), 7,311 (0.293); cumulative growth: 8,023 (0.350), 6,311 (0.369), 5,307 (0.460), 4,265 (0.485). Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.7: Learning-by-exporting hypothesis test results (ownership)

	Productivity growth	1	2	3	4
State	Annual growth	-0.00531	0.0511***	0.0410**	0.0110
		(0.0244)	(0.0107)	(0.0194)	(0.0121)
	Cumulative growth	-0.00531	0.0229	-0.0156	0.0223
		(0.0244)	(0.0187)	(0.0179)	(0.0198)
Collective	Annual growth	0.0355**	0.0507***	0.0257***	-0.00139
		(0.0162)	(0.0102)	(0.00950)	(0.0191)
	Cumulative growth	0.0355**	0.0359***	0.0398***	0.0188
		(0.0162)	(0.0135)	(0.0148)	(0.0187)
Private	Annual growth	0.0288***	0.0379***	0.0227***	0.00112
		(0.00971)	(0.00491)	(0.00453)	(0.00859)
	Cumulative growth	0.0288***	0.0295***	0.0354***	0.0302**
		(0.00971)	(0.00893)	(0.0122)	(0.0139)
HMT	Annual growth	0.0365**	0.0186	0.0357***	0.0307***
		(0.0177)	(0.0116)	(0.00924)	(0.00876)
	Cumulative growth	0.0365**	0.0504***	0.0654***	0.0577***
		(0.0177)	(0.0194)	(0.0234)	(0.0203)
Foreign	Annual growth	0.0156	0.0469***	0.0277***	0.00197
		(0.0194)	(0.0105)	(0.00986)	(0.00964)
	Cumulative growth	0.0156	0.0586***	0.0501***	0.0319**
		(0.0194)	(0.0192)	(0.0193)	(0.0156)

Note: Productivity growth is the dependent variable. Firm age at base year, productivity level at base year, sector dummies, and province dummies are controlled. Each regression is like a cross-section analysis, i.e. for export starters in 2000, when the author tests the learning-by-exporting effect in 2000, the dependent variable is the productivity growth from 1999 to 2000, and 1999 is the base year. Observations (goodness of fit) for state-owned firms, annual growth regression from left to right are 19,816 (0.312), 15,722 (0.283), 14,403 (0.340), 11,425 (0.277); cumulative growth regression from left to right: 19,816 (0.312), 14,964 (0.293), 12,097 (0.417), 9,561 (0.476). Similarly, for collective ownership, annual growth: 24,286 (0.253), 20,001 (0.360), 19,583 (0.241), 16,332 (0.114); cumulative growth: 24,286 (0.253), 17,802 (0.329), 14,822 (0.373), 11,956 (0.201). For private firms, annual growth: 17,819 (0.249), 19,848 (0.281), 29,405 (0.287), 34,530 (0.169); cumulative growth: 17,819 (0.249), 13,056 (0.265), 11,195 (0.361), 9,373 (0.326). For HMT-invested firms, annual growth: 3,553 (0.328), 4,389 (0.206), 4,996 (0.291), 5,099 (0.295); cumulative growth: 3,553 (0.328), 2,946 (0.340), 2,520 (0.311), 2,250 (0.372). For other foreign-invested firms, annual growth: 2,697 (0.302), 3,437 (0.320), 3,779 (0.258), 4,151 (0.200); cumulative growth: 2,697 (0.302), 2,304 (0.359), 1,983 (0.410), 1,814 (0.471). Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

There was no significant learning-by-exporting effect found in the sectoral analysis, meaning that the significant learning-by-exporting effect at aggregate level might be caused by productivity differences between exporters in some industries and non-exporters in other industries, which is the 'between-industry' productivity effect denoted by the author, but not by productivity differences between exporters and non-exporters within the same industry. At the regional level, only the eastern region displayed a significant learning effect, while in the middle and western regions, the learning effect was statistically insignificant. As for the different ownership types,

state-owned companies did not display a significant learning effect, but other domestically-owned firms and foreign-owned firms displayed a significant learning-by-exporting effect.

In order to carry out the robust test of the learning-by-exporting effect, some non-parametric matching econometrics method is employed to test the learning-by-exporting effect when controlling for the self-selection effect.

4. 4 The learning-by-exporting effect by matching econometrics

The method employed below aims to control for the self-selection process when testing the learning-by-exporting hypothesis by creating control groups using matching techniques based on average treatment models as suggested by Heckman et al. (1997). The aim of this approach is to evaluate the causal effect of exporting on productivity and productivity growth by matching those export starters with non-exporters.

The literature on matching econometrics is well established, with particular reference to Moffitt (2004), Cameron and Trivedi (2005), Lee (2005), and Abadie and Imbens (2006). This method exists in constructing a counterfactual in order to analyse how the productivity of a firm would have evolved if it had not started exporting. The main problem in this type of analysis is that the counterfactual is not observed and therefore the exporting firm needs to be matched with a control group of similar firms that do not export.

When using this approach, three assumptions are needed; the first is ‘conditional mean independence’ or ‘ignorability of treatment’ according to

Rosenbaum and Rubin (1983b), also called 'unconfoundedness', which means exporting is random. However, there is known to be a self-selection effect and exporting is not random, so it is possible to create a condition where the exporting is random by choosing a control group for exporting firms that are matched closely to the actual exporting firms in terms of all relevant covariates. The intuition behind selecting the appropriate control group is to find a group that is as close as possible to the exporting firm in terms of its predicted probability to start exporting. More formally, the author applies the 'propensity score matching' method as proposed by Rosenbaum and Rubin (1983a, 1983b and 1984).

The second assumption is called overlapping, which assures that for each productivity level there are both treated and untreated observations (both exporters and non-exporters), so firms that export over the entire sample period of 1999-2003 are not included, as their decision to export was not observed and consequently makes it impossible to identify the learning-by-exporting parameter.

The third assumption is generally referred to as the stable-unit-treatment-value assumption (SUTVA), which means the exporting status is identical for each exporting firm (i.e. no 'multiple versions' of the treatment) and exporters do not affect non-exporters. Generally, this assumption is suitable for this analysis.

The author assumes that the firm starts exporting at time s=0, and let p_{is} be the productivity of firm i at time s, just following the entry of exporting at s=0, and the dummy $START_i$ is one when the firm starts to export. The causal effect can be estimated by looking at the difference $(p_{is}^1 - p_{is}^0)$, where the superscript denotes the export behaviour. Since p_{is}^1 and p_{is}^0 may not be observed at the same time for the

export starters and only p_{is}^{1} is known, so we need matching to construct the counterfactual.

Formally, the author employs the micro-econometric model of average treatment effect which was developed by Heckman et al. (1997). Similarly, the average effect of exports on a firm's productivity is defined as:

$$E\left\{p_{is}^{1} - p_{is}^{0} \mid START_i = 1\right\} = E\left\{p_{is}^{1} \mid START_i = 1\right\} - E\left\{p_{is}^{0} \mid START_i = 1\right\} \qquad (4.14)$$

The biggest problem is that the last term of the equation (4.14) is not known, this is the productivity effect of the entry firms which is experienced if they do not export. In order to identify such a group, it is assumed that all differences between exporters and the appropriate control group can be captured by a vector of observables including the productivity of a firm. As mentioned above, the 'propensity score matching' method is used to create such a control group. The probability of starting to export is modelled as follows. $START_i$ is a dummy with a value of one when the firm *i* starts to export and once the firm enters the export market, the firm will keep exporting. From Table 3.7 in Chapter 3, it is known that most firms are those that keep exporting. A logit model is used to estimate the probability of $START_i$, and the most important independent variable is productivity, in addition, the author uses data for the firm operating history and sector, region (province), and ownership type dummies.[33] Formally the probability model of starting to export (the propensity score) can be represented as follows:

$$\Pr(START_{i,0} = 1) = \Phi\left\{h(p_{i,-j}, firmage_{i,-j}, region_{i,-j}, owner_{i,-j}, indus_{i,-j})\right\} \qquad (4.15)$$

where $\Phi(\bullet)$ is the logistic cumulative distribution function, similar to the self-selection test model, implying that the probability of starting to export is regressed on

[33] See footnote (32).

variables prior to this period s =0 and the author uses subscript -j denotes this. A full polynomial is used in the elements of $h(\bullet)$ to free up the functional form and improve the resulting matching (Woolridge, 2002). The matching is based on the method of the nearest neighbour, which selects a non-exporting firm j on the following criteria:

$$\left|\Pr_i - \Pr_j\right| = \min_{q\in\{Ex=0\}}\left(\Pr_i - \Pr_q\right) \tag{4.16}$$

Given the counterfactual, it is possible to assess the impact of exporting on productivity and use the difference in productivity growth to calculate the learning-by-exporting effect estimator (β_{LBE}). Here, just as with the parametric standard approach, there are usually two estimators to catch the learning-by-exporting effect; one is the productivity effect at every time s , the other is the cumulative productivity effect during the time period $s=(0,1,2\cdots S)$. The estimator at every time s after the firm enters the export market and the cumulative learning-by-exporting effect over a period S after the firm starts to export are defined as:

$$\beta^{s}_{LBE} = \frac{1}{N_s}\sum_i\left(p^1_{is} - \sum_{j\in C(i)} w_{ij}\, p^c_{js}\right) \tag{4.17}$$

$$\beta^{S}_{LBE} = \frac{1}{N_s}\sum_i\left(\sum_{s=0}^{S} p^1_{is} - \sum_{s=0}^{S}\sum_{j\in c(i)} w_{ij}\, p^c_{js}\right) \tag{4.18}$$

where, N is the number of firms which start to export, $C(i)$ is the set of control of units matched with firm i with propensity score $\Pr_i$, w_{ij} is the weight, $w_{ij} = \frac{1}{N^c_i}$ if $j \in C(i)$ and zero otherwise. This means that the productivity premium of firms starting to export at each period s or over a period S may be compared with (a weighted average of) the productivity of the control group based on nearest matching at every time s or over a period S. Thus both annual productivity growth $(p^1_s - p^1_{s-1})$

and productivity growth may be compared to the pre-export level of productivity $(p_s^1 - p_{s-1}^0)$.

Both effects will have somewhat different interpretations. Exporting firms should become more productive and grow faster with respect to their pre-export productivity level; however, they need not grow faster every year after entering the export market.

Finally, as mentioned in Chapter 2, a combination of matching techniques and DID is likely to improve the quality of the estimation of non-experimental evaluation studies (Blundel and Costa Dias, 2000). Essentially the DID can remove effects of common shocks and provides a clear estimate of the impact of the treatment variable (export) on the productivity difference (growth) between exporting and non-exporting firms. Therefore, the growth change in productivity is used here as the dependent variable, and the learning-by-exporting effect should be estimated by the following equation:

$$E\{DD(p) \mid START_i = 1\} = E\{D(p) \mid START_i = 1\} - E\{D(p) \mid START_i = 1\} \tag{4.19}$$

Here, in order to do the robustness test of the learning-by-exporting effect with matching econometrics, the author also chooses the firms which start to export in 2000 to investigate the learning-by-exporting effect because it offers more estimators than other cases, which can help to identify the trend of learning-by-exporting over time more clearly. The author chooses the variables including the productivity in the base year, firm age and the sector dummies, province dummies and ownership type dummies as matching variables. When estimating the yearly learning effect of year t based on year t-1, the author chooses variables in year t-1 as matching variables, and

when estimating the cumulative learning effect, the author chooses the variables in 1999 as matching variables.[34]

Table 4.8 reports the estimates of matching econometrics of the learning effect of the above two specifications of aggregate data and the commutative learning effects at regional level, industry level and different ownership types. The results show that, at an aggregate level, the learning-by-exporting effect is significant and consistent with our benchmark OLS estimates, the exporter's learning effect is the most significant in the second year after exporting and then decreases. At disaggregated levels, consistent with the benchmark results, within industry, no significant learning effect is found, meaning that the significant learning-by-exporting effect in aggregate analysis is caused by the between-industry effect, i.e. productivity differences between exporters in some sectors and non-exporters in other sectors, but not by productivity differences between exporters and non-exporters within a sector.

[34] The author uses the programme based on Abadie et al. (2004) in statistic software Stata to do the matching regression. In addition, the author does the balancing hypothesis test about how like between the match firms and the treated firms for those relevant covariates. Overall, at 10 percent significance level, over 90 percent of the covariates tests pass the test and at 1 percent level, more than half of the covariates tests pass the test. The matching estimation is performed as a robustness check for the benchmark results and there are 72 matching regressions with relevant covariates (each regression includes numerous covariates such as productivity level at base year, firm age at base year, 30 province dummies, 28 industry dummies and 4 ownership type dummies), so for brevity, the balance hypothesis results for each matching regression are not listed here.

