International Trade in a Competitive World: Empirical Evidence from the UK

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I dedicate this thesis to my family.
Without their patience, support and endless love, this work would have never been completed.

Abstract

This thesis aims to provide helpful insights into trade in goods and services. The first two chapters focus on the micro-level determinants of international trade in services in the UK: The aim of the first chapter is to investigate the determinants of trade in services in a gravity framework, considering both country- and firm-level factors. The second chapter investigates how the determinants of service trade vary along the distribution of trade value and how the firm-level characteristics influence the impact of typical gravity variables. The third chapter focuses on the UK's imports of goods from China and investigates the impact of increasing Chinese import competition on local labour market outcomes in the UK.

The results from the first chapter show that the gravity equation succeeds in explaining the determinants of service exports and imports. When the disaggregated level data is taken into account, the coefficients of the trade determinants change considerably, suggesting that the policies adopted according to the results of the country-level analyses do not fit all of the trading firms. The second chapter provides evidence for the parameter heterogeneity in firm-level service exports and imports in a gravity context. According to the findings, the impact of typical gravity variables is influenced by the firm characteristics and differs along the distribution of trade value. The findings from the third chapter show that exposure to Chinese imports does not have any significant impact on workers in the UK. The results are sustained when the different demographic groups, such as age, gender and education level are considered, except in the case of graduate employment. Accordingly, exposure to Chinese imports is associated with a decline in graduate employment only. The analysis regarding the firm characteristics suggests that exposure to Chinese imports within these local labour markets decreases the average firm size, whereas the average labour productivity remains unaffected.

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Introduction

Globalization is not a new phenomenon, however it has been defined in different ways over the last twenty-five years. The rise in globalization in different forms has been observed in the data and brought attention to its consequences for the firms and workers in economies. On one hand, it is mostly driven by observed increases in international trade which has output and employment effects that are associated with rising prosperity and increased specialization. On the other hand, the increased availability of micro datasets has evolved the existing trade theories in international trade. The theories have been moved away from being driven by country or industry differences towards being more about the characteristics of firms and products that they produce. Considering these changes in the international trade field, in this thesis, we are interested in investigating the determinants and impacts of increasing international trade.

To this end, this thesis aims at analysing empirically the trade flows in the UK from various perspectives. It examines the determinants of increasing trade flows in the UK and also the impacts of increasing trades on labour markets. Therefore, the objectives are two-fold. First, we investigate the firm-level services trade to understand which forces govern services trade at the firm-level. We examine the determinants of firm-level services trade in the gravity framework to comprehend how the effects of different determinants of firm-level services trade may differ from existing country and industry-level analyses in terms of both goods and services. Then we verify whether these determinants are different throughout the distribution of services trade and how their effects depend on certain firm characteristics. The first two chapters focus on this objective. Second, we focus on the UK's imports of goods from China to investigate the impact of increasing Chinese import competition on the local labour markets in the UK. The third chapter addresses the second objective.

As a result of the increasing importance of services in all economic activities, including international trade, researchers started to pay more attention to services and their policy implications. Services contain many heterogeneous activities from financial services to health services which identifies different characteristics that affect their tradability. Therefore, it is important to understand the consequences of trade in services in service trading countries. The trade in services has been

analysed from many viewpoints: the determinants of services trade (Head et al., 2009; Kimura and Lee, 2006; Mirza and Nicoletti, 2004); the similarities and differences between goods trade and services trade (Lennon, 2009); the importance of distance for trade in services (Amiti and Wei, 2005; Bhagwati, 1984); the relationship between and relative importance of different modes of trade in services (Christen and Francois, 2010; Lennon, 2008); and the effects of market structure, regulations, and trade policies on services trade (Deardorff, 2001; Francois and Wooton, 2001). Thanks to the increased availability of micro datasets on firms and plants, the recent trade literature has begun to examine these aforementioned aspects for service trading firms (Ariu, 2010; Breinlich and Criscuolo, 2011; Federico and Tosti, 2012; Kelle and Kleinert, 2010; McCann and Toubal, 2011). Although the number of firm-level studies on services trade is increasing, we still have limited understanding of its determinants and how they vary for firms with different characteristics. The effects of variables such as distance, cultural differences, and regulatory and policy barriers to services trade are likely to vary considerably between different types of firms, so it is important to undertake more research in this area to better understand aggregate level trade flows as well. The first two chapters in this thesis focus on firm-level services trade to this end. We use unique and well-established micro datasets to analyse the worlds third largest service exporter and fourth largest service importer, the United Kingdom (UK).

Chapter 1 focuses on the determinants of firm-level services trade in the UK. To the best of our knowledge, this is the first comprehensive study to investigate the determinants of services trade in a gravity framework. We aim at comparing the results from the firm-level analysis with the country-level results to understand how the effects of different determinants of firm-level services trade (e.g., distance and trade barriers) may differ from those obtained from aggregate-level data. Each firm has different characteristics that affect their trade decisions. In aggregate trade flows, it is not possible to observe the effects of firm characteristics. Therefore, it is likely to obtain different results, which might be of great importance in terms of policy implications. For example, if it is detected that more innovative firms are exporting more, then policymakers can design export promotion programs that specifically aim to help this group of firms. Another novelty of this study arises from the methodology that is used in the analyses. The nature of the data requires estimation approaches other than OLS. The existence of zero trade flows between some firms and some countries for some service types makes the implications of different estimation approaches reasonable and interesting. This is the first study to apply Pseudo Poisson Maximum Likelihood (PPML) to estimate determinants of firm-level services trade.

To achieve the objectives of the first chapter, we use several data sources. The first data source is the UK's International Trade in Services Inquiry (ITIS), which is collected from a number of

different surveys and administrative sources. It provides information on the imports and exports of 46 different types of services by country of origin and destination for almost all service traders in the UK. However, it only provides information on producer services. The Annual Respondent Database (ARD) and Business Structure Database (BSD) are additional micro datasets on firms in the UK. The former contains many variables, such as employment, turnover/output, capital expenditure, intermediate consumption, and gross value added, while the latter records a wide variety of firm demographics, including life span and postcodes. Finally, we combine these micro datasets with the CEPII Gravity database to analyse the effects of certain country characteristics, such as GDP, GDP per capita, geographical distance, and certain trade agreements, on firm-level exports and imports. The analyses focus on only the data from 2005, and merging the datasets yields 1,754 firms exporting to 181 countries in 46 service types and 1,909 firms importing from 177 countries in 46 service types.

The firm-level service exports and imports are estimated by the OLS, linear probability model (LPM), Tobit, and PPML. Estimating the log-linear gravity equation by OLS yields biased results because zero values are dropped out when we take the logarithms. To deal with this problem, the other three approaches have been used. The LPM considers the effects of different variables on export and import probability instead of exports and imports per se. TobitT is another approach to deal with the zeros; however, its consistency depends on the assumption of normality. The last approach, PPML, deals with not only biased but also inconsistent estimates because of heteroskedasticity in the multiplicative form of the gravity equation. Under the correct specification of the conditional mean, it provides unbiased and consistent estimates in the presence of zero trade values and heteroskedasticity.

After estimating the country- and firm-level determinants of firm-level service exports and imports, we compare these results with the results from aggregated data. To this end, the firm-level data is aggregated up to country-level and all the analyses are repeated on the aggregated data. OLS and PPML have been applied to a panel structured data as well, to take into consideration the firm-by-service type fixed effect. The panel data is created with countries and panel IDs that is generated by grouping each firm by each service type. These analyses are followed by an analysis of margins of services trade to investigate how different margins of UK service exports and imports contribute to variations across its trading partners and demonstrate how the effects of different determinants of service exports and imports may change across different margins. We decompose total exports and imports to/from a country into the number of firms trading with that country (extensive margin) and the average exports/imports per firm (intensive margin). After determining the margin that drives country-level variations in total service exports and imports, we estimate the determinants of each margin by OLS and PPML.

The results show that the gravity equation is successful in explaining the determinants of firm-level service exports and imports. Distance has a negative impact on firm-level service exports and imports, and the coefficients are lower in comparison to the country-level analysis results. In the firm-level data, the coefficients of other determinants change considerably compared to the aggregate analysis. This might suggest that the policies based on results from country-level analyses might not fit all the trading firms. In the analysis of country-level variations of total exports and imports, the results show that the relationship between distance and intensive margins of exports and imports is statistically significant. Accordingly, GDP and distance variables have significant effects on both extensive (number of firms) and intensive (average imports per firm) margins of exports and imports. However, the negative effect of distance is stronger for extensive margins of exports and intensive margins of imports, showing that distance between the UK and its trading partners is more important for the number of exporting firms and average import value per importing firm.

The comparison of the firm-level results with the country-level results shows that the OLS results are very sensitive to the aggregation level while the PPML is invariant to the level of aggregation when the regressors are the same. There is no additional benefit of collapsing data down to firm-level. This can be considered as another good property that PPML holds. For the PPML estimations, it is not necessary to take the log of dependent variable, the coefficients do not change by changing the level of aggregation. This implies that the PPML should be preferred not only because it provides consistent estimates in the presence of zero trade values and heteroskedasticity, but also because it provides similar coefficients in both firm-level and country-level analyses.

The investigation of possible coefficient heterogeneity in the gravity equation is the motivation of Chapter 2. This chapter aims at addressing three research questions. The first question is "*how do certain firm characteristics such as firm size and labour productivity influence the impact of typical gravity variables?*" To address this question, we estimate the gravity equation by OLS, interacting the main gravity variables GDP and distance with the number of employees in each firm and gross value added per worker in each firm. This enables us to control for firm size and productivity, which might influence the mean of the trade distribution. If the effects of GDP and distance change as firms become larger and more productive, this would suggest that policy-makers in the UK should categorise firms according to their size and productivity to increase the efficiency of trade policies.

The second question is "*how do the determinants of firm-level services trade in the UK alter along the distribution of trade value?*" If each firm is different from the others throughout the distribution of trade value, then a certain trade determinant would have different impact on different firms. To

detect possible parameter heterogeneity across the distribution of firm-level exports and imports, the gravity equation has been estimated using the quantile regression approach. Point estimates such as OLS assume that the conditional distribution of a dependent variable can be explained by the centre of the distribution and do not provide information on the non-central location of the data. However, in the case of imports and exports incurred by a large set of firms that may have different characteristics, the trade values are most likely heteroskedastic, varying from nil to infinity, in which case, it is very optimistic to expect the OLS results to be representative of the whole distribution.

The third question is "*how do the effects of different determinants of exports and imports vary across the distribution of total service exports and imports and their margins?*" To answer this question, we estimate total exports and imports and their margins using OLS and quantile regression. As in the first chapter, total exports and imports are decomposed into two margins: extensive margin as the number of firms and intensive margin as the average trade value per firm. This analysis enables us to compare the results from different margins with each other as well as with total exports and imports.

This chapter contributes to the literature by considering the possible parameter heterogeneity, which might arise in two forms. The first stems from the distribution of exports and imports and the second stems from the different firm characteristics. Although there are a few studies which consider parameter heterogeneity in the determinants of goods trade (Minondo Uribe-Etxeberria, 2010; Moelders, 2011; Navas et al., 2013; Wagner, 2006), in particular, in the services trade literature, there is no study (to the best of our knowledge) that investigates this using a gravity framework. In terms of successful policy implications, it is of great importance to look at the heterogeneous impact of a given variable throughout the trade distribution and to be concerned with heterogeneity in the impact of standard gravity variables in the mean of the distribution. Policies relying on standard trade estimations would be misleading if it is true that each coefficient estimate of the gravity variable varies throughout the trade distribution and is influenced by firm characteristics.

The datasets from the first chapter are used in this chapter, too. However, only positive trade values between firms and the partner countries are considered because of the computational problems in quantile regressions in the presence of an excess number of zeros. The results from the OLS regressions with interaction terms show that the effects of GDP and distance depend on only firm size in both the export and import analyses, while the productivity level in each firm has influences on the effects of GDP and distance in only the import analysis. According to the quantile regression results, the magnitude and significance level of each coefficient are different in each quantile as well

as in the OLS estimations in both the export and import analyses. The results show that the positive effect of GDP and the negative effect of distance on firm-level service exports and imports are stronger in higher quantiles, showing that firms in higher exports and imports quantiles are affected more by changes in GDP and distance. The results from margins of trade analysis demonstrate that the determinants of service exports and imports are not only different from the coefficients obtained from OLS but also those from each quantile. The effect of GDP and distance weaken from lower to higher quantile in the analyses for both exports and imports and their intensive and extensive margins.