Table 4.8: Learning-by-exporting hypothesis matching test results

Aggregate	1	2	3	4
Annual productivity growth	0.00558	0.0174***	0.0133***	-0.0148**
	(0.00867)	(0.00555)	(0.00472)	(0.00600)
Cumulative productivity growth	0.00558	0.0312***	0.0276***	0.0176*
	(0.00867)	(0.00969)	(0.0100)	(0.0102)
Within industry		Cumulative productivity growth		
Food, beverage, tobacco	-0.00153	-0.0205	-0.0285	0.0182
	(0.0453)	(0.0416)	(0.0605)	(0.0530)
Textile, fibre, leather	-0.00694	0.0238	-0.00627	0.0382
	(0.0169)	(0.0265)	(0.0211)	(0.0247)
Wood, straw, furniture	-0.0406	0.0312	0.0252	-0.0231
	(0.0271)	(0.0340)	(0.0319)	(0.0351)
Paper, printing, culture	0.0304	0.0498	0.0301	-0.00246
	(0.0433)	(0.0365)	(0.0400)	(0.0306)
Chemical-related, medicine	-0.00823	-0.00550	0.00725	-0.0201
	(0.0226)	(0.0240)	(0.0261)	(0.0261)
Metal-related	-0.0157	0.00629	-0.0124	0.0186
	(0.0203)	(0.0197)	(0.0200)	(0.0193)
Machinery and electronics	-0.0283*	0.00859	0.0101	0.00728
	(0.0170)	(0.0173)	(0.0179)	(0.0165)
Others	-0.0272	-0.00320	-0.000494	0.00717
	(0.0349)	(0.0800)	(0.0396)	(0.0504)
Region		Cumulative productivity growth		
East	0.0114	0.0316***	0.0288***	0.0235**
	(0.00861)	(0.00958)	(0.0110)	(0.0115)
Middle	0.00154	0.0553	0.00204	0.0307
	(0.0516)	(0.0397)	(0.0310)	(0.0299)
West	-0.0608	0.0678	-0.0255	0.00159
	(0.0729)	(0.0839)	(0.0831)	(0.0789)
Ownership		Cumulative productivity growth		
State	0.00641	0.0472*	0.0148	0.0486*
	(0.0283)	(0.0258)	(0.0272)	(0.0277)
Collective	0.0246	0.0368**	0.0246	-0.0107
	(0.0185)	(0.0147)	(0.0172)	(0.0226)
Private	0.00676	0.0122	0.0224	0.0125
	(0.0117)	(0.0108)	(0.0139)	(0.0142)
HMT	0.0190	0.0233	0.0523**	0.0331
	(0.0174)	(0.0222)	(0.0254)	(0.0209)
Foreign	-0.00348	0.0410*	0.0198	0.00716
	(0.0197)	(0.0225)	(0.0216)	(0.0172)

Note: Productivity growth is the dependent variable. Firm age at base year, productivity level at base year, province dummies, and ownership type dummies are controlled. Each regression is like a cross-section analysis, i.e. for export starters in 2000, when the author tests the learning-by-exporting effect in 2000, the dependent variable is the productivity growth from 1999 to 2000, and 1999 is the base year. Observations for aggregate analysis annual growth from left to right are: 54,923, 51,501, 60,251, and 60,938; for cumulative growth from left to right: 54,923, 40,951, 34,019, and 27,726. For sectoral analysis, food et al.: 4,123, 2,943, 2,333 and 1,684; for textiles et al.: 5180, 3,737, 3,054 and 2,222; for wood et al.: 1,556, 1,075, 820 and 625; for paper et al.: 4,882, 3,839, 3,206 and 2,664; for chemical-related and medicine: 10,388, 7,797, 6,568 and 5,423; for metal-related: 13,342, 9,597, 8,103 and 6,713; for machinery and electronics: 14,782, 11,491, 9,555 and 8,070; for others: 670, 472, 380 and 325. For east region: 31,190, 23,397, 19,559, and 16,632; for middle region: 15,710, 11,243, 9,153, and 6,829; for west region: 8,023, 6,311, 5,307, and 4,265. For state-owned firms: 19,816, 14,964, 12,097, and 9,561; for collective ownership: 24,286, 17,802, 14,822, and 11,956; for private firms: 17,819, 13,056, 11,195, and 9,373; for HMT-invested firms: 3,553, 2,946, 2,520, and 2,250; for other foreign-invested firms: 2,697, 2,304, 1,983, and 1,814. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

These results are similar to Luong (2011) who, using data from the Chinese automobile industry between 1998 and 2007, found no evidence of learning by exporting.[35] The insignificant learning-by-exporting effect in sectoral analyses implies that within industry there is no significant productivity gain from exporting. This finding is different from the literature which finds that less developed countries should have a more significant learning-by-exporting effect, even within industry than developed economies. Therefore, it is important to take consideration of the reasons behind this, maybe the processing exporting mode is the answer.[36]

Furthermore, the insignificant learning-by-exporting effect within industry also implies that the self-selection effect is more important than learning by exporting. In addition, though insignificant statistically, from the sign and magnitude of the estimators in Tables 4.5 and 4.8, sectoral analyses show that for the most export-oriented processing industries in China, i.e. machinery and electronics, the learning-by-exporting effect was smaller than for other industries, such as the furniture and paper-related industries, which demonstrates the need to look more closely at China's export success in the future.[37]

The eastern region reflects significant learning effects while in the middle and west regions, no significant learning effect are found. With different ownership types, the learning effect of matching results is not robust with benchmark results, and most of the estimates lose their significance in the matching test. However, there is still

[35] Kılıçaslan and Erdoğan (2012) also found no evidence of the learning-by-exporting effect using the largest 1,000 industrial enterprises of Turkey from 1997 to 2007.

[36] Dai et al. (2011) found the productivity puzzle in China, that is, the exporter's productivity is lower than the non-exporters (in Chinese). They offer the explanation that some firms are pure processing exporters with low levels of productivity and they just process for others. Lu et al. (2010) also found that foreign affiliates exporting all their output are less productive than those having both sales in China and exporting some of their output.

[37] These results are complemented with Jarreau and Poncet (2012), who found that there are no direct gains of economic growth resulting from processing trade activities, even though they are the main contributors to the global upgrading of China's exports.

some evidence of the learning effect across ownership types and some estimates are statistically large positive numbers, although it is not possible to compare the effects between ownerships directly and clearly.

4.5 Concluding remarks

This chapter uses a large sample of panel data of Chinese firms to investigate the relationship between productivity and exports in China. The author uses the OP method to control for the selection bias and simultaneity bias. The OP method is a more reliable approach to estimate firm productivity than the alternatives. After the estimation, the author uses both the parametric method and non-parametric econometric approach-matching techniques to test self-selection and learning by exporting. The author finds both a strong self-selection effect and learning-by-exporting effect at the aggregate data level in China.

In addition, the author finds that when more highly productive firms become exporters, the nearer to the time when they start exporting, the premium of ready-to-export firms is more significant, which implies that the productivity of future exporters increases much faster than for those firms which will never export. For the learning-by-exporting effect, usually, the exporter's learning effect is the most significant in the second year after exporting and then decreases.

Finally, for the learning-by-exporting effect at disaggregated level, the author finds no significant learning effect within industry, which implies that the learning-by-exporting effect at aggregate level is caused by between-industry productivity differences, i.e. productivity differences between exporters in some sectors and non-exporters in other sectors, but not by within-industry productivity differences. The insignificant learning-by-exporting effect within industry also implies that the self-

selection effect is more important than learning by exporting. Therefore, it is important to take consideration of the reasons behind China's export miracle, maybe the export of goods that are processed in China is the answer.

For different regions, the eastern provinces showed a significant learning-by-exporting effect, while the middle and west regions did not display significant learning effects. For ownership types, matching estimation results are not robust with the parametric results, while there is still some evidence showing the existence of a learning-by-exporting effect.

Chapter 5: Heterogeneous Export Premium: Inter-County, Inter-Provincial and International

5.1 Introduction

In this chapter, an exclusively private firm survey dataset for China is used to study the heterogeneous export premiums at three trade levels: inter-county, interprovincial and international. As reviewed in the literature (in Chapter 2), export premiums caused by the self-selection effect are well documented but the evidence for the learning-by-exporting effect is somewhat mixed (Wagner, 2007). An insignificant learning-by-exporting effect is found within sectors in China (in Chapter 4). In addition, the self-selection effect states that more productive firms become exporters because those higher levels of productivity are required to offset the cost of selling to distant destinations.

The export premium is expected to be different across different levels of trade. For example, the premium should increase with more distant destinations, assuming that more distant destinations will have higher trade costs. This analysis of the export premium at various trade levels provides the opportunity, when the self-selection effect is significant, to infer trade costs at different trade levels, especially with respect to the internal trade costs between Chinese provinces.

There is anecdotal evidence about high internal trade costs within China (Li, 2007; Amiti and Javorcik, 2008). For example, transport related factors, such as fuel costs and transport infrastructure, and especially the highway toll fees, when driving

from one province to another, are high.[38] Another example of high trade barriers between Chinese provinces is the local protectionism caused by the Hukou system: in order to do business in other provinces, the Hukou system can bring barriers when applying for the necessary documents from the local governments. [39]

In this chapter, it is shown that firms exporting at the international level have the highest premium, firms at interprovincial level have a lower premium, and firms exporting at inter-county level have the lowest premium. However, when comparing with the premium of inter-county trade, the export premium associated with interprovincial trade is much more similar to the premium of international trade. This suggests that the trade cost of interprovincial trade is as high as that of international trade.

The structure of the chapter is as follows. Section 5.2 presents the data and introduces the evolution history of private firms in China. Section 5.3 performs some preliminary analysis and reports the benchmark results. Section 5.4 discusses the endogeneity issues and presents robustness checks. Section 5.5 concludes the chapter.

5.2 Data and private firms

The dataset used in this study comes from a nation-wide survey of private enterprises. The survey was jointly conducted in 2000 by the All China Industry and Commerce Federation, the China Society of Private Economy at the Chinese Academy of Social Sciences, and the United Front Work Department of the Central

[38] On 21 December 2010 it was reported in the news in China that two farmers in Yuzhou of Henan province over eight months of tax evasion and tolls, accumulated more than 3.68 million RMB of debt, and were sentenced to life imprisonment. Reports have raised concern in the community. Xinhua News Agency, People's Daily, CCTV and a number of portals forwarded reports and commentaries. The incident is the first case where evasion of tolls and taxes has led to life imprisonment.

[39] Please refer to http://en.wikipedia.org/wiki/Hukou_system for more introductions for the Hukou system in China.

Committee of the Communist Party of China. The sample comprises large and small private firms, ranging from the individual household enterprises to firms that employ 20,000 employees. The private firms were drawn from all 31 provinces. The private firms are from 15 industries, which include agriculture, manufacturing and service industries.[40] Similar private datasets have been analysed in previous literature about political connections and firm performance as well as trade expansion by Li et al. (2008) and Lu (2011).

Private firms in China are of particular interest for economists because private firms in PRC have a short history and private firms face an unfair competitive environment compared with other types of ownership. A brief description of the history of the development of private firms follows, with particular focus on the institutional environment in which the private firms have grown up in the period since the late 1970s.[41]

After the Communist party became the ruling party in 1949, private firms were transformed during the socialist transformation activity between 1949 and 1952. Between 1952 and 1977, private firms were banned in mainland China, and although they were accorded a measure of political tolerance when they resurfaced in the early 1980s with some reform affecting private firms, from 1977 to the early 1980s, private firms could only hire a maximum of eight employees. This rule remained in place for about 10 years, after which time the national People's Congress authorized private enterprises to have more than eight employees.

Until 1992, after Deng Xiaoping's Southern Tour, private firms advanced in leaps and bounds. China's private sector grew from nothing in the late 1970s to

[40] The 15 industries are agriculture, forestry, animal husbandry and fish, mining, manufacturing, electricity and gas supplying, architecture, geology servicing and water resources supplying, transportation, commercial catering, finance and insurance, real estate, social services, health and sports goods retail, education and culture, scientific research, and other industries.
[41] The information comes from Li et al. (2008). Please refer to it for more detail.

providing almost 50 percent of total employment and 60 percent of industrial output by 2004. The growth rate of the private sector has far outpaced the public sector since its revival. [42] However, private firms have suffered both political and social discrimination. Private firms are still considered to be an inferior form of ownership for ideological reasons and the overall political environment is antagonistic toward the private enterprises.

Private enterprises not only experience political and social discrimination, but also deal with an unfavourable economic environment. The government controls most of the resources and state-owned firms enjoy preferential treatment in credit and key inputs (Che, 2002; Brandt and Li, 2003). In addition, private firms are subject to arbitrary harassment by government cadres because of the unenforceable or non-existent commercial and property laws (Pearson, 1997; McMillan, 1995).

Due to the survival environment of private firms in China as introduced in the above analysis, any selection process in which the government supported the private firms to become highly productive exporters is not a consideration here. This might have been the case for state-owned firms, but not for private firms. Hence, the dataset used here is the best for studying the heterogeneity of export and firm performance at different trade levels in China because there is not selection bias. The dataset comprises 3,073 privately-owned firms, which represented about 0.16 percent of the total number of private enterprises nation-wide in 2000. The survey involved intensive interviews with the firm owners with questions about the firm size, investment, profit, sales, employment, wage, loans, firm history, human capital and even the background of the entrepreneurs. More importantly, the survey collected

[42] In 2004, the National People's Congress approved a constitutional amendment to protect private property rights, making the first time in PRC history that the legal status of private property was officially endorsed by the Party.

information on where the products of each firm went within a county, to other counties within a province, to other provinces within the country or directly abroad.

Table 5.1 provides the summary statistics of the main variables of interest.[43] In the dataset 20 percent of firm owners were members of the Communist party of China. According to Li et al. (2008), the party membership of the private entrepreneurs is an important consideration as political connection has a positive effect on the performance of their firms. Most of the firm owners in the sample had a high school education and the average age was 43 years – the human capital of firm owners will have a positive impact on their own firm's performance. The firms on average had 6.5 years of operational history, which is not a long time and consistent with the short history about private firms in China. For firms' characteristics, take the employment for example, the firms had an average of 145 employees, which is much higher than the national average of 11.4 (Yicac, 2003). Although private firms are discriminated against by the government, they have made a significant contribution to the Chinese economy, especially in terms of employment.

More importantly, 15 percent of the firms were engaged in international trade, 52 percent of firms were selling their goods to other provinces within China and 60 percent of firms were doing business in other counties within the same province. The proportion decreases as distance increases, which reflects that the more productive firms will trade at the more distant destinations. The summation of the percentage at three trade levels exceeds 100 percent, which show that some firms engage in two levels of trade or even three levels of trade simultaneously.

[43] The minimum total asset is negative in the sample, which may be caused by mis-reporting or other rounding errors. However, in the following regression analysis, the log value is used, so the rounding errors will not severely affect the results.

Looking at these findings more closely, firms trading at the international level will tend to trade at interprovincial level and inter-county level at the same time, and some firms trading at the interprovincial level will also trade at the inter-county level simultaneously. For example, there are 462 firms exporting at the international level in our sample, of which 332 firms also export at the interprovincial level and 278 firms export at three levels of trade at the same time. This chapter will focus on the different export premiums at the three trade levels but will control for the characteristics of firms when they are engaged in multiple levels of trade: the question of why firms engage in multiple levels of trade is beyond the scope of this chapter.

Table 5.1: Summary statistics of variables of interest

Variables	Observations	Mean	S.D.	Min.	Max.
Firm owners' attributes					
Education	3,073	12.86	3.06	6	19
Age	3,041	43.38	8.27	22	75
Party membership	3,060	0.20	0.40	0	1
Firms' attributes					
Firm age	2,753	6.49	4.05	1	21
Sales	2,738	20.25	102.56	0	4,108.64
Total asset	1,776	19.63	71.09	-1.13	1,310
Investment	2,405	14.21	209	0	10,000
Profit	2,381	1.28	7.20	0.01	253.46
Bank loan	1,527	5.44	28.21	0	650.18
Wage bill	2,748	1.71	6.88	0.0025	181
Employment	2,861	171.09	637.22	0	20,000
Workers	2,804	144.58	578.14	0	18,000
Managing staff	2,890	13.19	30.49	0	550
Technical staff	2,703	15.37	62.96	0	2,700
Exporters' attributes					
International	3,073	0.15	0.36	0	1
Interprovincial	3,073	0.52	0.50	0	1
Inter-county	3,073	0.60	0.49	0	1

Note: the units for education and age are years; the units for sales, asset, investment, profit, bank loan, and wage bill are million RMB; and the units for employments, workers, managing staff and technical staff are persons. The party membership and exports attributes variables are dummies.

5.3 Export premiums by destinations

In this section, we first do the preliminary analysis for the firm performance variables between firms that export to various destinations and the non-exporters at the relative levels. Firm performance variables include total assets, sales, profit, bank loans, wage bill and employment.

5.3.1 Preliminary results

As shown in Table 5.2, for the firm performance variables, the mean differentials at the international and interprovincial levels are highly significant but at inter-county level, the significance is less. In addition, the comparison of the magnitude of the differentials indicates that the firms that engage in international trade have the highest premiums; firms trading at interprovincial level have intermediate premium levels, which are better than those engaged in inter-county trade; and the premiums at inter-county level are the smallest.

Firm age results show that the more productive firms are not necessarily the older firms. The investment variable estimates tell that the more productive firms do not necessarily invest more. Furthermore, for some firm performance variables, like profit, managing staff and technical staff, the differences between column I and column II are not very large when compared with column III. Take the firm profit for example, the difference between column I and column II is 0.4 but the difference between column II and column III is 0.61. For the other variables, the differences between column I and column II are a similar size compared to the difference between column II and column III.

Mean statistics results, however, are largely biased owing to omitted variables, especially the omitted information that the firms do multiple levels of trade at the same time. Regression analysis is applied in order to do the formal test for the heterogeneous export premium and the differences between premiums at different trade levels.

Table 5.2: Mean difference statistics at three levels of trade

	I	II	III
Variables	International	Interprovincial	Inter-county
Firm age (years)	0.26	0.23*	0.33**
	(0.22)	(0.15)	(0.16)
Sales (million RMB)	22.82***	14.22***	7.04*
	(5.39)	(3.92)	(4.03)
Total asset (million RMB)	15.82***	5.42*	0.20
	(4.51)	(3.40)	(3.55)
Investment (million RMB)	8.87	14.37**	12.61*
	(11.65)	(8.53)	(8.78)
Profit (million RMB)	1.33***	0.93***	0.32
	(0.40)	(0.30)	(0.30)
Bank loan (million RMB)	5.64***	3.47***	1.56
	(1.87)	(1.46)	(1.53)
Wage bill (million RMB)	2.08***	1.16***	0.68***
	(0.36)	(0.26)	(0.27)
Employment (persons)	213***	116***	70***
	(33)	(24)	(24)
Workers (persons)	187***	96***	63***
	(30)	(22)	(22)
Managing staff (persons)	8.06***	6.53***	3.45***
	(1.56)	(1.13)	(1.16)
Technical staff (persons)	8.71***	7.02***	-0.64
	(3.28)	(2.43)	(2.50)

Note: columns I, II and III denote the mean difference between firms that engaged in international trade, interprovincial trade and inter-county trade and the firms that do not engage in the corresponding levels, respectively. Standard errors are in the brackets. Significance levels 0.1, 0.5 and 0.01 are denoted by *, **, and ***, respectively.

5.3.2 Regression analysis

The following regression (5.1) is run in order to test how each export status affects the firm's performance at different trade levels. Previous literature on the

export premium like Bernard and Jensen (1999) and De Loecker (2007) finds that compared with non-exporters, exporters at the international level will be larger and more productive. Instead of using one export dummy at the international level as in the previous literature, the author includes three trade levels dummy variables together as independent variables to estimate the heterogeneous export premium. Because some firms will do multiple levels of trade at the same time, by using three trade levels dummy variables together, the author can disentangle the different export premiums at different levels of trade, controlling for the aggregate bias when using only one export dummy.

$$\log(x_{ijp}) = \alpha + \beta_1 International + \beta_2 Interprovincial + \beta_3 Intercounty + \sigma z_{ijp} + \delta_j + \delta_p + v_{ijp} \quad (5.1)$$

The dependent variable is the log value of firm performance characteristics, including sales (10,000 RMB), total assets (10,000 RMB), profit (10,000 RMB), investment (10,000 RMB), bank loans(10,000 RMB), wage bill (10,000 RMB), employment (persons), technical workers (persons) and managing staff (workers), where i refers to firm, p denotes province and j refers to industry. The three most important independent variables are export dummies at three trade levels: international, interprovincial and inter-county. The vector z_{ijp} contains other control variables that include party membership of firm owners;[44] each firm owner's human capital: age and education level; each firm's operating years; and firm human capital of technical staff ratio and managing staff ratio. In addition, δ_i captures the province-specific effects and δ_j controls the industry-specific effects.

[44] Previous literature finds that party membership affects firm performance (Li et al., 2008).

Table 5.3 presents the benchmark results of the regressions. The firm owner's education is shown to have a significant positive effect on firm performance. Firm owner's age does not seem to be very important. Party membership positively impacts firm profit, wage bill and employment. A firm's age appears to be an important factor for a firm's success. Firm human capital variables like technical staff ratio and managing staff ratio negatively affect the firm characteristics.

Table 5.3(a): Regression results

	I	II	III
Variables	Sales	Asset	Profit
International	0.600***	0.563***	0.556***
	(0.0890)	(0.103)	(0.0972)
Interprovincial	0.462***	0.486***	0.426***
	(0.0758)	(0.0876)	(0.0770)
Inter-county	0.209***	0.0758	0.0458
	(0.0757)	(0.0853)	(0.0753)
Firm owner’s age	0.00253	0.00987**	0.00179
	(0.00410)	(0.00477)	(0.00438)
Education	0.140***	0.145***	0.126***
	(0.0120)	(0.0133)	(0.0125)
Party	0.110	0.135	0.178**
	(0.0796)	(0.0912)	(0.0841)
Firm age	0.0272***	0.0391***	0.0383***
	(0.00853)	(0.00976)	(0.00891)
Technical ratio	-0.638**	-0.552**	-0.0561
	(0.263)	(0.273)	(0.276)
Managing ratio	-1.662***	-1.701***	-2.180***
	(0.547)	(0.638)	(0.607)
Constant	4.164***	3.836***	1.751***
	(0.361)	(0.400)	(0.390)
Province effects	yes	yes	yes
Industry effects	yes	yes	yes
Observations	2,187	1,484	1,914
R-squared	0.306	0.360	0.266

Note: Dependent variables take the logarithmic form. The units for sales, total assets and profits are 10,000 RMB. Firm owner's party membership, education, age, firm age, firm human capital such as technical staff ratio and managing staff ratio, 30 province dummies and 14 industry dummies are controlled. Robust standard errors are in brackets. Significance levels 0.1, 0.05 and 0.01 are noted by *, ** and *** respectively.

Table 5.3(b): Regression results cont.

Variables	IV Investment	V Bank loan	VI Wage bill
International	0.522***	0.575***	0.577***
	(0.0951)	(0.133)	(0.0683)
Interprovincial	0.385***	0.460***	0.337***
	(0.0742)	(0.115)	(0.0573)
Inter-county	0.199***	0.0626	0.0641
	(0.0723)	(0.122)	(0.0559)
Firm owner's age	0.00585	0.0133**	0.00388
	(0.00408)	(0.00667)	(0.00309)
Education	0.138***	0.137***	0.119***
	(0.0120)	(0.0183)	(0.00912)
Party	0.104	0.0259	0.164***
	(0.0852)	(0.123)	(0.0624)
Firm age	0.0563***	0.00724	0.0277***
	(0.00922)	(0.0123)	(0.00648)
Technical ratio	-0.346	-0.167	-1.050***
	(0.238)	(0.477)	(0.208)
Managing ratio	-2.010***	-1.515*	-3.184***
	(0.499)	(0.858)	(0.565)
Constant	3.360***	2.745***	2.572***
	(0.369)	(0.557)	(0.289)
Province effects	yes	yes	yes
Industry effects	yes	yes	yes
Observations	1,944	979	2,279
R-squared	0.308	0.285	0.397

Note: Dependent variables take the logarithmic form. The units for investments, bank loans and wage bills are 10,000 RMB. Firm owner's party membership, education, age, firm age, firm human capital such as technical staff ratio and managing staff ratio, 30 province dummies and 14 industry dummies are controlled. Robust standard errors are in brackets. Significance levels 0.1, 0.05 and 0.01 are noted by *, ** and *** respectively.

Table 5.3(c): Regression results cont.

Variables	VII Employment	VIII Technical	IX Managing
International	0.567***	0.425***	0.420***
	(0.0621)	(0.0602)	(0.0565)
Interprovincial	0.313***	0.293***	0.312***
	(0.0485)	(0.0460)	(0.0450)
Inter-county	0.0572	0.0364	0.0804*
	(0.0481)	(0.0466)	(0.0440)
Firm owner's age	0.00134	0.000352	0.00112
	(0.00266)	(0.00262)	(0.00246)
Education	0.0861***	0.0872***	0.0866***
	(0.00830)	(0.00794)	(0.00747)
Party	0.145***	0.100*	0.109**
	(0.0538)	(0.0518)	(0.0498)
Firm age	0.0269***	0.0238***	0.0200***
	(0.00574)	(0.00537)	(0.00546)
Technical ratio	-1.460***	3.046***	-1.412***
	(0.198)	(0.149)	(0.134)
Managing ratio	-3.334***	-2.861***	1.550***
	(0.624)	(0.221)	(0.215)
Constant	3.310***	0.334	0.524**
	(0.263)	(0.243)	(0.233)
Province effects	yes	yes	yes
Industry effects	yes	yes	yes
Observations	2,351	2,284	2,337
R-squared	0.411	0.371	0.300

Note: Dependent variables take the logarithmic form. The units for employment, technical staff and managing staff are persons. Firm owner's party membership, education, age, firm age, firm human capital such as technical staff ratio and managing staff ratio, 30 province dummies and 14 industry dummies are controlled. Robust standard errors are in brackets. Significance levels 0.1, 0.05 and 0.01 are noted by *, ** and *** respectively.

All of the coefficients of variables of *internatonal* and *interprovincial* trade levels are significant at the 1 percent level and most of the positive estimates of *intercounty* lose their significance except for sales, investment, employment and managing staff. Figure 5.1 shows the percentage premium of various firm characteristics with respect to firms trading at the three levels. Holding other determinants such as firm owners' age, education, party membership, firm age, firm technical staff ratio and managing staff ratio constant, comparing with those firms that do business within the same county, firms engaged in international, interprovincial and inter-county trade on average sold more, possessed more total assets, earned more profits, invested more, held more bank loans, paid more wage bills, hired more employees, appointed more technical staff, and appointed more managing staff, respectively.

Figure 5.1: The heterogeneous export premium at three trade levels

Similar to the preliminary results, the premium at international level is highest; the premium at interprovincial level is lower; and the premium at inter-county level is lowest. This confirms the expectation that the export premium will be heterogeneous depending on the destinations of the exports. Some tests are carried out for the heterogeneity of the export premium, and the results shown in Table 5.4. Overall, from the statistics, the premium of international trade and interprovincial trade are found to be similar, while the inter-county level premium is much lower, which could also be seen in Figure 5.1.

Table 5.4: Heterogeneous export premium test at three trade levels

	H0: International=Interprovincial		
F-statistics	1.29 (I)	0.32 (II)	1.03(III)
F-statistics	1.26(IV)	0.41(V)	7.30***(VI)
F-statistics	10.51***(VII)	3.07*(VIII)	2.16(IX)
	H0:Interprovincial=Inter-county		
F-statistics	4.11**(I)	11.52***(II)	9.68***(III)
F-statistics	2.47*(IV)	4.16**(V)	8.65***(VI)
F-statistics	10.59***(VII)	11.88***(VIII)	10.50***(IX)
	H0: International=Interprovincial= Inter-county		
F-statistics	6.24*** (I)	7.01***(II)	10.30***(III)
F-statistics	3.91**(IV)	4.77***(V)	16.75***(VI)
F-statistics	20.83***(VII)	13.74***(VIII)	12.10***(IX)

Note: Columns in Table 5.3 are in brackets. Significance levels 0.1, 0.05 and 0.01 are noted by *, ** and *** respectively.

Differentials of the export premium between international and interprovincial trade are much smaller than the export premium differential between interprovincial and inter-county, which tells us that relative to the inter-county premium, the premium of interprovincial trade is more similar to that of international trade (though the latter is actually larger than the former). It appears that once the firm can engage

in interprovincial trade, it has to be only a little more productive for international trade.

5.3.3 Multiple levels of trade

Some firms will engage in multiple levels of trade at the same time, and the sceptical readers may argue that only using three trade levels dummy variables would not be able to disentangle the different export premiums at different levels of trade. Thus, the author revises the regression function (5.1) to do the robustness check by adding the other dummies variables measuring the multiple levels of trade to the following:

$$\log(x_{ijp}) = \alpha + \beta_1 I + \beta_2 II + \beta_3 III + \beta_4 (I \times II) + \beta_5 (I \times III) + \beta_6 (II \times III) + \beta_7 (I \times II \times III) + \sigma z_{ijp} + \delta_j + \delta_p + v_{ijp} \quad (5.2)$$

where I denotes international trade, II denotes interprovincial trade and III denotes inter-county trade.