Finally, Chapter 3 explores the impact of increasing Chinese import competition on the local labour market outcomes. The disruptive effects of import competition from developing countries on labour markets in developed countries have been investigated since the 1990s in the international trade literature (Katz and Autor, 1999; Krugman, 2008; Krugman and Lawrence, 1993; Lawrence and Slaughter, 1993; Leamer, 1998; Wood, 1995a,b). As a large country with a rapidly growing economy, China has had a very strong effect on the world economy during the last two decades. A relatively cheap labour force in China made it one of the biggest exporters, especially after joining the World Trade Organization. Although, importing from China allows access to cheaper products, it has been argued that it may also cause higher unemployment, lower labour force participation, and lower wages in some importing countries. Nevertheless, the importance of China's rise is being increasingly recognised, as yet, its importance at the regional level has rarely been considered. Some local labour markets might be more vulnerable to importing from China depending on their industrial composition. The importance of the regional initial industrial specialization has been highlighted in recent studies following the novel approached proposed by Autor et al. (2013a) (Autor et al., 2013b; Dauth et al., 2012; Donoso et al., 2014; Mendez, 2013). This chapter aims at investigating these possible effects of imports from China on the local labour markets in the UK for both workers and firms.

The emergence of China has undoubtedly had some important effects on the UK as well because, in the last two decades, UK's imports from China have increased dramatically. China is the UK's third largest importing partner after Germany and the US. Therefore, the UK has been chosen for the analysis. To analyse the impact of rising Chinese import competition on different local labour market outcomes such as a change in employment, change in manufacturing employment, working population growth, and change in average weekly wages in each local labour market, we follow the methodology developed by Autor et al. (2013a). They propose an index that measures the cross-market variation in import exposure stemming from initial differences in industry specialization and instrument imports by using changes in Chinese imports to other high-income countries by

industry because of a possible endogeneity bias. We calculate the same index for the local labour markets in the UK and test their theoretical motivation to analyse the effects of Chinese imports in the country. However, we instrument the import exposure index by a non-UK import exposure index that considers the imports of 14 European Union countries (EU14) instead of the UK's imports from China. This will clean up the effects of possible shocks that simultaneously affect UK imports and local labour market outcomes. The import exposure index is the main explanatory variable and we explore its effects on change in employment as a share of working population, manufacturing employment as a share of working population, working population growth and average log weekly wages for three five-year time period from 1998 to 2013.

The data sources used to calculate the import exposure index and to analyse its impact on local labour market outcomes are the Quarterly Labour Force Survey (QFLS), the Annual Survey on Hours Earnings (ASHE), the Annual Respondent Database (ARD), the Business Structure Database (BSD), and the EUROSTAT database. All the data sources except EUROSTAT are surveys conducted by the UK Office for National Statistics. The first two are used to calculate the variables related to workers (e.g., employment, average wages, working population growth, share of female workers), while the next two surveys are used to produce firm characteristics. The last data source is employed to obtain information on industry-level imports of UK and EU14 from China. The *travel to work areas* (TTWAs) variable provided in the QFLS and ASHE is used as a proxy for the local labour markets for statistical purposes. A local labour market is an area in which all commuting occurs within the boundary of the area. TTWAs are the areas where the bulk of the resident population also works within the same area.

The main contribution of this chapter is that, to the best of our knowledge, this is the first regional level study that investigates the effects of Chinese imports on the local labour market outcomes in the UK. The amount of trade between the two countries makes it worth paying attention to import exposure to the UK's local labour markets. Moreover, the current literature that investigates the relationship between import competition and local labour market outcomes focuses only on the effects on the workers. However, it is also likely to observe changes in firm characteristics resulting from the increasing import competition in the local labour markets. Therefore, we examine the effects of Chinese import exposure on the change in average firm size and average labour productivity in each local labour market.

Our results show that exposure to imports from China does not have any significant impact on total employment, manufacturing employment, working population, and average wages in the UK's local labour markets. The results are sustained when we control for exposure to exports to China. In the

analyses of different demographic groups, such as age, gender, and education level, show that both total and manufacturing employment are unaffected by the increases in Chinese imports, except in the case of graduate employment. Exposure to Chinese imports is associated with declines in graduate employment. The analysis regarding firm characteristics in the local labour markets in the UK suggests that exposure to Chinese imports in the local labour markets decreases the average firm size, whereas the average labour productivity remains unaffected.

The thesis is organised as follows. Chapter 1 analyses the determinants of firm-level services trade and compares the results with the determinants of aggregated services trade. Chapter 2 investigates the possible parameter heterogeneity in the determinants of service trade. Chapter 3 addresses the effects of increasing Chinese imports on local labour markets. The last section gives the concluding remarks.

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Chapter 1

Determinants of Trade in Services: Evidence from UK Firm-Level Data using a Gravity Equation Approach[1]

1.1 Introduction

The importance of international trade in services has increased during the last two decades all over the world. It has demonstrated faster growth than goods trade. According to World Trade Organization (WTO) statistics, world exports in commercial services (services excluding governmental services) stood at 3.7 billion USD in 2010 with an average annual growth rate of more than 15% over the past 20 years. Its share in total world exports was around 20% while its share in GDP was roughly 12%. Moreover, World Development Indicators (WDI) produced by World Bank (WB) showed that nearly 71% of global value added in 2010 was generated in the services sector, with a 3% average annual growth rate from 1990 to 2010, while the services sector also accounts for around 45% of total employment.

Due to the increasing economic importance of trade in services within the economy, researchers have started to pay more attention to trade in services and its policy implications. Many aspects of trade in services have been analysed. Since services are very heterogeneous across a wide range of economic activities, it is difficult to capture the impact of services trade on economic growth and development. Most studies mostly focus on the similarities and differences between goods trade and services trade (Breinlich and Criscuolo, 2011; Lennon, 2009), the importance of distance for trade in services (Amiti and Wei, 2005; Bhagwati, 1984), the relationship between and relative importance

[1]This work was based on data from the International Trade in Services Survey, Annual Respondents Database and Business Structure Database, produced by the Office for National Statistics (ONS) and supplied by the Secure Data Service at the UK Data Archive. The data are Crown Copyright and reproduced with the permission of the controller of HMSO and Queen's Printer for Scotland. The use of the data in this work does not imply the endorsement of ONS or the Secure Data Service at the UK Data Archive in relation to the interpretation or analysis of the data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

of different modes of services trade (Christen and Francois, 2010; Lennon, 2009) and the effects of market structure, regulations and trade policies on services trade (Deardorff, 2001; Francois and Wooton, 2001) [2]. Moreover, the empirical framework of the gravity equation has been used to explain the determinants of service trade flows at country-level (Head et al., 2009; Kimura and Lee, 2006; Mirza and Nicoletti, 2004). More recently, firm-level datasets have been used to investigate the characteristics of the exporters and importers of services and the concentration of trade across firms; and to compare service traders and non-service traders with respect to productivity, wages, size, turnover and differentiation level. However, within the literature, there are only a few studies which apply the gravity framework to explain firm-level determinants of trade flows.

The theoretical and empirical literature analysing goods exporters and importers (mostly exporters) is also very recent. Melitz (2003) combines heterogeneous firm models with international trade theories to explain why international trade induces reallocations of resources among firms within an industry. Studies by Bernard et al. (2007) and Wagner (2007) are examples of empirical analyses which support the theory by showing that exporting firms are larger and more productive, use more capital-intensive production processes and employ more highly-skilled workforce. The share of these firms among all the firms is low and their exports are highly concentrated on just a few markets and products. Breinlich and Criscuolo (2011), Kelle and Kleinert (2010), and Federico and Tosti (2012) provide evidence of firms engaging in services trade in relation to the aforementioned finding using firm-level data from the UK, Germany and Italy, respectively. However, from the gravity model perspective, the existing literature (Ariu, 2010; Federico and Tosti, 2012; McCann and Toubal, 2011) focuses on the effects of distance on margins of trade and does not take into account the effects of differences between countries along with firm-level factors. The market structure, market regulatory policies and trade policies may play an important role in firms' productivity and skill intensity which may in turn have a determining effect on service exports and imports.

Having identified this deficiency in the existing literature, the aim of this study is to investigate the validity of the gravity model for trade in services in the UK, taking into account both country- and firm-level factors, and to analyse the importance of different determinants within this framework. The UK has been chosen for the analyses because it is among the largest service traders in the world (the third largest exporter and fourth largest importer in commercial services according to WTO (2011)) and the UK Office for National Statistics (ONS) provides a very-well established database of firm-level data.

[2] Francois and Hoekman (2010) provide a detailed literature review of the relationship between trade liberalization and growing services trade.

To the best of our knowledge, this study is the first study which applies the gravity equation to a firm-level data and comprehensively investigates determinants of firm-level services trade. The newly constructed data on the UK firm-level services trade produced by the ONS facilitates this research since it provides a wide range of variables related to almost all service traders in the UK. Another novel feature of this study involves the methodology that is used in the analyses. In order to examine how the effects of different determinants of firm-level services trade (e.g. distance or trade barriers) may differ from country and industry-level analyses, we use four estimation approaches to estimate the gravity equation, namely Ordinary Least Squares (OLS), the Linear Probability Model (LPM), the Tobit and the Poisson Pseudo-Maximum Likelihood (PPML). This is the first study that applies PPML to estimate determinants of firm-level services trade. The nature of the data (the existence of zero trade flows between some firms and some countries in some service types) makes the implications of PPML both reasonable and interesting.

The results show that the gravity equation is also successful in explaining the determinants of firm-level services trade and the RESET test results confirm that, among four different estimation approaches, the PPML is the preferred model since it is able to deal with the existence of zero trade values and heteroskedaticity problem in the data. Another good property that PPML holds is arisen when we compare the results obtained from firm-level analyses with the ones obtained from country-level analyses. The coefficients obtained from the OLS estimations are considerably different from each other while PPML provides the similar results in both firm-level and country-level analyses. Since for the PPML estimations, it is not necessary to take the log of dependent variable, the coefficients do not change by changing the level of aggregation. The PPML results suggest that there is no additional benefit of collapsing data down to firm-level.

The rest of the chapter is organized as follows. Section 2 provides a brief definition of the services trade while Section 3 contains a detailed literature review of the gravity equation and its implications for the services trade. Information on the databases, a description of the variables and the methodology used, are presented in Section 4. Section 5 provide the analysis results obtained from empirical models, and Section 6 concludes.

1.2 Definition of Trade in Services and GATS

Although the service industry contains many heterogeneous activities from financial services to health services, it also has special characteristics which affect its tradability. These are: *intangibility* (causes difficulties in monitoring, measuring and taxing); *non-storability* (producers and consumers need to

meet at the same location and time); *joint production* (producers and consumers have to participate in the production process together); and *differentiation* (services specialized for the needs of customers) (Francois et al., 2007). Because of these properties, the traditional definition of trade as exchange of products along borders does not explain service transactions betwwen countries. Therefore, the General Agreement on Trade in Services (GATS) broadly defines services trade according to the territorial presence of the supplier and the consumer at the time of the transaction. The definition stated in the GATS based on "modes of supply", is as follows [3]:

> Mode 1 (Cross-border trade): services supplied from the territory of one country into the territory of another country.
>
> Mode 2 (Consumption abroad): services supplied in the territory of one country to another country's service consumer.
>
> Mode 3 (Commercial presence): services supplied by a country in the other country through the activities of foreign affiliates.
>
> Mode 4 (Presence of natural persons): services supplied by a country in the territory of another country through the movement of an individual to the country of the consumer.

The GATS is the first multilateral trade agreement which covers trade in services, it is the counterpart of the General Agreement on Tariffs and Trade (GATT) in merchandise trade. It came into force in January 1995 as a result of the Uruguay Round negotiations to provide for the extension of the multilateral trading system to services. Its basic purpose is to contribute to trade expansion "*under conditions of transparency and progressive liberalization and as a means of promoting the economic growth of all trading partners and the development of developing countries*".

For the purposes of structuring their commitments, WTO Members have generally used a classification system comprised of 12 core service sectors: business services (including professional services and computer services); communication services; construction and related engineering services; distribution services; educational services; environmental services; financial services (including insurance and banking); health-related and social services; tourism and travel-related services; recreational, cultural and sporting services; transport services; and other services not included elsewhere. These sectors are further subdivided into a total of some 160 sub sectors. Under this classification system, any service sector may be included in a Member's schedule of commitments with specific market access and national treatment obligations. Each WTO Member has submitted such a schedule under the GATS (WTO, 2006).

[3] Table 1.1 provides examples of each mode of supply.