Table 5.5 reports the regression results. The multiple trade level dummies are generally insignificant and have negative values. The results of other control variables are similar to the results in Table 5.3. Figure 5.2 shows the percentage premium of various firm characteristics with respect to firms trading at the three trade levels. After controlling for the effects of firms trading at multiple levels, similar to Table 5.3, the premium at international level is highest; the premium at interprovincial level is lower; and the premium at inter-county level is lowest. Some tests are also all carried out for the heterogeneity of the export premium, and results are shown in Table 5.6. Overall,

from the statistics, the premiums from international trade and interprovincial trade are found to be similar, but notably higher than the inter-county level premium, which could also be seen in Figure 5.2.

Table 5.5(a): Regression results after controlling multiple levels of trade

	I	II	III
Variables	Sales	Asset	Profit
International	1.153***	0.736***	1.008***
	(0.165)	(0.203)	(0.188)
Interprovincial	0.926***	0.688***	0.904***
	(0.142)	(0.157)	(0.141)
Inter-county	0.444***	0.274**	0.231**
	(0.106)	(0.121)	(0.107)
National×provincial	-0.304	0.356	-0.679**
	(0.262)	(0.329)	(0.286)
National×County	-0.597	-0.458	-0.680
	(0.366)	(0.400)	(0.432)
Provincial×County	-0.302*	-0.296	-0.330**
	(0.166)	(0.188)	(0.166)
National×Provincial×County	0.118	-0.0558	0.826*
	(0.435)	(0.497)	(0.501)
Firm owner's age	0.00216	0.00952**	0.00168
	(0.00409)	(0.00475)	(0.00439)
Education	0.142***	0.145***	0.126***
	(0.0119)	(0.0134)	(0.0125)
Party	0.103	0.139	0.176**
	(0.0797)	(0.0918)	(0.0840)
Firm age	0.0261***	0.0391***	0.0373***
	(0.00851)	(0.00972)	(0.00890)
Technical ratio	-0.616**	-0.530*	-0.0197
	(0.262)	(0.273)	(0.275)
Managing ratio	-1.640***	-1.711***	-2.171***
	(0.538)	(0.629)	(0.589)
Constant	3.990***	3.717***	1.609***
	(0.367)	(0.404)	(0.395)
Province effects	yes	yes	yes
Industry effects	yes	yes	yes
Observations	2,187	1,484	1,914
R-squared	0.312	0.364	0.270

Note: Dependent variables take the logarithmic form. The units for investments, bank loans and wage bills are 10,000 RMB. Multiple levels of trade dummies, firm owner's party membership, education, age, firm age, firm human capital such as technical staff ratio and managing staff ratio, 30 province dummies and 14 industry dummies are controlled. Robust standard errors are in brackets. Significance levels 0.1, 0.05 and 0.01 are noted by *, ** and *** respectively.

Table 5.5(b): Regression results after controlling multiple levels of trade cont.

Variables	IV Investment	V Bank loan	VI Wage bill
International	0.560***	0.506**	0.814***
	(0.181)	(0.256)	(0.132)
Interprovincial	0.463***	0.420*	0.712***
	(0.132)	(0.237)	(0.103)
Inter-county	0.268***	0.138	0.150*
	(0.102)	(0.179)	(0.0800)
National×provincial	-0.00790	0.387	-0.180
	(0.287)	(0.418)	(0.238)
National×County	-0.235	-0.0804	-0.579**
	(0.373)	(0.459)	(0.254)
Provincial×County	-0.131	-0.144	-0.0972
	(0.158)	(0.273)	(0.122)
National×Provincial×County	0.219	-0.104	0.467
	(0.455)	(0.599)	(0.336)
Firm owner's age	0.00578	0.0132**	0.00374
	(0.00409)	(0.00666)	(0.00309)
Education	0.137***	0.138***	0.119***
	(0.0121)	(0.0184)	(0.00913)
Party	0.105	0.0317	0.163***
	(0.0853)	(0.123)	(0.0626)
Firm age	0.0560***	0.00683	0.0272***
	(0.00922)	(0.0124)	(0.00646)
Technical ratio	-0.339	-0.154	-1.037***
	(0.239)	(0.480)	(0.208)
Managing ratio	-2.013***	-1.521*	-3.174***
	(0.496)	(0.854)	(0.561)
Constant	3.323***	2.699***	2.517***
	(0.376)	(0.565)	(0.294)
Province effects	yes	yes	yes
Industry effects	yes	yes	yes
Observations	1,944	979	2,279
R-squared	0.308	0.287	0.399

Note: Dependent variables take the logarithmic form. The units for investments, bank loans and wage bills are 10,000 RMB. Multiple levels of trade dummies, firm owner's party membership, education, age, firm age, firm human capital such as technical staff ratio and managing staff ratio, 30 province dummies and 14 industry dummies are controlled. Robust standard errors are in brackets. Significance levels 0.1, 0.05 and 0.01 are noted by *, ** and *** respectively.

Table 5.5(c): Regression results after controlling multiple levels of trade cont.

Variables	VII Employment	VIII Technical	IX Managing
International	0.818***	0.502***	0.634***
	(0.118)	(0.108)	(0.105)
Interprovincial	0.802***	0.411***	0.519***
	(0.0903)	(0.0823)	(0.0774)
Inter-county	0.151**	0.0596	0.119*
	(0.0670)	(0.0642)	(0.0618)
National×provincial	-0.204	-0.119	-0.127
	(0.219)	(0.220)	(0.198)
National×County	-0.577**	-0.302	-0.511**
	(0.228)	(0.220)	(0.233)
Provincial×County	-0.115	-0.0286	0.00777
	(0.107)	(0.0974)	(0.0927)
National×Provincial×County	0.471	0.349	0.355
	(0.307)	(0.305)	(0.298)
Firm owner's age	0.00121	0.000338	0.00102
	(0.00266)	(0.00262)	(0.00246)
Education	0.0863***	0.0871***	0.0866***
	(0.00830)	(0.00795)	(0.00747)
Party	0.144***	0.101*	0.109**
	(0.0539)	(0.0519)	(0.0500)
Firm age	0.0263***	0.0235***	0.0196***
	(0.00572)	(0.00537)	(0.00545)
Technical ratio	-1.446***	3.052***	-1.406***
	(0.198)	(0.149)	(0.134)
Managing ratio	-3.323***	-2.857***	1.565***
	(0.619)	(0.221)	(0.214)
Constant	3.247***	0.318	0.499**
	(0.269)	(0.244)	(0.235)
Province effects	yes	yes	yes
Industry effects	yes	yes	yes
Observations	2,351	2,284	2,337
R-squared	0.413	0.372	0.302

Note: Dependent variables take the logarithmic form. The units for employment, technical staff and managing staff are persons. Multiple levels of trade dummies, firm owner's party membership, education, age, firm age, firm human capital such as technical staff ratio and managing staff ratio, 30 province dummies and 14 industry dummies are controlled. Robust standard errors are in brackets. Significance levels 0.1, 0.05 and 0.01 are noted by *, ** and *** respectively.

Figure 5.2: The heterogeneous export premium at three trade levels after controlling multiple levels of trade

Table 5.6: Heterogeneous export premium test at three trade levels after controlling multiple levels of trade

	H0:International=Interprovincial		
F-statistics	5.56** (I)	0.47 (II)	2.42(III)
F-statistics	0.26(IV)	0.09(V)	1.76 (VI)
F-statistics	0.05(VII)	2.81*(VIII)	1.19(IX)
	H0:Interprovincial=Inter-county		
F-statistics	3.91**(I)	8.28***(II)	11.83***(III)
F-statistics	2.17*(IV)	2.62**(V)	6.57**(VI)
F-statistics	8.28***(VII)	9.90***(VIII)	6.89***(IX)
	H0:International=Interprovincial= Inter-county		
F-statistics	9.72*** (I)	8.01***(II)	11.55***(III)
F-statistics	4.91**(IV)	4.55***(V)	13.55***(VI)
F-statistics	17.75***(VII)	10.99***(VIII)	13.37***(IX)

Note: Columns in Table 5.5 are in brackets. Significance levels 0.1, 0.05 and 0.01 are noted by *, ** and *** respectively.

5.4 Matching econometrics as a robustness check

In order to identify the robustness of the heterogeneous export premium results, the author performs further tests with some non-parametric matching techniques. The 'propensity score matching' method is applied as proposed by Rosenbaum and Rubin (1983a, 1983b and 1984). It is assumed that all differences between exporters and the appropriate control group can be captured by a vector of observables controlled above. Since the multiple levels of trade dummies variables are insignificant in Table 5.5, the author uses a vector of observables as suggested in equation (5.1) to do the matching estimation. A logit model is used to estimate the probability of exporting. The matching is based on the method of the nearest neighbour. The average of the matched firms' performance can be regarded as the performance of those exporters if they were not exporting. The differential between the observed performance variable and matched firms' characteristics is the matching estimator of export premium.

Before looking at the results, several tests were conducted on the matching quality because results could be biased if the quality of matching is poor. It is crucial to identify treatment and control groups with substantial overlapping firm characteristics and to make a match on those given variables, which can generate an adequate 'like-for-like' comparison. The straightforward approach is to test the equality of the given firm characteristics after matching between the treated group and control group and then check how large the differences are between these two groups after conditioning on the propensity score.

The T-test is used to test the covariate balancing after matching that in order to know whether there are still significant differences in a given covariate between

matched treated and untreated groups. A good matching is evident if the given firm characteristics are not different at a significant level, and it denotes that matched treated and untreated groups have more or less similar firm characteristics.

As indicated in Tables 5.7 to 5.9, most covariates between treated and untreated groups after the five nearest neighbour matching are similar.[45] The province dummies and sector dummies after the matching are also similar but not reported for the sake of brevity. The propensity score histogram of matched firms between treated and untreated illustrates the quality of the matching and allows the comparison of the quantity of matched firms between treated and untreated that accumulate within a given number of intervals of the propensity score range. Figures 5.3 to 5.5 show that there is not a high rate of overlapping propensity scores between treated and untreated firms. Both covariates balancing after matching and the propensity score histogram analysis demonstrate that the quality of matching is efficient.

Table 5.7: Balancing test of matched firms engaged in international trade using the nearest neighbour matching method

Variables	Mean		T-test	
	Treated	Control	T-statistics	P>T
Interprovincial	0.711	0.742	-0.97	0.330
Inter-county	0.655	0.646	0.27	0.788
Firm owner's age	44.08	43.87	0.35	0.723
Education	13.2	13.3	-0.59	0.553
Party	0.266	0.0265	0.05	0.961
Firm age	6.71	6.67	0.16	0.869
Technical ratio	0.098	0.104	-0.73	0.466
Managing ratio	0.100	0.105	-0.83	0.406

Note: This table shows balancing propensities of matched firms doing international trade. The test controls the province and sector effects and for the sake of brevity, the author does not report the 30 province dummies and 14 sector dummies. The results for the province and sector dummy variables pass the test.

[45] The balancing test for the covariate of the international dummy in Tables 5.8 and 5.9 is insignificant, which is caused by the fact that when firms do international trade, most will do interprovincial trade and inter-county trade but not vice versa. International dummy here is not an important covariate for the balancing test about interprovincial and inter-county trade and it has little effect on the analysis.

Table 5.8: Balancing test of matched firms engaged in interprovincial trade using the nearest neighbour matching method

Variables	Mean		T-test	
	Treated	Control	T-statistics	P>T
International	0.216	0.181	2.29	0.022
Inter-county	0.797	0.793	0.21	0.830
Firm owner's age	43.76	43.77	-0.03	0.974
Education	13.056	12.889	1.37	0.172
Party	0.233	0.247	-0.86	0.392
Firm age	6.64	6.38	1.59	0.113
Technical ratio	0.126	0.122	0.67	0.506
Managing ratio	0.118	0.117	0.19	0.850

Note: This table shows balancing propensities of matched firms doing interprovincial trade. The test controls the province and sector effects and for the sake of brevity, the author does not report the 30 province dummies and 14 sector dummies. The results for the province and sector dummy variables pass the test.

Table 5.9: Balancing test of matched firms engaged in inter-county trade using the nearest neighbour matching method

Variables	Mean		T-test	
	Treated	Control	T-statistics	P>T
International	0.172	0.140	2.44	0.015
Interprovincial	0.688	0.696	-0.46	0.646
Firm owner's age	44.54	43.28	0.85	0.395
Education	13.02	12.83	1.67	0.123
Party	0.208	0.199	0.62	0.537
Firm age	6.646	6.694	-0.32	0.751
Technical ratio	0.129	0.124	0.81	0.416
Managing ratio	0.119	0.114	1.42	0.155

Note: This table shows balancing propensities of matched firms doing inter-county trade. The test controls the province and sector effects and for the sake of brevity, the author does not report the 30 province dummies and 14 sector dummies. The results for the province and sector dummy variables pass the test.

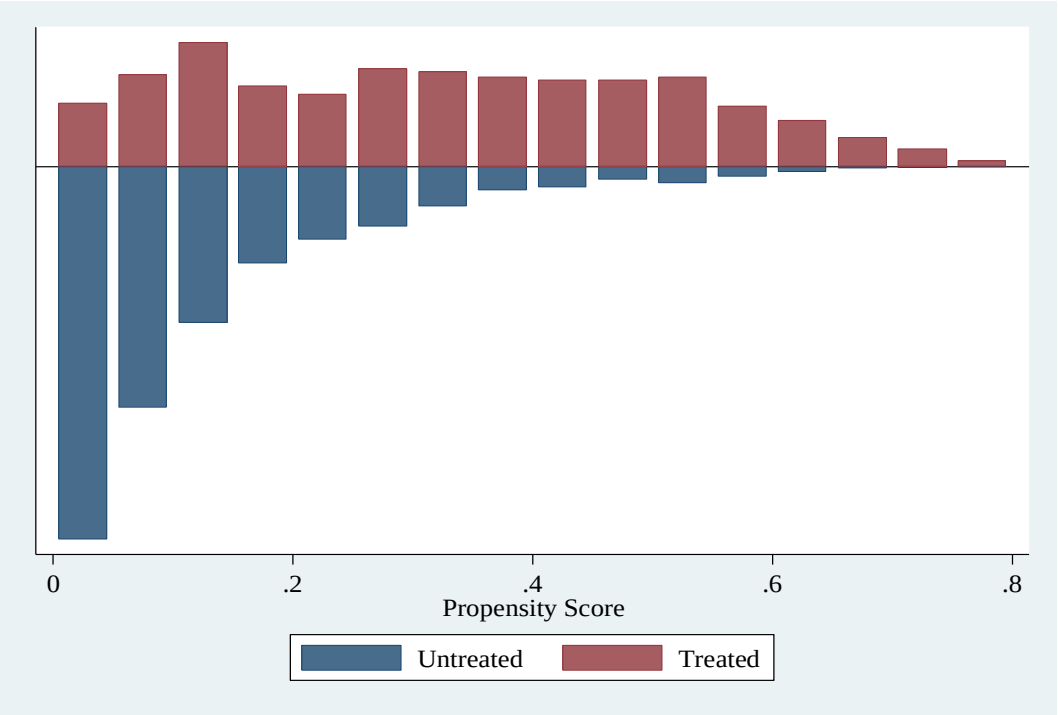

Figure 5.3: The propensity score histogram of matched firms engaged in international trade using the nearest neighbour matching method

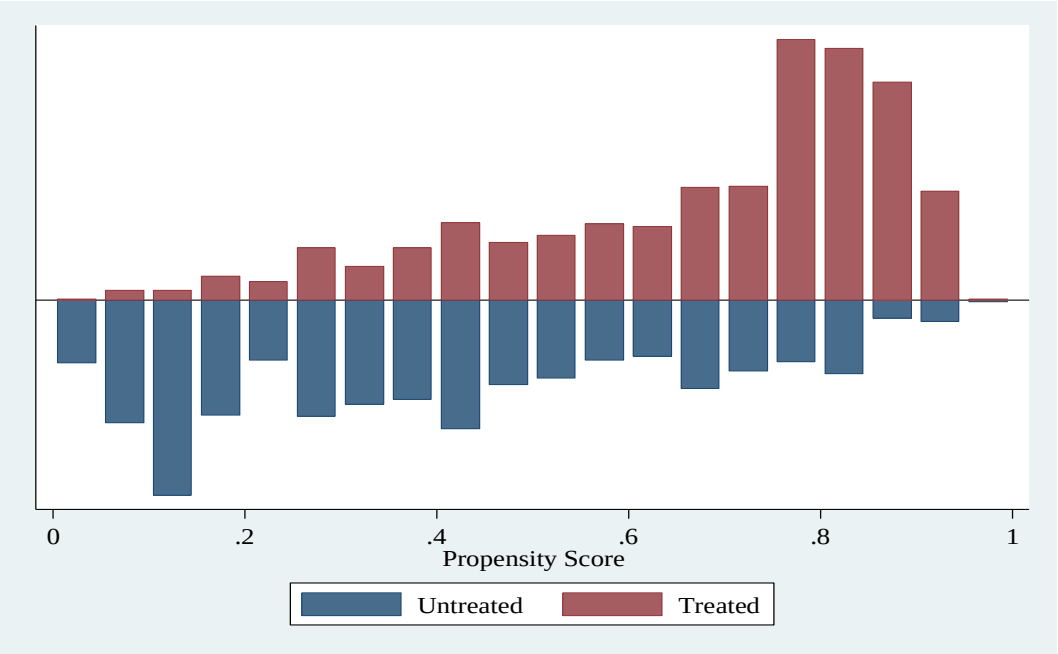

Figure 5.4: The propensity score histogram of matched firms engaged in interprovincial trade using the nearest neighbour matching method

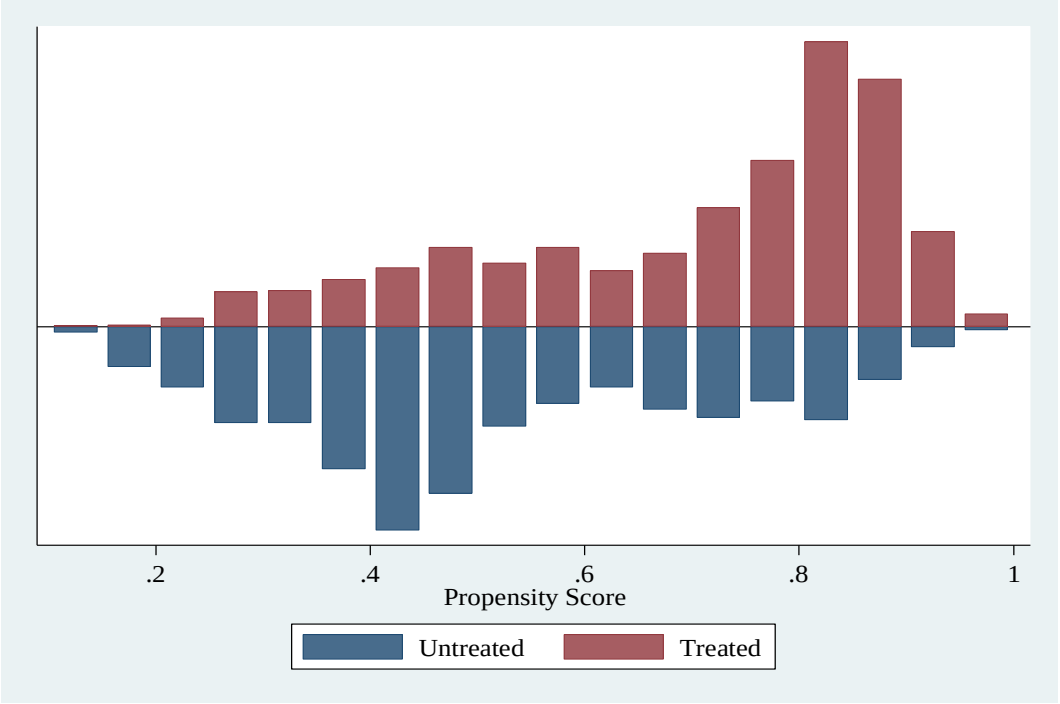

Figure 5.5: The propensity score histogram of matched firms engaged in inter-county trade using the nearest neighbour matching method

Table 5.10 reports the results of the matching test. Consistent with the benchmark results, the firms that engage in international trade have the highest export premium.[46] Firms which trade across province borders also have a higher premium than those which do business within the same province. All the estimators at inter-county level lose their significance and most even become negative.

[46] In this test, matching is similar to OLS. Angrist and Pischke (2008) show that matching and OLS estimators usually have the same assumption of conditional independence. Regression can be used as a computational device for a particular sort of weighted matching estimator, and therefore the differences between regression and matching are unlikely to be of major empirical importance.

Table 5.10: Matching estimators

Variables	International	Interprovincial	Inter-county
Sales (10,000 RMB)	0.810***	0.586***	-0.079
	(0.183)	(0.214)	(0.224)
Total asset (10,000 RMB)	0.607***	0.503***	-0.029
	(0.187)	(0.222)	(0.228)
Investment (10,000 RMB)	0.545***	0.407***	0.055
	(0.202)	(0.223)	(0.236)
Profit (10,000 RMB)	0.565***	0.554***	-0.05
	(0.191)	(0.222)	(0.232)
Bank loan (10,000 RMB)	0.687***	0.681***	-0.043
	(0.205)	(0.228)	(0.246)
Wage bill (10,000 RMB)	0.676***	0.425***	-0.220
	(0.157)	(0.185)	(0.198)
Employment (persons)	0.620***	0.402***	-0.182
	(0.136)	(0.160)	(0.171)
Technical staff (persons)	0.646***	0.455***	-0.048
	(0.145)	(0.148)	(0.168)
Managing staff (persons)	0.506***	0.323***	-0.029
	(0.121)	(0.140)	(0.139)

Note: Dependent variables take the logarithmic form. Firm owner's party membership, education, age, firm age, firm human capital like technical staff ratio as well as managing staff ratio, 30 province dummies and 14 industry dummies are controlled as matched variables. Standard errors are in the brackets. Significance levels 0.1, 0.5 and 0.01 are denoted by *, **, and ***, respectively.

The estimators of percentage premium are again compared in Figure 5.6. When comparing with the inter-county level premium, the premiums of exporting at interprovincial level are relatively similar to the premiums at the international level (though the former is actually smaller than the latter), even more similar than in the benchmark regression results.

Figure 5.6: The heterogeneous export premium according to the matching test at three trade levels

5.5 Concluding remarks

In this chapter, the author inspects the heterogeneity of export premiums across different borders. Previous literature has usually assumed a homogeneous export premium. This study uses a unique survey dataset from China which focuses on private firms. The dataset is ideal for studying the heterogeneity of the export premium. It includes information about trade within county, within province, within the country and overseas, and trade at three levels: inter-county trade, interprovincial trade and international trade.

The author first calculates the mean differential statistics of firm performance variables between firms that export at various levels and compared to non-exporters.

The comparison of the magnitude of the differentials indicates that the firms that engage in international trade do have the best performance; firms trading at interprovincial level have intermediate performance which is better than that of those engaged in inter-county trade; and the performance at inter-county level is the poorest.

Many factors may influence these average indicators of performance. Both parametric and non-parametric methods are then used to isolate the heterogeneous export premiums after controlling for the effects of trading at multiple levels. The premiums differ with the levels of exporting. Firms engaged in international trade execute the best performance. Firms exporting to other provinces demonstrate better performance than firms doing business within the same province. Both methods confirm the findings about the heterogeneity of the export premium.

In addition, when comparing the premium differentials between interprovincial and inter-county, it is found that the export premium of doing interprovincial trade is relatively similar to the export premium at the international trade level (though the former is actually smaller than the latter). As noted earlier, the export premium could be explained by the self-selection effect and learning by exporting. The literature suggests that export premiums caused by the self-selection effect are well documented but the evidence of the learning-by-exporting effect is somewhat mixed and earlier results in the thesis are that an insignificant learning-by-exporting effect is found within sectors in China.

Therefore, if as these results indicate the export premium is mainly caused by the self-selection effect, then the pattern of differences in the premiums indicate that trade costs within China are very large, especially for goods crossing provincial borders. Indeed, they are almost as great as those for international trade.

The results are significant because to the author's best knowledge, they attest to the anecdotal evidence that the trade costs between China's provinces are very high. This is the first time this has been demonstrated by econometric analysis. During the process into greater economic globalization after joining the WTO, China needs to liberalize the economic market within the country, and particularly aim to decrease the internal trade costs between provinces. By doing so, the government can further stimulate the domestic demand and truly make better use of the advantage of the potentially huge domestic market.

Chapter 6: Wage Inequality and International Trade: Evidence from China

6.1 Introduction

One of the core issues in international trade is the distribution of income across factors of production, especially wage levels. The traditional HO model predicts that trade can increase the real return to the factor that is relatively abundant in each country. Consider a world of skilled and unskilled labour with mobile capital, this means for example that for developing countries with an abundance of unskilled labour, trade can decrease wage inequality. Despite this expectation, a rise of wage inequality has been observed in the developing world including Mexico, Colombia, Argentina, Brazil, Chile, India and China (Attanasio et al., 2004; Goldberg and Pavcnik, 2007; Topalova, 2007; Menezes-Filho et al., 2008; etc) in association with the growth of trade.

What are the relationships between international trade and wage inequality in a developing economy like China? Trade economists have considered a number of factors that might explain the observed rise in inequality: these include skill-biased changes; weakening of labour market institutions such as unions and the declining real value of minimum wages; differential access to schooling; and immigration.

Another contributor is offshoring. The Feenstra and Hanson (1996) offshoring model predicts that trade in tasks will raise income inequality both in countries abundant in skilled labour and those abundant in unskilled labour. However, overall, Harrison et al. (2010) argue that there is a debate about assigning too great an importance to trade-based explanations for the increase in wage inequality in the

developing world. The question remains whether international trade will cause wage inequality to rise and in this chapter the evidence from China is examined.

More recently, new theoretical predictions about the relationship between international trade and wage inequality between exporters and non-exporters have been established (Davis and Harrigan, 2011; Egger and Kreickemeier, 2009, 2012; Helpman et al., 2010; Bustos, forthcoming). This stream of theory focuses on heterogeneous firms with labour market bargaining and friction: exporters are more productive and pay higher wages than non-exporters; exporters search for skilled labour in the labour market which has significant frictions; international trade allows exporters to employ more skilled labour and pay higher wages, thus causing wage inequality to increase.

This chapter employs Chinese firm-level data to study the effects of international trade on wage inequality between firms. The exercise is in two steps. First, in order to capture the trade openness characteristics, the two dimensions of international trade are calculated, namely intensive margin and extensive margin, in each province based on the large sample of firm-level data. In addition, the Gini and Theil wage inequality indexes are computed for each province with the firm-level data. In the second step, the wage inequality indexes are regressed on the extensive margin and intensive margin controlling for province and year fixed effects.

The results show that the impact of trade openness on wage inequality is very large. The variation of trade openness alone can explain about 70 percent of the variation of wage inequality across Chinese provinces. It is also found that the extensive margin has a larger effect on wage inequality than the intensive margin. IV regression results imply that one unit of change in the intensive margin increases

wage inequality by nearly one unit and a one unit change in the extensive margin increases wage inequality by 1.2 to 1.3 units.

The related literature on wage inequality and international trade at the firm level is reviewed in Chapter 2. The purpose of this chapter is to test the prediction that in the real world of firm heterogeneity, international trade will increase wage inequality. The rest of this chapter is organized as follows: section 6.2 presents the empirical strategy and the wage inequality as well as trade openness indexes. The regression results with panel data analysis are presented in section 6.3. The last section concludes the chapter.