1.3 Literature Review

The gravity framework has become one of the most widely used models to explain trade flows in the international trade literature. The pioneering studies by Timbergen (1962) and Poyhonen (1963) apply the gravity equation to the analyses of international trade flows. The model explains bilateral trade flows between any two countries as a function of their economic size and the distance between them. The theoretical foundation of the gravity model is initially laid by Anderson (1979), who shows that the gravity framework is consistent with the Armington assumption which assumes a world trade with product differentiation by country of origin. The model received its theoretical foundations due to the development of new international trade theories based on imperfect competition. Helpman and Krugman (1985) formalize the gravity equation by offering a monopolistically competitive market structure under increasing return to scale in production. Bergstrand (1989) extends the Helpman and Krugman model, taking into account the role of relative factor endowment differences and non-homothetic tastes in explaining trade flows. Deardorff (1995) derives the gravity model from the Hecksher-Ohlin model for both homogeneous and differentiated products. Anderson and van Wincoop (2003) add a multilateral resistance term into the gravity equation as a measure of trade barriers. Trade between any two regions is negatively affected by the trade barriers of each region relative to the average barrier of the two regions with all their trading partners. They propose that multilateral resistance cannot be measured using the distance between two countries since it does not take into account the price effects of barriers with other countries. Feenstra (2003) shows that the inclusion of country-specific fixed effects gives the same results in line with Anderson and van Wincoop (2003)'s analysis.

Although there are many studies which apply the gravity framework to the goods trade, the existing literature on the application of the gravity model to trade in services is starting to grow but currently remains limited. Moreover, the literature on services trade focuses mostly on country- or industry-level analyses with only a few studies using firm-level analyses, most of which are working papers. The leading study, by Francois (1993), applies the gravity model to the US bilateral services trade. More recent studies by Grunfeld and Moxnes (2003); Mirza and Nicoletti (2004), and Kimura and Lee (2006) use the gravity equation in order to assess the determinants of trade in services using bilateral services trade among OECD countries. Grunfeld and Moxnes (2003) estimate the determinants of bilateral services trade by demonstrating the complementary relationship between services trade and FDI [4]. Mirza and Nicoletti (2004) propose a theoretical model which extends

[4]There are other studies which apply the gravity framework to trade in services data at country-level. However, these studies mainly focus on the complementary relationship between cross-border trade and FDI. See Lennon (2008); Nefussi and Schwellnus (2010) and Fillat Castejon et al. (2008).

the gravity model by considering the important feature of services trade whereby traded services use inputs from both the exporting and importing countries interactively. Kimura and Lee (2006) employ an augmented gravity equation to assess the determinants of services trade in comparison to goods trade. Unlike Grunfeld and Moxnes (2003), they include the variable *economic freedom of the world* instead of the *trade restrictiveness index* as a measure of restrictiveness in market regulations. They conclude that trade in services is better predicted by the gravity framework than goods trade. Service imports increase exports of goods, indicating a complementary relationship. The effect of economic freedom is stronger for services trade than goods trade which implies that economic liberalization yields faster growth in services trade. In their country-level gravity equation analysis based on a WB sponsored dataset, Francois and Hoekman (2010) estimate determinants of bilateral service imports for 6 service categories. They use the Heckman two-stage selection model in order to avoid bias due to zero values in the trade flows. To isolate possible trade diversion effects within the EU and NAFTA trade blocks they use OECD non-tariff barriers indices. They find evidence of trade diversion within the EU but not within the NAFTA for most of the service categories, showing that services integration in the EU remains limited.

Head et al. (2009) analyse the determining role played by geographic distance and institutional differences in services trade for 65 countries [5]. Since they are interested in determinants of offshoring, they use the value of service flow created by offshoring in the "other commercial services" industry as the dependent variable. They find a negative and significant effect of distance, indicating that the cost of using foreign services increases with distance. Another sectoral analysis conducted by Tharakan et al. (2005) search for determinants of India's software exports and its similarities with goods exports by estimating the gravity equation using the Threshold Tobit Model. They find that exports of highly technological services such as the software industry can be better determined by the gravity equation than products within export-oriented sectors. Distance has an insignificant effect on software exports, showing an absence of the asymmetric information problem in this industry.

In their country- and industry-level study, Kandilov and Grennes (2010) compare the factors affecting service exports from Central and Eastern Europe and from the low-cost Asian and South American countries to high-income Western European countries. They find that the significance of geographical distance varies across different types of service exports; it has a negative impact on construction services, whereas its impact is negligible for computer-related services. Variables related to the legal environments of the trading partners are found to significantly enhance trade in services for CEE countries. In a country-level analysis for business services, Kandilov and Grennes (2012) analyse the effect of distance on offshore outsourcing by considering innovations in information

[5] 27 EU countries and Croatia, Japan, Norway, Turkey, and the US as reporting countries and their 33 trading partners.

technology. Unlike other studies within the existing literature, they use the PPML as an empirical approach, which is proposed by Silva and Tenreyro (2006), to estimate the gravity equation taking into account the problems caused by the OLS. They show that after controlling for non-transport trade costs such as cultural and linguistic differences, free trade agreements, social and business networks between partners, and informational barriers, the effect of geographical distance on services trade is negligible.

Freund and Weinhold (2002) apply the gravity model to determine whether or not the internet has a significant effect on international services trade. They use country-level US trade data for the "other private services" industry over the period 1996-1999. They find that internet developments in the trading partner countries have significantly increased US service imports. However, the same result is not valid for US service exports since they did not control for different trade policies implemented by these trading partners. Using data for 27 OECD countries over the period 1999-2001, Walsh (2006) employs the gravity equation, in order to assess the determinants of services trade and to examine the barriers to services trade. In order to estimate the tariff equivalent of the barriers to services trade, he incorporates the concept of non-tariff barriers (NTBs) of the importing country, as a measure of each country's level of trade barriers, into the gravity equation [6]. This is the first study in the literature which uses the Hausman and Taylor approach to avoid the heterogeneity bias due to pooled OLS [7]. He concludes that, in agreement with some of the previous literature, distance is not a significant determinant for service imports.

The literature on goods trade at firm-level offers a large set of stylized facts on trading firms, especially for exporters. Accordingly, those firms engaged in trade are larger, more productive, use a more capital-intensive production process and employ more highly-skilled workers (Bernard et al., 2003, 2007; Eaton et al., 2008; Greenaway and Kneller, 2008; Wagner, 2007). Chaney (2005); Eaton et al. (2004), and Bernard et al. (2007) are among the studies which apply the gravity framework to goods trade taking into account firm heterogeneity. In particular, they find that, productivity is the origin of firm heterogeneity: more productive firms can bear the costs associated with exporting (e.g. costs incurred due to trade barriers), are able to export to more destinations and capture a larger share of the market. When trade barriers are reduced, not only do existing firms export more but new firms also start exporting. Chaney (2005) examines the effects of trade barriers on trade flows for 169 countries over the period 1980-1997, taking into account differences in market structure and firm

[6] NTBs is calculated by the trade restrictiveness index produced by the Australian Productivity Commission (Walsh, 2006).

[7] If the unobserved individual effects are correlated with explanatory variables, this leads to the pooled OLS estimator being biased. In order to avoid this problem, Hausman and Taylor (1981) proposed an IV approach which uses information from the dataset to discard the correlation between unobserved individual effects and the explanatory variables. This approach is superior to REM and FEM because REM is also affected by the heterogeneity bias while there are problems with FEM due to the use of time-invariant variables.

heterogeneity, and concludes that both these factors reduce the effects of trade barriers on export flows. Helpman et al. (2008) conducted another study which uses country-level data to estimate the gravity equation by considering firm heterogeneity and fixed trade costs. They find that earlier gravity estimations are biased, not due to selection, but due to the omission of the extensive margin. To eliminate the upward bias in the coefficient of the distance variable, they add the fraction of firms that export to a particular country. They claim that firm heterogeneity explains why most firms prefer to export to more attractive countries.

Bernard et al. (2007) use US firm-level goods exports data for 2000 from the Linked-Longitudinal Firm Trade Transaction Database produced by the US Census Bureau and the US Customs Bureau in order to examine how the effect of distance on bilateral trade flows operates through firm participation, the number of products exported, or the average value of exports per firm per product. They find that the total amount of US exports is strongly affected by extensive margins, and that distance and GDP have negative and positive effects on extensive margins respectively. However, the intensive margin for US exports is found to be decreasing in relation to importer's income and increasing in relation to distance. According to Bernard et al. (2007), these unexpected effects can be explained by the idea that the costs of exporting might depend on quantity or weight rather than on quality or value of the content. In order to determine the importance of differences in quality, Crozet et al. (2012) apply the gravity framework to French firms operating in the wine industry. Accordingly, they find that quality sorting ability is explained by the heterogeneous firms theory: good firms have the ability to serve most markets whereas bad firms can only serve markets which are easily accessible and profitable. Using firm-level exports data for the period 1989-1992, Crozet and Koenig (2008) carry out a detailed study for French goods exports. They first estimate three parameters: the elasticity of substitution; the elasticity of trade cost to distance; and the degree of firm heterogeneity, which determine trade flows in the gravity equation. They then decompose the aggregate exports within an industry into extensive and intensive margins. According to their findings, distance has a greater effect on the extensive margin whereas size of the importing country has a stronger effect on the intensive margin.

These analyses have also been applied to trade in services. However, the literature analysing the determinants of services trade using the gravity model with firm-level data is much more limited, with only a few firm-level studies having been undertaken so far. Breinlich and Criscuolo (2011) present a pioneering analysis of international trade in services. They use International Trade in Services data provided by the ONS which introduces a unique dataset for the UK firm-level variables. They carry out several analyses from different perspectives and find that many stylized facts which have been confirmed as true for goods trade also hold for trade in services: only a few firms engage in services

trade but their share in economic activity is larger in terms of employment and value added; service traders are larger and more productive than non-service traders; services trade is concentrated in a small number of products and markets. Analysis of the margins of trade shows that intensive margin is the major source of firm variation for both exports and imports while extensive margins are of greater importance for cross-sectional variations. They decompose the effects of standard gravity variables (GDP of partner and distance) on aggregate trade into extensive and intensive margins. They find that the aggregate effects of these variables are mainly driven by the extensive margin [8]

Another study which analyses the similarities and differences between trade in services and goods for both exports and imports is carried out by Kelle and Kleinert (2010). They provide evidence from German firms for 2005. Following Eaton et al. (2004), they focus on firm characteristics rather than sector characteristics in terms of explaining trade participation and trade values. They conclude that services imports and exports in Germany are dominated by large, globally-engaged, multi-product firms. Total exports and imports in services are mostly explained by intensive margin rather than extensive margins. German firms are highly concentrated on the most important trading partners and service products for both services exports and imports. In order to explain the heterogeneity among firms, they run a regression of the intensive margin on the extensive margins, and find that all the extensive margins contribute to the heterogeneity.

A recent firm-level study by Federico and Tosti (2012) investigates the pattern of trade in services for Italy over the period 2008-2009. Their findings are in line with the results of Breinlich and Criscuolo (2011). They search for both country-level and firm-level variations taking into account both the extensive and intensive margins of trade. Accordingly, while country-level variation is driven by extensive margin, firm-level variation is driven by intensive margin. They also apply the standard gravity equation to total services trade and its margins. They find that distance does not have a significant impact on the intensive margin of exports and imports. In addition, although distance has a negative impact on both goods and services trade, its impact on trade in services is stronger than its impact on goods trade because of the closer interaction between producer and consumer in trade in services.

Using a transaction level dataset covering the period 1995-2005, Ariu (2010) provides a detailed analysis of Belgium's services trade. In the first part of the study, cross-firm and cross-country variations are investigated, explaining the effects of the different margins. He finds that differences

[8] A report by Kneller et al. (2010) also uses the same datasets for the UK and analyses the relationship between exporting and firm performance for the service exporters in a number of dimensions. Their results are in line with the existing results obtained for manufacturing firms. However, this study mainly focuses on the effects of exporting on the firm characteristics.

across countries can be largely explained by extensive margins, whereas differences across firms are mainly explained by intensive margin. He then uses the gravity equation in order to analyse the determinants of total services trade and its margins. As well as the standard gravity variables such as GDP and distance, he employs dummies for common language, common border and legal origin, a dummy for EU membership and a time zone variable. The distance variable has a negative impact on the intensive margin but the number of transactions is positively affected by an increase in distance. His last analysis provides evidence showing how changes in values traded vary over time. Accordingly, over-time variations mainly stem from intensive margin rather than firm entries and exits.

McCann and Toubal (2011) use French firm-level data for the period 1999-2004 in order to analyse the similarities and differences between goods and services trade by focusing on the geographic scope of trade and its relationship with firms' performance. After giving some descriptive analyses of services and goods trade for French firms, they use the gravity equation to estimate the relationship between market attractiveness and firm performance (total factor productivity and sales) for four extensive margins (service exporters/importers and goods exporters/importers). Following Crozet et al. (2012), they define a market's "attractiveness" as one which is geographically closer and has higher demand. They find that firms sort their trading activities geographically by difficulty of market access. In particular, less productive firms trade with countries that are closer and wealthier and share a common language with France.

Although the studies mentioned above investigate trade in services from different perspectives, we still only have a limited understanding of which forces govern services trade at the firm-level. Given that the effects of variables such as distance, cultural differences, or regulatory and policy barriers to services trade are likely to vary considerably between different types of firms, it is important to undertake more research in this area in order to better understand aggregate level trade flows as well. For example, if certain types of trade barriers are particularly important for more innovative firms, export promotion programs could be specifically targeted to help this group of firms.