6.2 Empirical strategy

The dataset used in this Chapter is the same as in Chapter 3 and Chapter 4 (Please refer to Chapter 3 for the details for the firm-level data). From the findings in Chapters 3 and 4, it may be concluded that the Chinese firm-level data are generally in line with the stylized facts about the firm heterogeneity model and previous findings, that is, the self-selection effect is significant and only a small proportion of firms are exporters; and exporting will increase wage levels of exporting firms. Therefore, from the general theoretical predictions in the literature, it would be expected to observe that the growth of international trade results in increasing wage inequality between exporters and non-exporters.

6.2.1 General approach

The main specification comes from previous empirical studies on wage inequality and trade openness, for example, Attanasio et al. (2004), Topalova (2007), Breau and Rigby (2010) and many others. In the literature, the left-hand-side variables are usually wage or salary (to study the wage premium and then discuss the wage inequality) and right-hand-side trade openness variables are usually policy changes like tariff reductions or measures of trade openness like import penetration rates and others.

Our main estimating equation relates to wage inequality for province i at year t, as

$$\text{Wageinequality}_{\text{it}} = c_w + \beta \text{Tradeopenness}_{\text{it}} + \mu_i + \mu_t + \varepsilon_{it} \quad (6.1)$$

where trade openness is the main causal variable of interest, and c_w is a constant term. The author lets μ_i be a generic representation of province fixed effects that capture all time-invariant province-specific characteristics and permanent differences, and μ_t be a generic representation for time-varying macroeconomic shocks that affect all the provinces within China identically. Finally, ε_{it} is the idiosyncratic error term clustered at the province level.

In order to find the reliable value of wage inequality and trade openness in each province, our analysis goes in two steps. This is a significant difference compared to the earlier studies. The author calculates the wage inequality and trade openness indexes first. Therefore, our dependent variables are directly characterizing the wage inequality and the independent variables are exactly equivalent to the trade openness. Thereafter, the author uses panel data to estimate the effect of trade openness on wage inequality.

Trade openness may be endogenous in the regression analysis, for example, omitted variable bias. To solve this problem, the two-stage least square (2SLS)-IV method is employed. Detailed information regarding IV will be introduced in section 6.3. The empirical strategy is as follows. Using an IV, the exogenous variation of trade openness can be identified. The estimating equation relating to trade openness in this case is given by

$$\text{Tradeopenness}_{\text{it}} = c_t + \alpha \text{IV}_{\text{it}} + \mu_i + \mu_t + w_{it} \tag{6.2}$$

Equation (6.2) is the first stage of the 2SLS-IV regression and the 2SLS-IV regression is equal to the reduced regression divided by the first stage regression, therefore, the author also estimates the reduced regression as follows,

$$\text{Wageinequality}_{\text{it}} = c_w + \delta \text{IV}_{\text{it}} + \mu_i + \mu_t + \tau_{it} \tag{6.3}$$

6.2.2 Wage inequality and trade openness indexes

In order to measure trade openness, both margin characteristics about China's exporting firms are used. Following Alessandria and Choi (2010), the author introduces the ratio of exports to total sales of exporters and non-exporters and decomposes the ratio into three components: intensive margin, export premium and extensive margin, as shown in equation (3.1) in Chapter 3 and the author rewrites it in a revised form as follows:

$$\overbrace{\frac{\sum_{i=1}^{n} ex_i}{\sum_{i=1}^{N} sales_i}}^{Export\ share} = \overbrace{\left(\frac{\sum_{i=1}^{n} ex_i / n}{\sum_{i=1}^{n} sales_i / n}\right)}^{Intensive\ margin} \bullet \overbrace{\left(\frac{\sum_{i=1}^{n} sale_i / n}{\sum_{i=1}^{N} sales_i / N}\right)}^{Export\ premium} \bullet \overbrace{\left(\frac{n}{N}\right)}^{Extensive\ margin} \tag{6.4}$$

The intensive margin shows the percentage of sales which are exported. According to Helpman et al. (2010), if a firm is productive enough to export, the volume of exports (intensive margin) is mainly affected by the transport costs, however, the extensive margin is the fraction of the exporters divided by the total number of firms and this margin is determined by a large category of trade costs, for example, fixed export costs and transport costs. Fixed export costs include border-related costs, distributional costs, non-tariff costs, etc.[47]

Figure 6.1 shows the trends in both margins for each province, and consistent with Table 3.1, for the coastal provinces, the intensive and extensive margins were much higher than those for central and western provinces. For some provinces, like, Tianjin (12) and Chongqing (50), the intensive and extensive margins significantly increased over time; for some provinces, both margins changed very little; and for some other provinces, both margins displayed different trends. Therefore, there is significant variation relating to trade openness across the provinces.

[47] See Anderson and van Wincoop (2004) for more detailed discussion about trade costs.

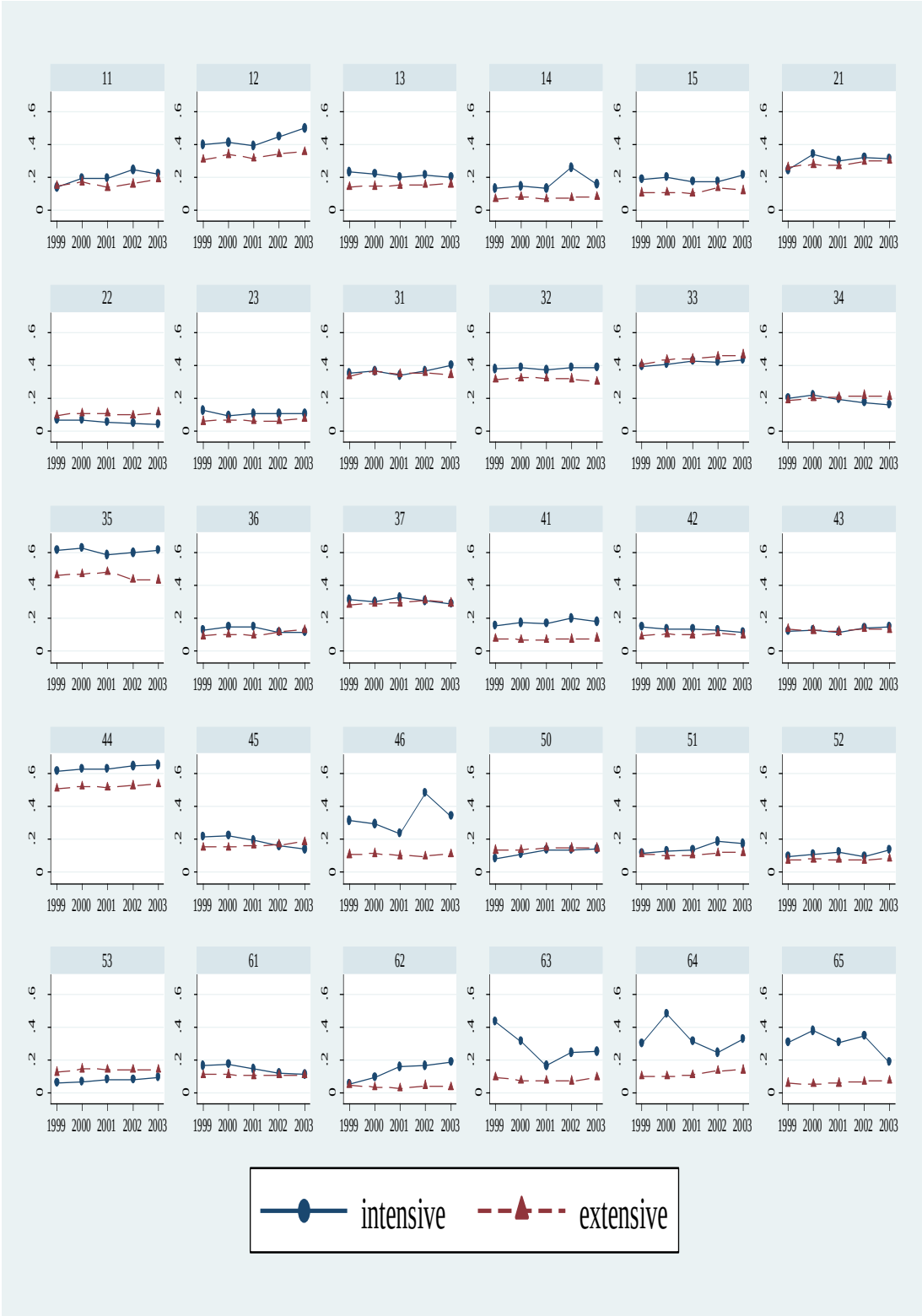

Figure 6.1: Intensive margin and extensive margin in Chinese provinces

For wage distribution and inequality across provinces, two wage inequality indexes are introduced, one is the Gini index and the other is the Theil index. The two indexes are defined as follows:

$$Gini = \frac{1}{n}\left(n + 1 - 2\left(\frac{\sum_{i=1}^{n}(n+1-i)wage_i}{\sum_{i=1}^{n} wage_i}\right)\right) \tag{6.5}$$

$$Theil = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{wage_i}{wage} ln \frac{wage_i}{wage}\right) \tag{6.6}$$

Wage is the wage per capita in each firm and n is the number of firms in each province. For the Gini index, the average wage values are indexed in non-decreasing order, for $i = 1$ to n and a value of zero expressing total equality and a value of one maximal inequality. For Theil, a value of zero expresses total equality and a value of $ln(n)$ means maximal inequality.

Table 6.1 shows the wage inequality indexes and trade openness indexes in China from 1999 to 2003 based on the aggregate firm-level data. Generally, it is clear that wage inequality increased with the increase of trade openness, which is the case in the Helpman et al. (2010) simulation results when the fraction of exporting firms is small, an increase in the extensive margin will increase wage inequality between firms.

Table 6.1: Indexes of wage inequality and trade openness in China

Year	1999	2000	2001	2002	2003
Gini	0.37782	0.39371	0.42223	0.43691	0.45021
Theil	0.30224	0.45951	0.81798	0.85409	0.94558
Extensive margin	26.71	28.40	29.17	30.54	31.34
Intensive margin	0.3552	0.3705	0.3781	0.3931	0.3986

Figure 6.2 shows the Gini index for each year from 1999 to 2003 for each province.[48] There is significant variation in wage inequality between provinces and different trends in wage inequality over time, but the trends are very similar with the trade openness across China's provinces. This shows that there is a positive relationship between trade openness and wage inequality. In addition, Figure 6.3 draws the Gini index in 2003 across China's provinces. From the cross-section case, The author finds that those coastal provinces with higher trade openness also display higher wage inequality indexes, also implying the clear relationship between wage inequality and trade openness.

[48] The Theil index trends across Chinese provinces are very similar to the Gini index. If we draw both indexes in the same figure, it is hard for us to distinguish.

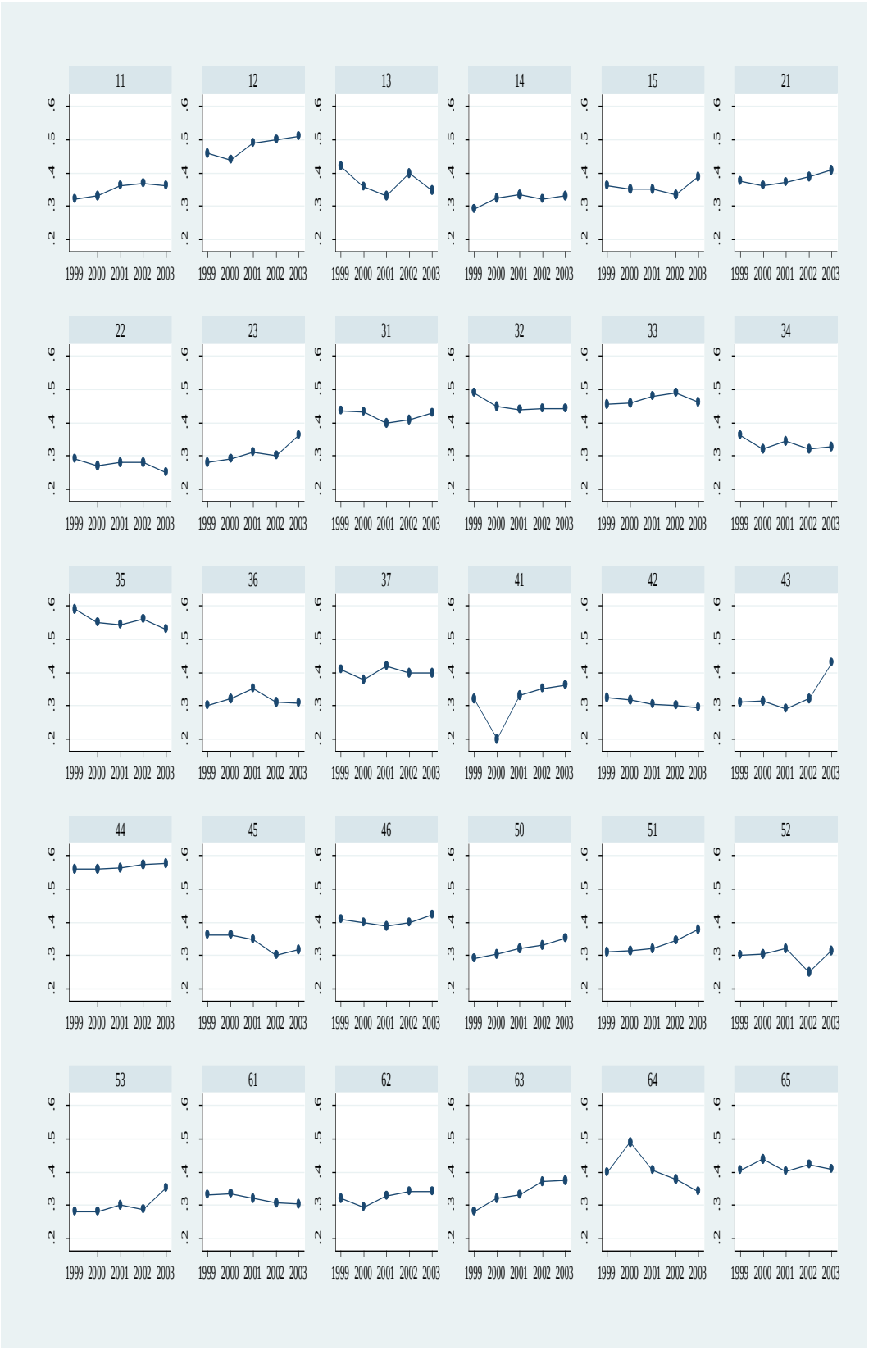

Figure 6.2: The Gini indexes over time in Chinese provinces

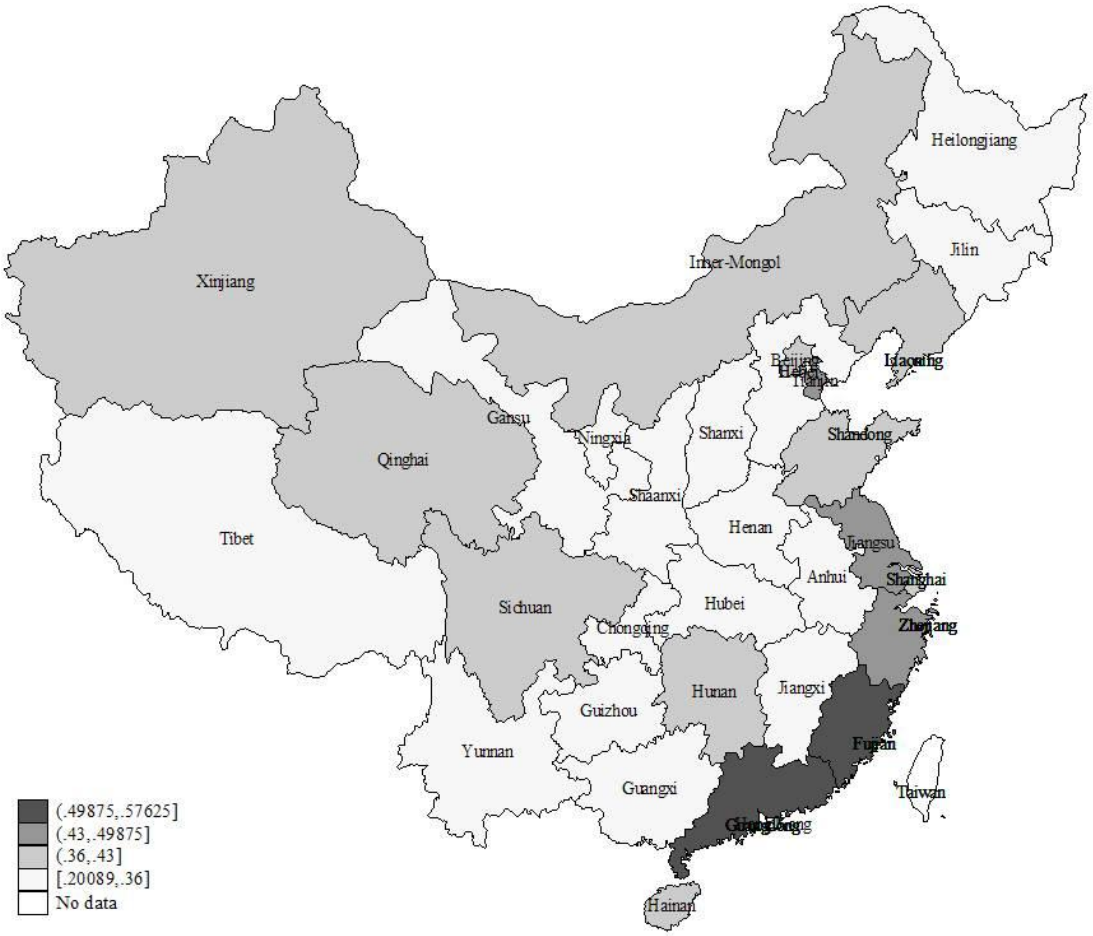

Figure 6.3: The Gini wage inequality index in 2003 across China's provinces

In order to test the positive relationship between wage inequality and trade openness, the author uses disaggregated province panel data to do the regression analysis. Panel data econometrics is used to estimate the effect of trade openness on wage inequality since cross-section data may suffer from omitted variable bias. Table 6.2 presents the summary statistics of our main variables.

Table 6.2: Summary statistics of indexes

Variable	Obs	Mean	Std Dev.	Min.	Max.
Gini	155	0.355	0.070	0.201	0.803
Theil	155	0.322	0.488	0.075	5.603
Extensive margin	155	0.175	0.130	0.021	0.536
Intensive margin	155	0.254	0.171	0.032	1.000

6.3 Trade openness on wage inequality

In this section, panel data analysis is used to investigate the relationship between trade openness and wage inequality, in particular, whether trade openness increases wage inequality. The two wage inequality indexes and two trade openness margins are used to test the effect. Panel data analysis can effectively solve the omitted province specific variable bias in cross-section data, which do not vary over time, and time effects which affect the provinces identically.

6.3.1 Benchmark results

Tables 6.3 to 6.6 report the results showing the effects of trade openness on wage inequality. Table 6.3 shows the impact of the intensive margin on the Gini index; Table 6.4 shows the impact of extensive margin on the Gini index; Table 6.5 shows the impact of intensive margin on the Theil index; and Table 6.6 shows the impact of extensive margin on the Theil index.

Table 6.3: Intensive margin on wage inequality (Gini index)

Variables	(1) Pooled OLS	(2) LSDV(FE)	(3) LSDV(FE)	(4) RE(MLE)
Intensive	0.972***	0.519***	0.502***	0.502***
	(0.0583)	(0.0441)	(0.0441)	(0.0387)
Province effects	No	Yes	Yes	Yes
Time effects	No	No	Yes	Yes
Observations	155	155	155	155
R-squared	0.675	0.971	0.974	

Note: Clustered robust standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1

Table 6.4: Extensive margin on wage inequality (Gini index)

Variables	(1) Pooled OLS	(2) LSDV(FE)	(3) LSDV(FE)	(4) RE(MLE)
Extensive	1.285***	2.577**	2.483**	0.671*
	(0.0812)	(1.123)	(1.003)	(0.407)
Province effects	No	Yes	Yes	Yes
Time effects	No	No	Yes	Yes
Observations	155	155	155	155
R-squared	0.597	0.944	0.950	

Note: Clustered robust standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1

Table 6.5: Intensive margin on wage inequality (Theil index)

Variables	(1) Pooled OLS	(2) LSDV(FE)	(3) LSDV(FE)	(4) RE(MLE)
Intensive	0.916***	0.442***	0.411***	0.411
	(0.121)	(0.0492)	(0.106)	(0.278)
Province effects	No	Yes	Yes	Yes
Time effects	No	No	Yes	Yes
Observations	155	155	155	155
R-squared	0.231	0.450	0.482	

Note: Clustered robust standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1

Table 6.6: Extensive margin on wage inequality (Theil index)

Variables	(1) Pooled OLS	(2) LSDV(FE)	(3) LSDV(FE)	(4) RE(MLE)
Extensive	1.197***	2.802	5.442**	5.442
	(0.161)	(1.964)	(2.544)	(3.430)
Province effects	No	Yes	Yes	Yes
Time effects	No	No	Yes	Yes
Observations	155	155	155	155
R-squared	0.199	0.444	0.483	

Note: Clustered robust standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1

The first column in each table shows the pooled OLS regression results. The second and third columns use the FE approaches and the least square dummy variables (LSDV) methods are used to control the fixed effects. Column (2) for controls the province effects and column (3) includes both province and year fixed effects. The last column is the random effect of maximum likelihood estimation (MLE) results controlling province and year effects.

As shown in Table 6.3, similar to the cross-section case in Figure 6.3, the pooled OLS can explain nearly 70 percent of the variation of wage inequality across Chinese provinces for the period 1999 to 2003. With each additional unit of intensive margin, the Gini index increases by nearly one unit. After controlling for fixed effects, the explanatory power increases significantly from 67.5 percent to 97 percent, and the coefficient measuring the impact of intensive margin on the Gini index is 0.5. Random effect results show the robustness of the regression. Extensive margin variation can explain 60 percent of the variation in wage inequality across the provinces and years, and the coefficient measuring the impact of extensive margin on the Gini index is 1.285, meaning that when the extensive margin increases by one unit, wage inequality will increase by 1.285 units. After controlling for the fixed effects, the explanatory power is also significantly higher and the coefficients increase to nearly 2.5 and the random effect also shows the robustness of the impact of trade openness on wage inequality.

For the Theil index, trade openness can explain 20 percent of the variation of wage inequality. However, for the intensive margin, similar to the Gini index, the coefficient is also near one and after controlling for fixed effects, the coefficients decrease to nearly half of the pooled OLS result at about 0.4. For the extensive margin, the coefficients also increase, with the pooled OLS coefficient near 1.2 and after controlling for the fixed effects, the effect of extensive margin on wage inequality is as high as 5.442.

For Gini and Theil, the extensive margin effect on wage inequality is much larger than that of the intensive margin. The extensive margin is associated with fixed export costs and iceberg transport costs but the intensive margin is only affected by transport costs (Helpman et al., 2010). Over time, transport costs have fallen

significantly. However, with regard to trade costs, Glaeser and Kohlhase (2004) and Disdier and Head (2008) have found that the trend is upwards and this is a puzzling finding. It is clear from Tables 6.3 to 6.6 that the extensive margin has a much more substantial impact on wage inequality than the intensive margin. Compared with the intensive margin, the extensive margin can be a more reliable indicator of trade openness since it includes a wider range of costs, and this is why the extensive margin has a larger effect.

6.3.2 Endogeneity

In this section, the author considers the possible endogeneity issues regarding the trade openness variable. One possible reason for endogeneity is that there are some omitted variables relating to trade openness that differ over time and regions, for example, technology change and policy change. To make it clearer, after China's entry to the WTO, China needed to fulfil the WTO commitments for some service sectors like allowing foreign direct investment in banking. This policy change affects China's international manufacturing trade and wage levels (through credit and financial market channels).[49] The other possible reason for endogeneity is that wage inequality will also affect trade. If firms pay higher wages, their labour productivity increases, and they will be able to export to the international market. Both of these possible endogeneity issues must be considered. Because of data is constructed from the firm-level, it is hard to control the omitted variables like technology change, due to the unavailability of the data, even at the province level, let alone at the firm level, therefore, the IV is used to control for the endogeneity problems.

[49] See footnote 19 for the effect of credit on exports.

The author uses an assessment of business regulations for local firms as an IV for trade openness. The business regulation measure is provided by the World Bank under the *Doing Business* project identifying the bureaucratic and legal hurdles an entrepreneur must overcome to incorporate and register a new firm. This study uses the (monetary) cost (percent of provincial GDP per capita in China) and the (informal) time cost of starting a new business with up to 50 employees and start-up capital of 10 times the economy's per-capita gross national income (GNI) in each capital of provinces and municipal cities. This indicator reflects the trade costs of doing business in each province and will definitely have correlations with the trade openness in every region.[50]

Table 6.7 presents the summary statistics of the instruments. Tables 6.8 and 6.9 report the IV first-stage regression and reduced regression results using formal business monetary cost and time cost separately to see the robustness. Table 6.10 presents the first stage and reduced form regression results using monetary and time cost simultaneously to see which cost variable is more important. Throughout Tables 6.8 to 6.10, there is a clear and statistically negative relationship between trade openness and the business costs across provinces and the first-stage F-statistics (actually hundreds) are well above the rule-of-thumb threshold of 10 suggested by Staiger and Stock (1997) but are not reported.

In addition, the reduced form IV regressions show significant results; especially for the Gini regression for which both coefficients are negative. These results imply the usefulness of our IV. The results in Tables 6.8 and 6.9 are very

[50]The informal business costs of trade, such as time or information required to complete the transaction, may be the leading reasons to help explain the mystery of the missing trade (Trefler, 1995) or the home bias in international trade found by McCallum (1995) as well as Anderson and van Wincoop (2003). Also see footnote 4 and the 'home bias' is also known as the 'border effect puzzle'. Evidence suggesting that such informal costs as barriers to international trade are being increasingly recognized both in empirical and theoretical work, and see Belderbos and Sleuwaegen (1998), Rauch and Casella (2003) for example.

similar when using the business monetary costs and time costs separately. In Table 6.10, first stage results show that time costs matter more for trade openness while the reduced regression shows contradictory results.