Taking into account this deficiency in the existing literature, this study contributes to the literature by carrying out a detailed analysis of firm-level services trade. To this end, we estimate a gravity equation to show how the effects of different determinants of firm-level services trade may differ from country and industry-level analysis. These variations are important for policy makers to enable them to design appropriate economic policy to encourage/dampen trade flows, as necessary.

1.4 Data and Methodology

Information on databases, and a detailed description of the variables and methodology used in the analyses are presented in this section.

1.4.1 Data

In this part of the study, we provide information about the databases, followed by an explanation of the data management process. In adition, a detailed description of the variables used in the analyses is presented.

1.4.1.1 Data Sources

This study considers both country- and firm-level factors in order to evaluate the validity of the gravity model for trade in services and to analyze the importance of different determinants within this framework. To this end, several data sources are used. The main data sources are surveys on UK private sector companies conducted by the Office for National Statistics (ONS). Each survey contains Inter-Departmental Business Register (IDBR) reference numbers which are anonymous but unique reference numbers assigned to the business organizations. This allows us to combine different surveys. In the following subsections, details are provided about each dataset that is used in this study.

International Trade in Services The main data source that is used in this study is the UK's International Trade in Services Inquiry (ITIS). ITIS data is collected from a number of different surveys and administrative sources. The sample size of the survey is roughly 20,000 firms (from 2001 onwards, prior to which it was approximately 10,000). However, when the nil returns (the firms which do not report international transactions) are considered, the data provides service exports and imports figures of around 5,000 firms for 46 different types of services classified by country of origin and destination for over the period 1996-2005 [9]. Only companies with over 10 employees have been included in the inquiry. ITIS provides information on producer services and excludes travel and transport, some banking, financial and legal services, higher education and film and television companies. Since the firms included in the surveys change every year and the highest number of firms covered occured in 2005, this study focuses on the data from 2005.

[9] The list of service types are provided in Table 1A.4 in the Appendix

The Annual Respondent Database The Annual Respondent Database (ARD) is the second data source that is used to obtain structural variables for firms. It is constructed from a compulsory business survey which is based on the Annual Business Inquiry (ABI) from 1998 onwards[10]. This dataset was created for the Economic Analysis and Satellite Accounts Division for research purposes. To create the ARD, the other surveys are converted into a single consistent format linked by the IDBR reference over time. The data encompass many variables such as employment, turnover/output, capital expenditure, intermediate consumption, gross value added (derived), postcodes, industrial classification, owner nationality, acquisitions and disposals of capital goods for both smaller and larger businesses (firms with more than 100 or more than 250 employees, depending on the year). To control for firm specific characteristics, variables relating to firm size, productivity and research and development (R&D) engagement are obtained from the ARD.

The Business Structure Database Another database provided by the ONS is the Business Structure Database (BSD). The BSD contains a small number of variables for almost all business organisations in the UK for the period 1997-2010. The purpose of the BSD is to create a version of the IDBR for research use, reflecting a wide variety of firm demographics. Specifically, the BSD aims to embody the following characteristics: record life span of enterprises; takeovers and mergers; account for restructuring/changes in enterprises; accurately identify dates of birth and death; and improve demographic statistics and facilitate historical analysis. As other firm characteristics, the firm age variable has been generated from the relevant birth and death variables, while the Limited Liability Company (LLC) dummy is generated from the legal status variable provided in the BSD.

CEPII Gravity Database In order to analyze the country- and firm-level determinants of trade in services for the UK using the gravity equation, data sources providing country-level data are combined with the firm-level datasets described above. All country-level variables except the dummy for European Union (EU) membership (GDP and GDP per capita of the trading partner, distance and time differences between the countries, dummies for colonial relationship, common language, common legislation, regional trade agreement and GATT (WTO) membership) are obtained from the CEPII Gravity database. This is a freely available dataset generated by Head et al. (2010).

[10]Although the dataset covers the period 1973-2008, the ABI only started to cover the service sectors after 1997.

1.4.1.2 Data Management Process

The ITIS covers reported data for almost all service traders with over 10 employees. These firms are trading with 213 countries in a total of 46 types of services in 2005. For the same year, the ARD reports variables for firm characteristics for over 50,000 firms which are operating in 8 different sectors classified according to the UK Standard Industrial Classification of Economic Activities 1992 (SIC92): catering; construction; motor trades; production; property; retail; other services; and wholesale. By merging these two databases as well as the gravity dataset, we obtained export and import datasets: 1754 firms exporting to 181 countries in 46 service types; and 1909 firms importing from 177 countries in 46 service types. However, the ITIS only reports observation with positive transaction values. If a firm does not import from or export to a particular country in a particular service type, it is excluded from the ITIS. Therefore we enlarged the data using observations with zero trade values. After obtaining rectangularized data, there are around 15 million observations in each dataset.

Although the observations in the ITIS are produced by a random sample method, in the ARD, the annual selection is a combination of a stratified random sample (based on employment) and simple random sampling. Sample fractions differ for firms of different sizes. A weight variable has therefore been provided in the ARD which has been calculated by employment size bands stratified by industry and region. According to Deaton (2000), different selection probabilities across individual units matter when one is aiming to obtain estimates to represent the population. In this study, we are not interested in how the estimate of a certain variable would change if the sampling fraction changes in each stratum. Instead, the aim of this study is to investigate the effects of different country- and firm-level variables on exports and imports for trading firms only, and to compare them with existing literature on trade in services and goods. The results are not generalized for all British firms. Therefore, *weighting* has not been used in the analyses.

However, another problem has arisen related to the data used in the regressions. In this paper, we combine country-level data with firm-level data in order to investigate the effects of country characteristics on firm-level exports and imports. With such data, the true inference can be obtained only if the random disturbances in the regression are independent within the groups. If the disturbances are correlated within the groups (in our case, countries) that are used to merge firm-level data with country-level data, then even small levels of correlation can cause poor inference because of the downward biased standard errors (Moulton, 1990). In the case of within-group correlation, cluster corrected standard errors can be used to improve the inference (Angrist and Pischke, 2009). In our case, the ITIS reports data on 1754 firms exporting to 181 countries and 1909

firms importing from 177 countries in 46 service types. The main explanatory variables of interest vary only at country-level. It is expected that firms trading with a certain country might share some unobservable characteristics which would lead the regression disturbances to be correlated. Therefore country-cluster corrected standard errors are used in all the models.

1.4.1.3 Variable Description

To examine determinants of firm-level service exports and imports in the UK, transaction values (£'000) of exports and imports have been used as dependent variables. To explain variations in firm-level exports and imports, GDP and GDP per capita of trading partner, distance and time differences between the countries, dummies for colonial relationship, common language, common legislation, regional trade agreement and GATT membership, firm size, firm age, productivity of firms, legal status indicator and a dummy for R&D engagement variables have been employed as explanatory variables [11].

GDP and GDP per capita of trading partners are the proxies of economic size and development level respectively. GDP of trading partners is expected to have a positive impact on UK firm-level exports and imports because it refers to the potential demand and production level in a country. A positive sign is also expected for GDP per capita of the partner country. Helpman and Krugman (1985) suggest that higher GDP per capita corresponds to higher capital intensity in a country, indicating that the country is a developed country. Thus, it is expected that a country with a higher GDP per capita will also have higher imports and exports. Bergstrand (1990) investigates the effect of GDP per capita on exports and imports separately. According to Bergstrand (1990), GDP per capita of an exporter is a proxy for capital-labour ratio but it represents per capita income for the importer country. Therefore, if a trading partner of the UK has a higher GDP per capita income, then imports into the UK would also be higher due to a higher capital-labour ratio in the exporting country, and exports from the UK would be higher due to the demand for greater variety within the importing country. Moreover, the Linder hypothesis suggests that the GDP per capita is an important determinant of tastes, and that trade volumes are larger across countries with similar income levels. Fieler (2011) predicts that as GDP per capita increases in a country, consumers tend to consume higher quality goods and, correspondingly, producers tend to produce higher quality goods. High-quality goods are usually more differentiated, and therefore, if a trading partner of the UK has a higher GDP per capita income, then it is expected that they will trade in more differentiated goods.

[11] A brief explanation of variables used in the analyses is given in Table 1A.3 in the Appendix.

As in the goods trade literature, the distance variable is expected to have a negative impact on services trade as well. However, we expect to obtain a stronger negative relationship between distance and service exports and imports than is the case with goods exports and imports because of the non-storability property of services which requires physical proximity between a service producer and consumer. The population-weighted great circle distance between large cities of the UK and her trading partners has been used as a proxy of transportation costs for trade, following the method used by Mayer and Zignano (2006). To find the net effect of geographical distance, we eliminate the effects of other factors that affect firm-level services trade. To this end, we include dummies for common language, common legislation, regional trade agreement, GATT membership, and colonial relationship. We also add time differences between the UK and her trading partners as a proxy for trade costs. Although trading in the same time-zone might increase coordination between countries, its effects on services trade might also depend on the types of services traded. A positive impact would be expected if the service type does not require synchronization of office hours, but the effect is likely to be negative if the service type requires time coordination between the producer and consumer (Kandilov and Grennes, 2010). Christen (2012) finds a positive effect on US foreign affiliate sales in services for time zone differences of 5 hours, and 9 or more hours, while she finds a negative impact for time zone differences of 1 and 2 hours.

To control for the firm size and productivity of firms, the variables of employment and gross value added per employee have been used in the analyses. The firm age variable is calculated by using the *birth date* and *active* variables provided by the BSD. First we considered firms that were active in 2005 then we subtracted their year of birth from 2005. The R&D variable is an indicator variable that shows whether a firm engaged in research and development work on a regular basis during the year in question. Depending on this indicator, we create a dummy variable which takes the value of 1 if a firm is engaged in R&D work. Lastly, we create an LLC dummy using the legal status of a firm variable provided by the BSD as a measure of the extent to which business operations were financed by external sources. Although there are seven different legal status categories (LLC, sole proprietor, partnership, public corporation, central government body, local authority and non-profit making body) that a British firm can be classified as, the service trading firms fitted into only three of these categories (LLC, partnership and non-profit making body). The company dummy takes the value of 1 if a trading firm is an LLC and 0 otherwise.

All firm-level variables except firm age are expected to have a positive impact on firm-level exports and imports. Love and Mansury (2009) confirm the positive impact of firm size and productivity for US business services firms in the year 2004. They find that larger and more productive firms are more export oriented, showing the self-selection effect of more successful firms in relation to exporting.

They also analyze the effect of exporting on the productivity of firms, in order to investigate the endogeneity between these two variables and find a weak relationship [12]. In his literature survey of 45 microeconometric goods trade studies using data from 33 countries that were published between 1995 and 2004, Wagner (2007) also confirms that exporting does not necessarily increase firms' productivity. However, Yasar et al. (2006) show that the effect of exporting on productivity depends on several factors such as life duration and firm size and the type of goods that are exported. Eickelpasch and Vogel (2009) analyse the impact of various firm-specific characteristics such as size, productivity, human capital and experience on firms' exporting performance in the German national market and other markets by using a panel dataset of firms from the business services sector covering the period from 2003 to 2005. They find that when the unobserved heterogeneity is controlled by firm fixed effects, the positive effects of productivity on export performance disappear, which is converse to the findings of previous studies on manufacturing firms. Size still appears to have a positive and significant effect.

The effect of firm age on trade is unclear. Although mature firms may have accumulated more knowledge, more experience in the market and developed wider networks, younger firms are more flexible and are quicker to adapt to changing international conditions and new technology. Most existing firm-level studies focus on the effect of firm age on goods exports. Duenas-Caparas (2008) finds a positive impact of firm age on the export performance of firms in three main manufacturing sectors in the Philippines. Studies by Majocchi et al. (2005); Niringiye and Tuyiragize (2010); Roberts and Tybout (1997) find a positive relationship between age and internationalisation for exporting firms in Colombia, Italy and Uganda respectively. In contrast with these studies, Roper et al. (2006) find a positive relationship between export propensity and younger Irish manufacturing plants, while Iyer (2010) does not discern any significant effect of firm age on the export intensity of firms in the New Zealand Agriculture and Forestry industries.

In the literature, it is common to employ R&D expenditure as a measure of the level of technology that is used in firms, and its effect on exports tends to differ across countries and industries (Duenas-Caparas, 2008; Lefebvre et al., 1998; Wagner, 2001; Willmore, 1992). However, the datasets that are used in the current study do not provide an equivalent variable. Therefore the R&D engagement variable has been used as a measure for improvements in technology and skills within a firm. It is expected that there will be a positive relationship between R&D engagement and trade, since firms with higher levels of R&D engagement are likely to have more knowledge and skills to enable them to adapt to increasing international competition.

[12]The current study does not investigate the direction of the causality. It only focuses on the effects of firm characteristics on services trade.