Table 6.7: Summary statistics of IV

Variable	Obs	Mean	Std Dev.	Min.	Max.
Monetary cost	150	10.96	5.27	3.1	26.6
Time cost(days)	150	41	6.60	28	55

Table 6.8: IV first-stage and reduced regression results using monetary cost

	First stage		Reduced regression	
	(1)	(2)	(3)	(4)
Variables	extensive	intensive	Gini	Theil
Start business	-0.0115***	-0.0107***	-0.0030***	-0.0028
	(0.000215)	(0.000554)	(0.000851)	(0.004457)
Constant	0.375***	0.388***	0.369***	0.235***
	(0.00539)	(0.0118)	(0.0074)	(0.0709)
Province effects	yes	yes	yes	yes
Time effects	yes	yes	yes	yes
Observations	150	150	150	150
R-squared	0.995	0.942	0.611	0.258

Note: Clustered robust standard errors in parentheses;*** p<0.01

Table 6.9: IV first-stage and reduced regression results using time cost

	First stage		Reduced regression	
	(1)	(2)	(3)	(4)
Variables	extensive	intensive	Gini	Theil
Time cost	-0.015***	-0.011***	-0.0032***	-0.005
	(0.0002)	(0.001)	(0.0008)	(0.004)
Constant	0.935***	0.942***	0.464***	0.442***
	(0.008)	(0.044)	(0.292)	(0.167)
Province effects	yes	yes	yes	yes
Time effects	yes	yes	yes	yes
Observations	150	150	150	150
R-squared	0.995	0.942	0.611	0.258

Note: Clustered robust standard errors in parentheses;*** p<0.01

Table 6.10: IV first-stage and reduced regression results using both costs

	First stage		Reduced regression	
	(1)	(2)	(3)	(4)
Variables	extensive	intensive	Gini	Theil
Start business	-0.0045***	-0.008***	-0.0028**	-0.0026
	(0.0001)	(0.001)	(0.0011)	(0.0059)
Time cost	-0.016***	-0.016***	-0.0013***	-0.004
	(0.0001)	(0.0010)	(0.0004)	(0.003)
Constant	0.991***	1.138***	0.428***	0.421***
	(0.005)	(0.025)	(0.022)	(0.156)
Province effects	yes	yes	yes	yes
Time effects	yes	yes	yes	yes
Observations	150	150	150	150
R-squared	0.995	0.942	0.611	0.258

Note: Clustered robust standard errors in parentheses;*** p<0.01

It is intuitive that the business costs associated with starting a new business activity and time costs act as a possible instrument of trade openness. The author uses the 2SLS method to run the regression. Tables 6.11 to 6.13 report the final results of the impact of trade openness on wage inequality using both cost variables separately and simultaneously. Table 6.11 only uses the monetary cost of starting a business. Table 6.12 only uses the time cost and Table 6.13 uses both costs.

Table 6.11: IV second-stage regression results: Trade openness on wage inequality (monetary cost)

	Gini		Theil	
Variables	1	2	3	4
Extensive	1.27***		1.23***	
	(0.110)		(0.220)	
Intensive		1.05***		1.02***
		(0.137)		(0.113)
Province effects	yes	yes	yes	yes
Year effects	yes	yes	yes	yes
Observations	150	150	150	150
R-squared	0.61	0.70	0.18	0.22

Note: Clustered robust standard errors in parentheses;*** p<0.01

Table 6.12: IV second-stage regression results: Trade openness on wage inequality (time cost)

	Gini		Theil	
Variables	1	2	3	4
Extensive	1.29***		1.25***	
	(0.108)		(0.205)	
Intensive		1.09***		0.98***
		(0.107)		(0.143)
Province effects	yes	yes	yes	yes
Year effects	yes	yes	yes	yes
Observations	150	150	150	150
R-squared	0.60	0.69	0.19	0.21

Note: Clustered robust standard errors in parentheses;*** p<0.01

Table 6.13: IV second-stage regression results: Trade openness on wage inequality (monetary cost and time cost)

	Gini		Theil	
Variables	1	2	3	4
Extensive	1.28***		1.19***	
	(0.180)		(0.215)	
Intensive		1.07***		1.01***
		(0.127)		(0.153)
Province effects	yes	yes	yes	yes
Year effects	yes	yes	yes	yes
Observations	150	150	150	150
R-squared	0.62	0.71	0.20	0.23

Note: Clustered robust standard errors in parentheses;*** p<0.01

It is found that the trade openness, both intensive margin and extensive margin, have a significant effect on the wage inequality indexes of Gini and Theil. The results are very similar regardless of whether monetary cost or time cost are used in isolation as in Tables 6.11 and 6.12, or whether these are combined as repressors as in Table 6.13.

Compared with the benchmark OLS results, especially the results estimated after controlling for both time-invariant province-specific effects and time-varying macroeconomic shocks (column 3 in Tables 6.3 to 6.6), it can be seen that the effect

of extensive margin on wage inequality indexes between firms is over-estimated while the effect of intensive margin on wage inequality is under-estimated. However, the extensive margin still has bigger effects than the intensive margin on increasing wage inequality between firms.

Quantitatively, with one unit of increase in intensive margin, the wage inequality index between firms will increase by around one unit, and one unit of increase in extensive margin will cause the wage inequality indexes to increase by 1.2 to 1.3 units. Take the distribution of the Gini coefficient between 0.201 and 0.803 in the sample for example, with a 1 percent increase in intensive and extensive margin; wage inequality will increase by 1.7 and 2 percentage points.

6.4 Concluding remarks

In this chapter, the author uses Chinese firm-level data to investigate the relationship between wage inequality and trade openness. To the best of the author's knowledge, this is the first study to employ Chinese firm-level data to directly investigate the impacts of trade openness on wage inequality rather than average wage premium in China. The general theoretical idea behind the study is that within a world of firm heterogeneity where only a few firms can become exporters and exporters are usually more productive and pay higher average wages, trade openness can cause wage inequality between firms to increase.

The methodology comprises two steps. First, the firm-level data are used to construct the indexes for trade openness and wage inequality in each province and the author uses two indexes for both trade openness and wage inequality, in particular, the intensive margin and extensive margin are used to characterize trade openness and the

Gini and Theil indexes are used to capture wage inequality. Then the author employs a panel data approach to investigate the effect of trade openness on wage inequality.

Our results show that trade openness significantly increases wage inequality, and trade openness itself can explain nearly 70 percent of the variation in wage inequality. Generally, the extensive margin has a larger effect on wage inequality than the intensive margin. IV regression results show that with one unit of change in trade openness, the intensive margin increases wage inequality by one unit and the extensive margin increases wage inequality by 1.2 to 1.3 units.

The author closes with some cautions. The first caution is that the instruments here are not purely exogenous and the use of instrumental variables would benefit from further development to address the endogeneity of trade openness, and that the causal relationship of trade openness and wage inequality remains an open issue in the empirical literature. Another caution is that the wage inequality indexes in this paper measure the wage inequality between firms but not the true wage inequality in each province and the trade openness variables are not really the policy changes like tariff reduction but capture a larger category of trade costs in each province. The author leaves these issues to future research.

Chapter 7: Conclusion

7.1 Summary

The thesis uses a large firm-level panel dataset and a private enterprise survey dataset from China to empirically study the relationship between export activity, productivity and wage inequality. The large dataset covers more than 150,000 firms every year from 1999 to 2003 and covers over 70 percent of China's manufacturing exports. The private firm data, with more than 3,000 firms, come from a survey which was jointly conducted in 2000 by the All China Industry and Commerce Federation, the China Society of Private Economy at the Chinese Academy of Social Sciences, and the United Front Work Department of the Central Committee of the Communist Party of China.

Briefly, the four main chapters examine four research questions. Chapter 3 asks the question of whether exporters are better performers than non-exporters, that is, whether an export premium exists in China's developing and transitional economy. Chapter 4 seeks answers to the question of whether there is a self-selection effect and learning-by-exporting effect across China's exporting firms, with the investigation focusing on the learning-by-exporting effect. Chapter 5 tries to answer the question of whether there is a heterogeneous export premium at different levels of trade. Chapter 6 examines the research question of whether trade openness will cause wage inequality between firms to increase.

In Chapter 3, an extensive study and investigation shows some consistent findings with previous literature on the export premium at the firm level. The author finds four key features of Chinese firms: first, exporting firms account for about 30 percent of all firms; second, most of the firms have a short life span, and 33.4 percent

firms have a life span of just one year; third, when firms begin to export, most will keep exporting; fourth, both intensive margin and extensive margin of firms' exports increases over time.

In Chapter 3, the author finds that there is a series of export premium in wages, production, sales, value added, employment scales and capital intensity. Using TFP estimated by the FE approach as a rough measure for productivity, exporting firms are on average 2.54 percent more productive. In addition, the author finds that firms with higher export values will have a higher export premium. Using TFP estimated by the FE method, an additional 1 percent increase in export value increases productivity by 0.06 percent. According to the quantile regression, the results show that the higher the quantile of firm performance characteristics, the lower the premium.

Finally, the author tests the export premium across years, industries, provinces and ownership types. The export premium is shown to decrease over time; in the machinery and electronics industry the export premium was lower than for other less export intensive industries; coastal provinces had a much lower export premium than other provinces; and foreign-invested firms, especially, HMT-invested ones, had a much lower export premium than domestic firms.

Due to China's increasing exports especially processed by HMT-invested enterprises over time, and exports being predominantly in the machinery and electronics industry and in coastal provinces, it is safe to conclude that the more export intensive an industry, a province, an ownership type or even a year, the lower the export premium. The reason behind this observation is that the trade costs decrease with an increase in export intensity, especially processing exports, thus causing the export premium to fall.

In Chapter 4, the author tests the self-selection effect and learning-by-exporting effect in China. First, the author uses the OP method to control for the self-selection bias and simultaneity bias and to obtain a reliable productivity estimate of Chinese firms. Second, the author uses both the parametric method and non-parametric econometric approach-matching techniques to find both a strong self-selection effect and a strong learning-by-exporting effect at the aggregate data level in China.

In addition, the author finds that when more productive firms become exporters, the nearer to the starting point of exporting, the higher the premium of ready-to-export firms, which implies that the productivity of future exporters increases much faster than those firms which will never export. For the learning-by-exporting effect, usually, the exporter's learning effect is the most significant in the second year after exporting and then decreases.

Finally, the learning-by-exporting effect is investigated at various disaggregated levels. Using data from 1999 to 2003, the author finds no significant learning effect within an industry, which implies that the apparent learning-by-exporting effect at aggregate level is caused by between-industry productivity differences, i.e. productivity differences between exporters in some sectors and non-exporters in other sectors, but not by within-industry productivity differences between exporters and non-exporters. The insignificant learning-by-exporting effect within an industry also implies that the self-selection effect was more important than learning by exporting.

For different regions, the eastern provinces showed a significant learning-by-exporting effect, while the middle and western region did not display a significant learning effect. For ownership types, matching estimation results were not robust with

the parametric results, while there was still some evidence showing the existence of the learning-by-exporting effect.

In Chapter 5, the heterogeneous export premium was investigated using a unique private firm-level dataset for 2000. Both parametric and non-parametric methods were used to isolate the heterogeneous export premium. It was found that the heterogeneous export premium varies across different levels of exporting. Firms engaged in international trade showed the best performance. Firms exporting to other provinces were better performers than firms only doing business within the same province.

Both methods confirm the findings relating to the heterogeneity of the export premium. In addition, when comparing the estimators quantitatively further, it was found that the export premium differentials between international trade and interprovincial trade levels were much smaller than the differentials between interprovincial and inter-county trade levels, which were relatively larger. This result tells us that compared to the export premium at the inter-county level, the premiums of exporting at interprovincial level are insignificantly different from the premiums at the international level (though the former is actually smaller than the latter). If the export premium is mainly caused by self-selection effect, to reflect the trade cost at different trade levels, this finding implies that the trade costs in domestic China when crossing provinces are as high as when crossing country borders.

In Chapter 6, the author asks the question: does international trade increase the wage inequality in China? The methodology goes in two steps. In the first step, the firm-level data are used to construct the indexes of trade openness and wage inequality in each province, and two indexes are used each for trade openness and wage inequality. In particular, the intensive margin and extensive margin characterize

trade openness, and the Gini and Theil indexes capture wage inequality. The second step employs a panel data approach to investigate the effect of trade openness on wage inequality.

The results show that, based on the data at province level, trade openness significantly increased wage inequality, and trade openness itself can explain nearly 70 percent of the variation of wage inequality. Generally, the extensive margin had a larger effect on wage inequality than the intensive margin. IV regression results show that with one unit of change in trade openness, the intensive margin increased wage inequality by one unit and the extensive margin increased wage inequality by 1.2 to 1.3 units.

Finally the author should caution that our results are based on the indexes constructed with the firm-level data. The use of instrumental variables would benefit from further development to address the endogeneity of trade openness in this paper. The causal relationship of trade openness and wage inequality remains an open issue.

7.2 Policy applications

The findings of this thesis have strong policy applications. A strong export premium and the heterogeneous export premium which increases with trade costs suggest that the government should try to remove obstacles to export, and in particular to decrease the internal trade costs between provinces, e.g. decreasing local protection, decreasing or cancelling some highway toll fees, and launching reforms of *Hukou* system.

By doing so, the domestic demand can be stimulated and we can truly make better use of the opportunity of the potentially huge domestic market, which brings

the comparative advantage of home market effect. Home market effect, on one hand, can attract industries with increasing return to scale to cluster in a country where the domestic market is huge, on the other; it can expand the exports of such industries. Therefore, decreasing the trade cost both external and internal, more and more scaled industries will cluster in China, produce locally and export.

The insignificant learning-by-export effect within industry implies that the learning effect at aggregate level is caused by between-industry productivity differences of exporters and non-exporters and not within-industry productivity differences of exporters and non-exporters. There is no productivity gain from exporting within industry and in the more processing-oriented industries in China, i.e. for machinery and electronics; the learning-by-exporting effect was shown to be smaller than for other industries, like furniture and paper-related industries. Therefore, it is important to consider the reasons behind China's export miracle, especially the processing exporting mode. Upgrading the export structure may seem to be necessary for China including the services, and during this process, we also need to consider the issue of employment.

There is a concern that international trade will increase wage inequality after the trade liberalization. Hence, the government should take this into consideration when designing the trade policies. Reforms to the labour market including increasing the flexibility of the labour market are also necessary, which can alleviate the effect of trade openness on wage inequality based on the theory of firm heterogeneity and labour market frictions. This is a very important policy application because the labour market in China is lacking the free movement between regions, especially between urban and rural areas, big cities and small and medium sized cities.

Appendix A: List of Abbreviations

Instrumental variable: IV

People's Republic of China: PRC

Gross domestic product: GDP

World Trade Organization: WTO

Heckscher-Ohlin: HO

Research and development: R&D

Total factor productivity: TFP

Ordinary least squares: OLS

Olley-Pakes: OP

Fixed effect: FE

Levinsohn and Petrin: LP

Difference-in-difference: DID

Hongkong, Macao and Taiwan: HMT

Standard Industrial Classification: SIC

Stable-unit-treatment-value assumption: SUTVA

The two-stage least square: 2SLS

Least square dummy variables: LSDV

Gross national income: GNI

Maximum likelihood estimation: MLE

Appendix B: List of Tables

Appendix C: List of Figures

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