A positive sign is expected for the LLC dummy because companies can export more, since they can find external sources of finance more easily to cover the additional costs incurred by exporting. Eickelpasch and Vogel (2009) use three dummies for firms' legal status and find that *private companies* and *public limited companies* have a higher probability of being exporters and trading in a higher volume of exports than *sole proprietors*.

1.4.2 Methodology

The gravity model is used as an empirical tool in this study. It is one of the most widely used models in international trade due to its simplicity. It fits the available data well and makes it easy to obtain econometric estimations. The most commonly used definition of the gravity equation is the standard form of the gravity equation which estimates bilateral trade proportional to the products of country sizes:

$$T_{od} = \beta_0 \frac{Y_o^{\beta_1} Y_d^{\beta_2}}{D_{od}^{\beta 3}} \tag{1.1}$$

where T_{od} is the trade flow from the origin country to the destination country. Y_o and Y_d are the economic sizes of the origin and the destination countries, mostly measured by GDP. D_{od} is the proxy for transaction cost measured by the geographical distance between countries. Lastly, β_0 is termed as the gravitational constant. Starting from Timbergen (1962), this equation has been used in a number of studies to explain trade flows. $\beta_1 \neq \beta_2 \neq 1$ is assumed in preceding studies. However, most theories predict unit elasticity for GDP. Another restriction of this definition is that D_{od} is assumed to be constant, which means that the effects of different trade costs incurred by each country are overlooked (Head and Mayer, 2013).

In this study, an augmented version of the gravity equation has been used, which has been adapted to the firm-level data. The augmented gravity equation is given below:

$$T_{ids} = A_d^{\alpha} B_i^{\beta} \exp(Z'\gamma + \epsilon_{ids}) \tag{1.2}$$

where T_{ids} denotes export (import) flows by firm i to (from) the destination (the origin) country d in service type s. There are two sets of explanatory variables on the right-hand side. A_d contains country-level variables, such as GDP of trading partner, bilateral distance and time differences, whereas variables related to the firm characteristics such as firm size and productivity are included

in the set B_i [13]. Z denotes the vector of other control variables including firm and/or service type fixed effects and dummies such as common language and R&D engagement. ϵ_{ids} is the error term from this multiplicative form.

In the first analyses, the log-linearized form of this equation is estimated by OLS to find the determinants of the UK firm-level services trade for 2005. However, since the ITIS reports only positive trade values of each firm with a particular country in a particular service type, we enlarge the dataset with zero trade values and use alternative estimation approaches. The existence of zero values in trade flows causes bias in the OLS estimation because zero values are omitted when taking the logarithms. To overcome this problem we use three different methods. The first one is the Linear Probability Model (LPM) which considers the effects of different variables on export and import probability instead of on exports and imports per se. To this end we generate export and import status dummies as dependent variables. The second approach is the Tobit estimation proposed by Eaton and Tamura (1994). It overcomes the problem of zero values; however, its consistency depends on the normal distribution assumption. The last estimation approach is the PPML proposed by Silva and Tenreyro (2006). According to Silva and Tenreyro (2006), the OLS estimator is not only biased but also inconsistent because the error term in the model depends on the regressors due to heteroskedasticity in multiplicative form. Therefore, it deals with both the existence of zero values and heteroskedastic error terms and provides consistent estimates under the correct specification of the mean of the dependent variable.

1.4.2.1 Linear Probability Model

The Linear Probability Model is the first estimation approach that we use as an alternative to the OLS. In fact, the LPM is an implication of the OLS when the dependent variable is a binary variable. It considers the effects of different variables on export and import probability instead of on exports and imports per se. To this end we generate a binary dummy variable for export and import status as dependent variables, i.e. $F_{ids} = 1$ if the firm exports (imports) and $F_{ids} = 0$ otherwise:

$$F_{ids} = \begin{cases} 1, & \text{if } T_{ids} > 0 \\ 0, & \text{if } T_{ids} = 0 \end{cases} \tag{1.3}$$

$$F_{ids} = \alpha \ln A_d + \beta \ln B_i + Z'\gamma + \epsilon_{ids} \tag{1.4}$$

[13] The logarithms of all variables except dummies and time differences between countries are taken in line with the gravity framework.

Since the dependent variable is dichotomous, the expected value of export (import) status is the same as the probability of export (import), i.e. $F_{ids} = 1$. Therefore, by using the LPM, we can identify how the different factors change the probability of export and import decision.

$$Pr\{F_{ids} = 1|A_d, B_i, Z\} = E(F_{ids}|A_d, B_i, Z) = \alpha \ln A_d + \beta \ln B_i + Z'\gamma \tag{1.5}$$

Although the LPM deals with excess zeros in the data, it causes some problems which affect the validity of the estimates. Firstly, the predicted probabilities from the regression would fall outside the range of 0-1. Moreover, depending on the sign of the variable, the probability of exporting (importing) increases or decreases monotonically, resulting in predicted values which are outside the boundaries since the dependent variable is linearly related to the independent variable. Another problem with the LPM is that it produces heteroskedasticity in the residual variance resulting in invalid standard errors and hypothesis tests. This shortcoming is exacerbated when the first two problems occur. Observations with outlier values will tend to have predicted values that are much higher than 1 or much smaller than 0. This generates errors that are correlated with the predicted values and causes heteroskedasticity (Wooldridge, 2001, pp. 454-456).

Despite these problems, we employ the LPM model to investigate which factors affect export and import decisions and to show how export and import probabilities alter in response to changes in these factors. To this end, we present both the LPM regression results and baseline probabilities for export and import decisions.

1.4.2.2 Tobit Model

When considering bilateral trade flows between all countries or firm-level trade flows from a specific country to many other countries, it is expected that there will be a huge number of zero trade flows. In such cases, log-linear OLS does not provide consistent estimates because the censored sample is not representative of the population (Wooldridge, 2001, pp. 519-520) To overcome this problem, Eaton and Tamura (1994) proposed the Threshold Tobit Model which is adapted from the standard Tobit Model. In the standard Tobit model, the dependent variable is bounded by a minimum value of zero, and therefore the following equation is used to estimate trade flows:

$$T_{ids} = \max\{A_d^{\alpha} B_i^{\beta} \exp(Z'\gamma + \epsilon_{ids}), 0\} \tag{1.6}$$

T_{ids} denotes the trade flows. To estimate equation (1.6) by the Maximum Likelihood method under the normally distributed error term assumption, we define the latent variable V_{ids} as follows:

$$V_{ids} = A_d^{\alpha} B_i^{\beta} \exp(Z'\gamma + \epsilon_{ids}) \tag{1.7}$$

where

$$T_{ids} = \begin{cases} V_{ids}, & \text{if } V_{ids} > 0 \\ 0, & \text{otherwise} \end{cases} \tag{1.8}$$

However, when equation (1.2) is log-linearized, we encounter problems associated with taking the log of zero. Therefore, the above model has been rearranged by including a *threshold parameter* a.

$$\ln(V_{ids} + a) = \alpha \ln A_d + \beta \ln B_i + Z'\gamma + \epsilon_{ids}, \epsilon_{ids} \sim N(0, \sigma^2) \tag{1.9}$$

$$T_{ids} = \begin{cases} V_{ids}, & \text{if } V_{ids} > 0 \\ 0, & \text{if } -a < V_{ids} \leq 0 \end{cases} \tag{1.10}$$

Tobit provides consistent estimates under the normality assumption. If the error term is not normally distributed or if it is heteroscedastic then the results are inconsistent. Moreover, the comparison of coefficients from the OLS and the Tobit is not very informative, since in the Tobit model, the linear effect is on the uncensored latent variable, not the observed outcome (Wooldridge, 2001, p. 528). However, it is possible to obtain the effects of each independent variable on the conditional mean of the dependent variable by calculating marginal effects without censoring on $E(V_{ids}|A_d, B_i, Z)$ where $V_{ids} = E(T_{ids}|T_{ids} > 0)$.

1.4.2.3 Poisson Pseudo-Maximum Likelihood

The Tobit allows us to obtain estimates in the case of zero trade flows and the LPM identifies how the different factors affect the probability of export and import decisions. However, both adopt the linear specification, similarly to OLS, and therefore they are subject to heteroskedasticity due to Jensen's inequality, as pointed out by Silva and Tenreyro (2006). According to Silva and Tenreyro (2006), the OLS estimator is not only biased but also inconsistent because the error term in the model depends on the regressors due to heteroskedasticity in multiplicative form. Therefore, the PPML

is a consistent estimator under the correct specification of the conditional mean of the dependent variable as well as being able to deal with zero trade flows.

PPML models the dependent variable y by a Poisson distribution as $f^p(y_i|\mu_i) = \frac{\exp(-\mu i)\mu_i^{y_i}}{y_i!}$ where μ_i is the mean parameter and is defined as $\mu_i = \exp(x_i'\beta)$ (Greene, 2003, p. 765). Estimating the Poisson regression by Maximum Likelihood yield first order condition for β estimate as:

$$\sum_{i=1}^{n}(y_i - \mu_i)x_i = 0 \tag{1.11}$$

Although the Poisson regression is mostly applied to count data, from equation (1.11), it is clear that, in order to obtain consistent estimation, it is only necessary to specify the correct conditional mean as $E(y_i|x_i) = \exp(x_i'\beta)$ (Silva and Tenreyro, 2006).

The model that will be estimated by the PPML in this study and the predefined conditional mean are as follows:

$$T = \exp(\alpha \ln A_d + \beta \ln B_i) + Z'\gamma + \epsilon_{ids}, \text{with } T_{ids} \geq 0 \text{ and } E(\epsilon_{ids}|A_d, B_i, Z) = 0 \tag{1.12}$$

$$E(T_{ids}|A_d, B_i, Z) = \exp(\alpha \ln A_d + \beta \ln B_i) + Z'\gamma \tag{1.13}$$

There are few studies that estimate the gravity equation using the PPML approach (Martin and Pham, 2008; Prehn and Brummer, 2011; Silva and Tenreyro, 2006; Tran et al., 2012), and most of these analyse the performance of PPML compared to other estimation approaches using country- or industry-level data. To the best of our knowledge, this is the first study that applies PPML to firm-level data.

In this study, the aforementioned approaches, as well as OLS are used to estimate the determinants of the UK firm-level services exports and imports for 2005. In all the models, country-cluster corrected standard errors are used to obtain robust inference. In addition to these analyses, we apply OLS and PPML to panel structured data to control for the unobserved heterogeneity by firm-by-service type fixed effects. We compare the firm-level results with the results obatined from aggregated data up to service type and country-level.

1.4.2.4 Margins of Trade

This part of the study investigates how different margins of UK exports and imports contribute to variations across the UK's trading partners and shows how the effects of different determinants of exports and imports vary across different margins. There are different definitions of margins of trade in the trade literature. Following Bernard et al (2009), most of the existing firm-level services trade studies break down the total trade figures into *the number of firms* and *the number of traded products* as extensive margins and *average export or import value per firm per product* as intensive margin (Ariu (2010) [14], Federico and Tosti (2012), Breinlich and Criscuolo (2011)). These studies find that extensive margins of exports and imports play a significant role in explaining country variations and that distance has a significant effect on extensive margins while its effect on intensive margin is insignificant.

Following the existing firm-level studies, we also analyse country variations for the UK services trade. To this end, we aggregate UK firm-level services exports and imports up to the country level and decompose the effects of the explanatory variables into the extensive and intensive margins. However, we define the extensive margin only as *the number of firms* because of the estimation problems highlighted by Silva et al. (2014). According to Silva et al. (2014), extensive margins such as *number of sectors* or *number of products* are bounded and, when they are used as dependent variables, the partial effects of the explanatory variables on the conditional mean of the dependent variable are not constant and therefore they approach zero as the dependent variable approaches the bounds. In such cases, conducting estimation approaches as described above would yield misleading estimates. In our case, the UK exports and imports 46 types of services with her trading partners. With some countries such as Germany, the UK trades in all of the service types, which might lead to the aforementioned problem. Therefore we break down total exports (imports) to (from) country d into *the number of firms* (n_d) trading with that country (extensive margin) and *the average export (import) value per firm* ($\bar{t}_d$) (intensive margin):

$$T_d = n_d * \bar{t}_d \tag{1.14}$$

Taking the natural log of both sides of equation (1.14) and running each margin on total exports and imports, we obtain the contribution of each margin to the explanation for the total variation of exports and imports.

[14] Ariu (2010) considers three extensive margins (number of service types; number of transactions; and number of firms).

$$\ln T_d = \ln n_d + \ln \bar{t}_d \tag{1.15}$$

After determining the margin that drives country-level variations in total services exports (imports) by using equation (1.15), we estimate equation (1.2) for each margin of exports (imports) using OLS and PPML.

1.5 Analyses

In order to analyse how the effects of different determinants of services trade might differ for firm-level services trade, we use four estimation approaches to estimate the gravity equation. Since the existing literature on firm-level analyses mostly uses OLS, it is also used in the current study to enable comparisons to be drawn. OLS is applied only to positive trade values. However, when the trade between all firms and all countries is considered, zero trade values are appeared. Although the ITIS reports only positive trade flows, we enlarge the dataset with zero trade values and use alternative approaches. The existence of zero trade flows leads to bias in the OLS estimations. We therefore employ three estimation approaches to deal with biased estimates. The first one is LPM, which considers the effects of different variables on export and import probability instead of on export and import value. LPM estimates are consistent under the normality and homoskedasticity assumptions. Moreover, the predicted probabilities from LPM would fall outside the range of 0-1. Despite these flaws, we use LPM to investigate which factors affect export and import decisions and to show how export and import probabilities vary in response to changes in these factors. Tobit is the second approach which is used in the analyses. It is able to deal with zero trade values but its consistency depends on normal distribution as well. The last estimation approach used is PPML. Under the correct specification of the conditional mean, it provides unbiased and consistent estimates in the presence of zero trade values and heteroskedasticity.

All analyses have been reported for the UK firm-level services exports and imports in 2005. In order to deal with correlated residuals across countries, country clusters are used to obtain cluster-corrected standard error in all firm-level analyses [15]. We compare firm-level results with the results obtained from the aggregated data. To this end, we aggregate service types for each firm, and then aggregate the firm-level data up to country level. We repeat all the analyses on the aggregated data. In addition to these analyses, we apply OLS and PPML on panel structured data to control for firm-by-service

[15] All firm-level analyses have been repeated with service type cluster-corrected standard errors since it is expected that firms operating within a specific service type might have similar properties. However, the significance levels of the coefficients remain the same in all the analyses.

type fixed effects. In the last section of the analyses, we investigate how different margins of UK services exports and imports contribute to variations across the UK's trading partners and demonstrate how the effects of different determinants of services exports and imports may alter across different margins.

1.5.1 Firm-level Analysis

In this part of the study, the four estimation approaches described above are applied to exports and imports of the UK firms to investigate the effects of both country- and firm-level variables.

1.5.1.1 Export Analysis

Unlike other analyses, LPM investigates the effects of different factors on export and import decisions. Therefore we start our analyses with LPM. Table 1.2 and Table 1.3 present the results from the LPM analyses. Column 1 and column 2 in Table 1.2 show the results from the LPM regressions. In the LPM regressions, the dependent variable is a dummy variable which takes a value of 1 if a firm has a positive exports with a particular country in a particular service type. Since the dependent variable is a binary variable, its expected value gives the export probability of a firm exporting to a particular country in a particular service type. In the LPM without firm variables, all variables except GDP per capita and colonial relationship have significant effects on export probability, but time difference and regional trade agreements have unexpected signs. Adding firm-level variables does not change the value of the coefficients very much and only the R&D engagement variable is insignificant among the additional variables. Among the significant variables, the dummy for being an LLC has an unexpected sign, indicating that being an LLC has a negative effect on export decisions. Table 1.3 provides baseline probabilities and deviations from the baseline probabilities when there is a change in a variable. For continuous variables, we calculate baseline probabilities at their mean and analyse how the probability of exporting changes as a continuous variable deviates from its mean by 10%. However, for discrete variables, we calculate the baseline probability when they take the value of 0 and check for how the probability of exporting changes as they take the value of 1. The first three columns in Table 1.3 present the results from the baseline probabilities and the change in it for determinants of exports without firm-level variables, while the last three columns show the results with firm-level variables. According to the table, when the log of GDP deviates from its mean by 10%, then the probability of export increases by 14%. Changes in all the variables except the log of distance, colonial relationship and regional trade agreement increase the export probability. Distance, common legislation and EU membership have strong effects on export

decisions. For example, a 10% increase in the log of distance decreases the export probability by 96% from its baseline value. With the additional firm-level variables, there is no significant change in probabilities. However, among the additional variables, being an LLC has the strongest effect on export decisions.

Table 1.4 shows the results from the gravity equation estimated by OLS, PPML and Tobit for the UK firm-level exports. According to the table, all the variables except regional trade agreement, GATT membership and EU membership have the expected signs. The coefficients for GDP, GDP per capita and distance are significant with expected signs, and the R&D engagement variable is insignificant in all the models except PPML ($T \geq 0$). The odd-numbered columns present the results for the models without firm-level variables, while the even-numbered columns display the results with firm-level variables. The first and second columns of the table present the OLS results without and with firm-level variables respectively. The coefficients of the country-level variables are closer to each other in both estimations. GDP and GDP per capita of the trading partner country and the colonial relationship between the UK and the importing country have positive effects on the UK firm-level exports, whereas distance between the UK and the importing country, regional trade agreement, GATT membership and EU membership negatively affect the UK firm-level exports. After controlling for the size, productivity, age, legal status and R&D engagement of the firms, the magnitudes of country-level variables increase slightly. All firm-level variables have a significant effect on the firm-level exports. Accordingly, firm size and labour productivity and being an LLC have a significant positive effect on exports, while firm age has a negative effect. Regional trade agreements between the UK and her trading partners, GATT membership and EU membership have significant negative impacts on exports in contrast with the theoretical expectations.

Columns 2-3 and 4-5 depict the results of PPML. Since the ITIS reports trade statistics for only trading firms (no zero trade), PPML has been applied to the data provided by the ITIS ($T > 0$) and to the enlarged data, including zero export flows ($T \geq 0$). The level of exports is used as the dependent variable in the PPML analyses. Both the coefficients and significance levels of the variables alter considerably in both regressions without and with firm characteristics. The results for PPML on positive export flows ($T > 0$) are different from the results obtained from using OLS. This difference can be largely accounted for by the heteroskedacticity problem in the error term since these regressions are estimated only for positive export flows. Distance, colonial relationship and EU membership become insignificant while dummies for common legislation and common language turn out to be significant in the PPML ($T > 0$) regression without firm-level variables, and the coefficients from this regression are closer to the coefficients from the PPML ($T > 0$) regression with firm-level

variables. However distance has a significantly negative impact on export flows in the PPML ($T > 0$) regression with firm-level variables.

When we consider zero trade flows by firms with a country in a specific service type, the coefficients obtained from PPML ($T \geq 0$) are mostly higher than the coefficients obtained from OLS. GDP and GDP per capita of trading partner countries and distance have stronger effects on firm-level exports, according to the PPML results, showing that OLS underestimates these coefficients. PPML determines a significant positive effect for common legislation and common language. Moreover, colonial relationship, regional trade agreements and EU membership turn out to be insignificant in the PPML ($T \geq 0$) regression. The PPML results with the additional firm-level characteristics are closer to the PPML results without firm-level variables. With the firm-level variables, the effects of the coefficients obtained from PPML are still stronger than the results obtained from OLS. However, according to the PPML results, the effect of common legislation is significantly positive while the colonial relationship and dummies for regional trade agreements and EU membership have no significant effect on firm-level exports. Moreover, the dummy for being an LLC loses its significance in the PPML regression. Although most of the studies on goods trade (Duenas-Caparas, 2008; Majocchi et al., 2005; Niringiye and Tuyiragize, 2010; Roberts and Tybout, 1997) predict that firm age will have a positive effect, a negative relationship is also possible since the younger firms would be more flexible and quicker to adapt to changing international conditions and new technology. In the models with and without firm-level variables, the significant coefficients for regional trade agreement, GATT and EU memberships are all negative. Trefler (2004) shows that the FTA between the US and Canada has increased the labour productivity of Canadian firms which can act as a channel for increasing firm-level exports between the countries over time. However, since the current study considers the UK firm-level exports for only 2005, the results relating to the regional trade agreement variable might not accurately reflect the effect on the firm-level exports.

The Tobit model is an alternative to the PPML model designed to be able to deal with excess zeros. However, its validity depends on the normality assumption of error term. Columns 7 and 8 in Table 1.4 report the results of marginal effects (marginal effects on $E(y|X)$) from Tobit regressions with and without firm-level variables. The coefficient estimates from both regressions are smaller than both the estimations obtained from OLS and PPML. All the coefficients except the common legislation dummy, time difference variable and the EU membership dummy in the Tobit model without firm-level variables are significant and have expected signs. The Tobit model with the firm-level variables, firm age and R&D engagement have no significant effect on service exports. The coefficient for GATT becomes insignificant after adding firm-level variables. Moreover, adding these

variables decreases the magnitude of the coefficients of country-level variables in the Tobit model while the opposite is true in the OLS estimations.

The last rows in Tables 1.2 and 1.4 give the RESET test probability values for each model. Accordingly, the PPML ($T \geq 0$) regression without firm variables strongly passes the test. However, the PPML ($T \geq 0$) regression with firm variables only passes the test weakly. This result may imply that the gravity equations estimated by the PPML provide truly specified estimations, showing that both the OLS and Tobit results report underestimated coefficients.

The OLS and the PPML methods are also applied to panel structured data in order to take into consideration the firm-by-service type fixed effect. To this end, we generate a panel identification (id) category by grouping each firm by each service type. These panel ids and countries are then used to create a panel dataset. Since there are some firms that do not export to any of the countries included in the panel, some groups have been omitted. Moreover, since the firm-level variables are constant within a group, the coefficients for these variables are not estimated. However, the results obtained with the firm-level variables are still comparable to the regressions without firm-level variables. The results are shown in Table 1.5.

According to Table 1.5, the fixed effect estimations confirm the aforementioned results. In particular, the PPML with fixed effects provides exactly the same results. Because the set of explanatory variables are the same and the PPML regression does not require the log transformation, it is invariant to the level of aggregation. In the OLS regressions, all the variables except common legislation have similar coefficients and significance levels. When we control for firm-by-service type fixed effects, the coefficient for common legislation becomes significant, showing that firm-level exports will be higher if the UK shares common legislation with the importing country. Moreover, the coefficients of regional trade agreement, GATT and EU memberships have a stronger effect on firm-level exports when we control for the firm-by-service type fixed effect. However, they have unexpected signs in both the OLS and FE estimations. Adding firm-level variables does not change the magnitude and significance of country-level variables. The coefficients obtained from FE are lower than the coefficients obtained from the PPML fixed effect regressions. The RESET test results confirm that OLS underestimates the effect of variables on firm-level exports.

1.5.1.2 Import Analysis

In this section, the analyses described above are applied to the UK firm-level imports. As in the export analyses, we start our analyses with LPM to investigate the effects of different factors on

import decisions. Table 1.6 and Table 1.7 present the results from LPM analyses. Column 1 and column 2 in Table 1.6 show the results obtained from the LPM regressions. In the LPM regressions, the dependent variable is a dummy variable which takes the value of 1 if a firm's imports with a particular country in a particular service type is positive. Since the dependent variable is a binary variable, its expected value gives the import probability of a firm importing from a particular country in a particular service type. In the LPM without firm variables, all the variables except GDP per capita and colonial relationship have significant effects on import probability but time difference and regional trade agreements have unexpected signs. Adding the firm-level variables does not cause the value of the coefficients to change very much and all the variables except firm age have a significant impact on import probability.

Table 1.7 illustrates the baseline probabilities and deviations from the baseline probabilities when there is a change in a variable. For continuous variables, we calculate the baseline probabilities at their mean and analyse how the probability of importing changes as a continuous variable deviates from its mean by 10%. By contrast, for discrete variables, we calculate the baseline probability when they take the value of 0 and check for how the probability of importing changes as they take the value of 1. The first three columns in Table 1.5 present the results from the baseline probabilities and the change in baseline probabilities for the determinants of imports without firm-level variables, while the last three columns show the results with firm-level variables. According to the table, when log of GDP deviates from its mean by 10%, then the probability of importing increases by 19%. Changes in all the variables except log of distance and regional trade agreement increase the import probability. Distance, common legislation, common language, regional trade agreement, GATT membership and EU membership have strong effects on import decisions. For example, a 10% increase in the log of distance decreases the import probability by 149% from its baseline value. With the additional firm-level variables, there is no significant change in the probabilities. Among the additional variables, the variables for being an LLC and firm age decrease the import probability. Nevertheless, as stated above, the predicted value of import probability falls outside the range of 0-1 in the baseline probabilities calculated for the distance and regional trade agreement variables.

Table 1.8 shows the results from the gravity equation estimated by OLS, PPML and Tobit for the UK firm-level imports. According to the OLS results in column 1 and 2 of the table, among the country-level variables, only GDP and distance are statistically significant. The magnitudes of the coefficients of significant variables are smaller than those obtained from the export analyses. There is little change in the coefficients after controlling for the firm characteristics. The effect of regional trade agreements turns out to be significant at the 10% significance level with the additional firm variables. However, its impact is negative, similarly to the export analyses. Firm age does not have

a significant impact on firm-level imports, while firm size, labour productivity, R&D engagement and the dummy for being an LLC have a significant impact on firm imports. Among the significant firm-level variables, R&D engagement has a negative impact on firm-level imports.

Columns 3-4 and 5-6 depict the PPML results. Since the ITIS reports trade statistics only for trading firms (no zero trade), as in the export analyses, PPML is applied to the data provided by the ITIS ($T > 0$) and to the enlarged data including zero import flows ($T \geq 0$). The level of imports is used as the dependent variable in the PPML analyses. For the significant variables obtained through OLS with and without firm variables, the estimates obtained from PPML with positive export flows ($T > 0$) are closer to the results obtained from OLS, but in the PPML models, GDP per capita becomes significant. The regional trade agreement dummy turns out to be insignificant in the PPML analysis ($T > 0$) with firm variables as well. For the significant firm characteristics, the magnitudes of the coefficients double in the PPML ($T > 0$) regression. When we consider zero trade flows by firms with a country in a specific service type, the coefficients and significance levels of the variables obtained from PPML ($T \geq 0$) alter considerably in the regressions without and with firm characteristics. They are higher than the coefficients obtained from OLS. GDP and GDP per capita of trading partner countries and distance have stronger effects on firm-level imports according to the PPML results, showing that OLS underestimates these coefficients. PPML determines a significant positive effect for colonial relationship and time difference variables. Although the PPML results with the additional firm-level characteristics are closer to the PPML results without firm-level variables, after adding the firm-level variables, time difference becomes insignificant. With the firm-level variables, the effects of the coefficients obtained from PPML are still stronger than the results obtained from OLS. Among the additional firm-level variables, only firm age is insignificant and the coefficients obtained from PPML are considerably higher than the coefficients obtained from OLS.

Columns 7 and 8 in Table 1.8 report the results of marginal effects (marginal effects on $E(y|X)$) from the Tobit regressions with and without firm-level variables. The coefficient estimates obtained from both regressions are smaller than both the OLS and PPML estimations. Only the dummies for common language, regional trade agreement and EU membership are insignificant in the Tobit model without firm-level variables and all significant coefficients have expected signs except time difference. The time difference variable has a positive impact contrary to expectations, showing that there is no need for time coordination between countries, while the language dummy is statistically insignificant. This result is valid for the Tobit model with firm-level variables as well. In this model, all the additional firm-level variables except firm age are significant. Moreover, adding these variables

decreases the magnitude of the coefficients of country-level variables in the Tobit model while the opposite is true in the OLS and PPML models.

The last rows in Table 1.6 and Table 1.8 give the RESET test probability values for each model. Accordingly, all the PPML regressions pass the test. This implies that the gravity equations estimated by the PPML provide truly specified estimations, showing that both the OLS and Tobit results report underestimated coefficients.

Following the export analyses, the OLS and the PPML are also applied to a panel structured data for UK imports in order to take into consideration the firm-by-service type fixed effect. To this end, we generate a panel id by grouping each firm by each service type. These panel ids and countries are used to create a panel data set. Since there are some firms that do not import from any of the countries, some groups have been omitted. Moreover, since the firm-level variables are constant within a group, the coefficients for these variables are not estimated. However, the results obtained with the firm-level variables are still comparable to the regressions without the firm-level variables. The results are shown in Table 1.9. The last two columns in Table 1.9 present the PPML fixed effect results. The results are exactly the same as those shown in columns 5 and 6 1.8. Since the regressors are the same, the coefficients do not change by changing the level of aggregation. However, the FE results differ from the OLS results shown in Table 1.8. The coefficients for colonial relationship and GATT membership become significant in the FE regressions while EU membership becomes insignificant. According to the FE estimations, firm-level imports in the UK are significantly affected by colonial relationship. Adding firm-level variables does not change the coefficients. However, when we control for firm characteristics, the effect of common legislation becomes insignificant, suggesting that additional firm characteristics are more important in determining service imports. As was the case with the export analyses, the coefficients obtained from the PPML fixed effect regressions are larger than the coefficients obtained from the FE regressions. However, in the import analyses, FE also passes the RESET test.

For the sake of completeness, we compared the results of this study with the analyses of the aggregated data obtained from the existing data, as well as earlier studies on country-level services exports and imports. Table 1.10 and Table 1.11 show the analysis results from firm-level exports and imports aggregated by service type. OLS regressions carried out on aggregated firm-level exports produce similar results, while PPML regressions yield exactly the same results since the set of explanatory variables are the same and the PPML does not require the log transformation. The coefficients obtained from OLS on aggregated firm-level exports are higher than the coefficients obtained from OLS on disaggregated exports, keeping the significance levels unchanged. This implies

that when we ignore the types of services that each firm exports, the effects of the export determinants becomes stronger. All the additional firm-level variables except firm age have a positive impact on aggregated service exports. The PPML regressions yield exactly the same results for the import analyses as well. However, the OLS result obtained for aggregated firm-level imports differ from the OLS result obtained from disaggregated firm-level imports. Colonial relationship and regional trade agreement are the other variables which become significant by aggregation. Controlling for firm characteristics does not change the OLS results significantly and the significance of each variable remains the same in most cases after aggregation, but the effects of firm size and labour productivity on imports become stronger. The effect of firm age becomes significant while the effect of R&D engagement becomes insignificant when compared to the disaggregated results.

Table 1.12 presents the OLS and PPML results obtained from the country-level data. In these analyses, firm-level exports and imports data are aggregated up to country level. The first four columns in Table 1.12 show the determinants of aggregate exports of the UK to 171 trading partners while the last four columns present the results obtained from the aggregate imports traded between the UK and 165 trading partners. According to the table, the coefficient of GDP is closer to 1 in the OLS regressions for both exports and imports but the effect is stronger for imports. Unlike for the disaggregated analyses, the OLS results are higher than the PPML results. GDP per capita is significant in the OLS regressions for exports while it is insignificant for imports. This implies that the development level of the partner country is a more important determinant for UK exports than for imports. The distance variable has an insignificant coefficient in the OLS regression for total exports while it is significant in the PPML regressions. It has a significant coefficient in all the import regressions, and the coefficients are closer to each other. Distance yields higher coefficients for aggregate imports in comparison to firm-level imports analyses. Among other country-level variables, colonial relationship is more important for imports while common language is of importance for services exports. GATT membership is a significant determinant only for exports; however, it has an unexpected coefficient as in the disaggregated analyses. Meanwhile, regional trade agreement is insignificant in all the analyses. The comparison of the results from firm-level analyses with the ones obtained from country-level analyses demonstrates that the OLS results are very sensitive to the aggregation level while the PPML is invariant to the level of aggregation when the regressors are the same. A summary of the results obtained from firm-level and country-level export and import analyses are provided in Tables 1A.5 (without firm characteristics) and 1A.6 (with firm characteristics) in the Appendix. This is another good property that PPML holds. Since for the PPML estimations, it is not necessary to take the log of dependent variable, the coefficients do not change by changing the level of aggregation. This implies that the PPML should be preferred not only because it provides consistent estimates in the presence of zero trade values and heteroskedasticity,

but also because it provides similar coefficients in both firm-level and country-level analyses. PPML is also better at dealing with the problems arisen in aggregated data. There is no additional benefit of collapsing data down to firm-level.

These findings relating to aggregated exports and imports and their comparison to the disaggregated analyses (firm-level exports and imports) are mostly confirmed by the existing literature. The coefficients obtained from the firm-level exports and imports analyses are less than the coefficients found by the existing country-level studies (Kandilov and Grennes, 2010, 2012; Kimura and Lee, 2006; Walsh, 2006). According to these studies, GDP, GDP per capita, common language, colonial relationship and regional trade agreements have a positive impact on services trade while distance has a negative impact. The coefficients for GDP and GDP per capita are closer to 1 while distance has a coefficient which is generally higher than 0.6. The magnitudes of the coefficients for these variables are smaller for the firm-level analyses. This shows that when the country-level trade data is disaggregated by firms, the coefficients change considerably, suggesting that the policies followed according to the results obtained from the country-level analyses do not fit all of the trading firms. Since each firm has different characteristics, they also have different motivations for trade. As stated by Chaney (2005, 2008), differences between firms in terms of size or productivity reduce the effects of trade barriers on trade flows. Kimura and Lee (2006), compare the coefficients of country-level exports and imports. They find that the coefficients of the variables mentioned above are slightly stronger for service exports than imports. Although the coefficients decrease significantly with disaggregation, the pattern remains the same; the policies implemented to affect trade flows would affect service exports more than service imports in the case of both firm-level and country-level trade.

1.5.2 Margins of Trade

In this section, country-level variations in the UK's total exports and imports are analysed to determine to what extent the variation in total exports and imports across countries is driven by different margins. To this end, the export values and import values of UK firms have been aggregated by countries. The logs of total exports and total imports are decomposed into the log of the number of firms (extensive margin) and the log of the average exports and imports value per firm (intensive margin) [16]. The gravity equation estimations are then replicated for each margin.

[16] The level of exports, imports and their margins are the dependent variables in the PPML regressions.

1.5.2.1 Export Analysis

In order to determine the country-level variations in total exports, the simplest form of the gravity equations has been estimated using both OLS and PPML for total exports and its margins. The results are given in Table 1.13. Panel A in Table 1.13 presents the regression results of each margin on total exports. Accordingly, each margin contributes to the country-level variations almost equally and their effects are statistically significant. However, the total variations in exports across countries can be explained more by extensive margin than intensive margin. Panel B in the table presents the OLS and PPML results for the simple form of the gravity equation applied to total exports and its margins. First three columns of Panel B show the results for the OLS estimations. Both the GDP and distance variables have expected signs for the total exports and its margins. The coefficient of the distance variable is significantly negative whereas the coefficient of GDP is significantly positive for all the components. However, these results are not in line with the existing literature. Federico and Tosti (2012), and Breinlich and Criscuolo (2011) find insignificant coefficients for distance in the intensive margin regression for Italian service exporters and UK service exporters respectively. Contrary to their findings, Ariu (2010) also finds a significantly positive relationship between distance and intensive margin for Belgian service exporters [17]. Both these studies and the current study show that country-level variations for total exports are mostly driven by extensive margins. The analysis results for margins of UK service exports can be compared with Bernard et al. (2007) which provide detailed firm-level analyses for the US goods trade. Accordingly, the effects of GDP on total exports of goods and total exports of services are closer to each other and in both cases the country-level variations are driven by extensive margin. However, they find a negative relationship between GDP and intensive margin, showing that larger countries have a smaller average export value per firm. Moreover, the effects of distance on export margins are higher for service exports than goods exports. This might be explained by the non-storability feature of services. Services trade requires close interaction between producers and consumers. The OLS results for GDP are confirmed by the PPML regressions shown in the last three columns of Table 1.13 although the coefficients are lower than the OLS coefficients. However, distance has an insignificant coefficient for the intensive margin in the PPML regressions, as found by Federico and Tosti (2012) and Breinlich and Criscuolo (2011).

In Table 1.15, additional country-level variables and firm-level variables (average employment size and labour productivity of firms exporting to a particular country) have been added to the OLS regressions for total exports and extensive and intensive margins of exports. The coefficients of

[17] Ariu (2010) considers three extensive margins (number of service types; number of transactions; and number of firms). Federico and Tosti (2012) and Breinlich and Criscuolo (2011) decompose the extensive margin into number of exporters, and number of service types, while the latter works on a panel dataset.

GDP for extensive margins are higher than the coefficients of GDP for intensive margins. However, distance has a significantly negative effect only on the extensive margin of export regression with firm variables. The dummies for colonial relationship, common legislation, regional trade agreement and EU membership positively affect the number of firms, whereas GATT membership and time difference between the UK and the importing countries negatively affect the average export value per firm. Colonial relationship, common legislation, regional trade agreement and EU membership do not have significant effect on intensive margin. Dummy for common language has a significant and positive effect on both extensive and intensive margins with and without firm variables. These results show that having the same legal origin and colonial relationship, and having a trade agreement with a country increases the number of exporting firms but not the level of transactions. The negative effect of the time difference variable can be explained by the importance of coordination problems due to different office hours. According to the results with the additional firm variables, average labour productivity of all exporting firms has a significantly positive impact on both margins, whereas average firm size matters only for the extensive margin of export. This is consistent with the existing literature which shows that larger and more productive firms are more trade oriented because of the self-selection effect (Bernard et al., 2003, 2007; Breinlich and Criscuolo, 2011; Federico and Tosti, 2012; Kelle and Kleinert, 2010; Love and Mansury, 2009; Wagner, 2007). The results obtained for extensive margin can be compared with the results obtained for the French goods industry by Crozet and Koenig (2008). GDP and colonial relationship have stronger effects on the extensive margin of the UK service exports than the extensive margin of French goods exports. However, the effects of distance and common language are stronger for the extensive margin of French goods exports than extensive margin of the UK service exports. After controlling for the average firm size and productivity level, the coefficients change slightly showing that aggregation does not allow us to detect the variation in the gravity variables due to the firm heterogeneity. Again, the magnitudes and significances of the coefficients in the PPML regressions differ from the OLS results. The results are given in Table 1A.1 in the Appendix.

1.5.2.2 Import Analysis

Following the margins of export analyses, the simplest form of the gravity equation is estimated by both OLS and PPML for total imports and its margins in order to determine country-level variations in total imports. The results are given in Table 1.14. Panel A in Table 1.14 presents the regression results of each margin on total imports. Accordingly, each margin contributes to the country-level variations almost equally and their effects are statistically significant. However, total variations in imports across countries can be explained more by extensive margin than intensive margin. Panel

B in the table displays the OLS and PPML results for the simple form of the gravity equation applied to total imports and its margins. The first three columns of Panel B show the results for the OLS estimations. The results are similar to the margins of the export analyses. Both GDP and distance variables have the expected signs for the total imports and its margins. The coefficient of the distance variable is significantly negative whereas the coefficient of GDP is significantly positive for all the components. However, in contrast to the export analyses, the coefficient of distance for intensive margin is higher than the coefficient of distance for extensive margin This implies that the distancevariable is more important for average import value per firm than for the number of importing firms. As in the exports analyses, these results contradict the existing literature. On one hand, Federico and Tosti (2012), and Breinlich and Criscuolo (2011) find insignificant coefficients for intensive margins for Italian service importers and UK service importers respectively. On the other hand, Ariu (2010) finds a significant relationship between distance and intensive margin for Belgian service importers. However, he predicts that there is a positive relationship. Similarly to Federico and Tosti (2012), we find that the negative effect of distance is higher for the margins of imports than the margins of exports. The results obtained in this study for total imports and its extensive margin are valid for US goods imports as well. However, Bernard et al. (2007) show that the intensive margin is negatively affected by GDP and there is no significant relationship between the distance and the intensive margin for US goods imports. The OLS results for both GDP and distance are confirmed by the PPML regressions in the last three columns of Table 1.14 although the coefficients differ from the OLS coefficients. However, the effect of distance is stronger for the intensive margin in the OLS estimations while it is stronger for the extensive margin in the PPML estimations.

According to the existing country-level studies on services trade (Kandilov and Grennes, 2010, 2012; Kimura and Lee, 2006; Walsh, 2006), the coefficient for GDP is expected to be closer to 1. The current study confirms this result for the UK's total exports and imports and this effect is mainly driven by extensive margins. The effect of GDP on extensive margins of exports and imports is twice the magnitude of the coefficient of GDP on intensive margins of exports and imports. However, the negative effect of distance is stronger for the extensive margin of exports and the intensive margin of imports, showing that distance between the UK and her trading partners is more important for number of exporting firms and average import value per importing firm.

In Table 1.16, additional country variables and firm-level variables (average employment size and labour productivity of firms importing to a particular country) have been added to the OLS regressions for total imports and its margins. The coefficients of GDP for extensive margins are higher than the coefficients of GDP for intensive margins. Distance has a significantly negative effect

on both margins of imports, except the extensive margin regression without firm-level variables. The dummies for common language, common legislation, regional trade agreement and GATT and EU membership positively affect the number of firms, whereas, time difference between the UK and exporting countries negatively affects the average import value per firm. Common language, common legislation and GATT and EU membership do not have a significant effect on intensive margin. This result shows that speaking the same language, having the same legal origin, and having a trade agreement with a country increases the number of importing firms but not the level of transactions. The negative effect of the time difference variable can be explained by the importance of coordination problems due to different office hours. Ariu (2010) confirms most of the aforementioned results for Belgian service importers. After controlling for average firm size and productivity level, the coefficients change slightly, showing that aggregation does not allow us to detect the variation in the gravity variables due to the firm heterogeneity. As in the export analysis, the results from the regressions with additional firm variables show that the average labour productivity of all the importing firms has a significantly positive impact on both margins, whereas the average firm size matters only for the extensive margin of imports. When we compare the augmented form of the margins of trade analyses for exports and imports, we find that the magnitude of the significant coefficients is higher for the extensive margin of imports than the extensive margin of exports, as in the simple form. However, most of the variables are insignificant in the intensive margin of imports regressions. Again, the magnitudes and significance of the coefficients in the PPML regressions are different from the OLS results. The results are given in Table 1A.2 in the Appendix.

1.6 Conclusion

In this study, we examine the determinants of services trade for UK firms. To this end, we combine the unique firm-level services trade data - ITIS - provided by the UK Office for National Statistics with different firm-level and country-level data sources. In the first part of the analyses, four estimation approaches are used to estimate the gravity equation in order to analyse how the effects of different determinants of services trade may vary across firms with different characteristics. Since the existing literature on firm-level analyses mostly uses OLS, it is also used in this study to enable comparisons. The dataset is then enlarged with zero trade flows since the ITIS reports only positive trade values for each firm with a particular country in a particular service type. This enables us to apply the LPM, Tobit and PPML models to deal with the presence of zero trade flows and to obtain more accurate results. Among these models, the PPML is the only model which also considers the heteroskedastic error term in the multiplicative form of the gravity equation. Therefore, it provides consistent estimates under the correct specification of the mean of the dependent variable. In the second part of

the analyses, we investigate how different margins of UK exports and imports contribute to variations across the UK's trading partners and show how the effects of different determinants of exports and imports vary across different margins. To analyse country variations for UK service exports and imports, we aggregate UK firm-level service exports and imports up to country level and decompose the effects of the explanatory variables into the extensive and intensive margins. To estimate total exports and imports and their margins, we employ the OLS and PPML methods.

The results obtained from the firm-level exports analyses show that the gravity equation is successful in explaining the determinants of service exports. In all the regressions, GDP, GDP per capita and distance are significant and have the expected signs. Adding firm-level variables does not change the coefficients very much. According to the LPM results, all the variables except colonial relationship have significant effects on export probability. In other estimations, all the significant variables except GATT and EU memberships and regional trade agreements have the expected signs. Among the firm-level variables, R&D engagement is insignificant in most of the models. Under the condition where zero trade flows are present and there is heteroskedasticity in the error term, the OLS results are biased and underestimate the coefficients. Using Tobit and LPM overcomes the problem of zero trade flows but their consistency depends on the normality assumption. Therefore, PPML is the preferred model since it is able to deal with both of the aforementioned problems. The RESET test results confirm this prediction. According to the PPML results, in addition to significant standard gravity variables, common legislation, common language and GATT membership have significant impacts on firm-level exports. However, GATT membership negatively affects service exports. One reason for this unexpected result could be the analysis period. This study considers only the year 2005. It would not be possible to predict the true effect of this variable for a single year. All firm-level variables except the dummy for being an LLC have significant effects on firm-level service exports. Firm size, labour productivity and R&D engagement affect service exports positively, whereas firm age has a negative effect on service exports. This implies that younger firms export more than mature firms. When we control for firm characteristics, the coefficient of the common language dummy becomes insignificant, showing that these characteristics are more important in determining firm-level service exports.

According to the LPM regressions for the firm-level import analyses, all the variables except colonial relationship have significant effects on import probability while additional firm-level variables do not change the magnitude of the coefficients to any great extent. In the OLS regressions only GDP, distance and EU membership are statistically significant. However, these results are biased and inconsistent due to the existence of zero trade values and heteroskedasticity. Therefore, PPML is the preferred model and it passes the RESET test as in the export analyses. The coefficients obtained

from PPML are higher than the coefficients obtained from OLS and Tobit, while GATT membership has a positive influence on service imports. Moreover, the coefficients obtained from PPML are higher than those obtained for firm-level exports which may imply that any policy that aims to affect services trade would have a stronger impact on service imports. Adding firm characteristics increases the effects of GDP, distance and colonial relationship and decreases the effects of GDP per capita and common legislation. Firm size, labour productivity and R&D engagement have a positive impact on service imports as is the case for service exports. However, the coefficient of the firm age variable becomes significant while the coefficient of the dummy for being an LLC becomes significant. Accordingly, being an LLC increases firm-level imports. The positive impact of this variable can be explained by the existence of fixed costs that are borne only by LLCs.

The results discussed above have been largely confirmed by FE analyses which consider unobserved firm heterogeneity. In the export analyses, all the variables except common legislation have similar coefficients and significance levels. However, in the import analyses, the coefficients for colonial relationship and GATT membership become significant in the FE regressions while EU membership becomes insignificant. By contrast, the coefficients increase significantly with the aggregation, suggesting that the policies according to results obtained from the aggregated data do not fit all of the trading firms. However, the pattern remains the same, showing that the policies applied to influence trade flows would affect exports more than imports. Nevertheless, these results hold only for the OLS since the PPML is invariant to the level of aggregation when the regressors are the same. Since for the PPML estimations, it is not necessary to take the log of dependent variable, the coefficients do not change by changing the level of aggregation. This implies that the PPML should be preferred not only because it provides consistent estimates in the presence of zero trade values and heteroskedasticity, but also because it provides similar coefficients in both firm-level and country-level analyses. PPML is also better at dealing with the problems arisen in aggregated data. There is no additional benefit of collapsing data down to firm-level.

For the country-level variations of the total exports and imports analyses, in contrast to the existing literature, this study finds a statistically significant relationship between distance and intensive margins of exports and imports. According to the results, both the GDP and distance variables have significant effects on both extensive and intensive margins of exports and imports. However, the magnitudes of the coefficients for the extensive margin are higher than the intensive margin in the exports analysis, while the coefficient for distance for the intensive margin is higher than the coefficient for the extensive margin in the imports analysis. This shows that distance is more important for average imports value per firm than for the number of importing firms. In other words, the negative effect of distance is stronger for the extensive margin of exports and the intensive margin

of imports compared to the other margins, showing that distance between the UK and her trading partners is more important for the number of exporting firms and average imports value per importing firm. After additional country-level variables and firm-level variables are included in the regressions, the effect of distance turns out to be insignificant for the intensive margin of total service exports. Moreover, the magnitude of the significant coefficients for the extensive margin of imports is higher than the extensive margin of exports, as in the simple form.

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Tables

Table 1.1: Examples of the Four Modes of Supply

Mode 1: Cross-border	A user in one country receives services from abroad through its telecommunications or postal infrastructure. Such supplies may include consultancy or market research reports, tele-medical advice, distance training, or architectural drawings.
Mode 2: Consumption abroad	Nationals of one country moves abroad as tourists, students, or patients to consume the respective services.
Mode 3: Commercial presence	The service is provided within a country by a locally-established affiliate, subsidiary, or representative office of a foreign-owned/controlled company (bank, hotel group, construction company, etc.)
Mode 4: Movement of natural persons	A foreign national provides a service within a country as an independent supplier (e.g., consultant, health worker) or employee of a service supplier (e.g. consultancy firm, hospital, construction company).

Source: WTO (2006), Introduction to GATS.

Table 1.2: Firm-level Exports: LPM

	without firm variables	with firm variables
Dependent Variable	Export dummy	Export dummy
Log of GDP partner	0.000507***	0.000507***
	(6.34)	(6.38)
Log of GDPPC partner	0.000528	0.0000535
	(1.02)	(1.03)
Log of distance	-0.00121***	-0.00122***
	(-4.17)	(-4.15)
Colonial relationship	-0.0000274	-0.0000202
	(-1.14)	(-0.10)
Common legislation	0.000765***	0.000766***
	(3.30)	(3.30)
Common language	0.000639***	0.000636***
	(2.87)	(2.86)
Time difference	0.000117***	0.000116***
	(2.81)	(2.80)
Regional trade agreement	-0.000670**	-0.000669**
	(-2.09)	(-2.08)
GATT membership	0.000308*	0.000309*
	(1.77)	(1.77)
European Union membership	0.00114**	0.00115**
	(2.55)	(2.56)
Log of # of employees		0.000174***
		(8.54)
Log of labor productivity		0.000295***
		(11.13)
Log of age of the firm		0.000120*
		(7.06)
Dummy for being an LLC		-0.000834***
		(-7.46)
R&D engagement		0.0000620
		(1.42)
Constant	0.00833***	0.00668***
	(3.44)	(2.78)
N	15,148,899	14,608,164
R-squared	0.003	0.003
RESET (p-values)	0.000	0.000

The dependent variable is a dummy variable which takes value of 1 if a firm carries out positive exports with a particular country in a particular service type. t-statistics in parentheses are calculated based on country clustered robust standard errors. P-values of RESET test for the model in each column is provided in the last row. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1.3: Baseline Probabilities for Firm-level Exports

	Without firm variables			With firm variables		
	Baseline probability	probability of creation	% change in probability	Baseline probability	probability of creation	% change in probability
Log of GDP partner	0.00107	0.00123	14.22	0.00108	0.00122	13.62
Log of GDPPC partner	0.00107	0.00112	3.99	0.00108	0.00112	4.02
Log of distance	0.00107	0.00004	-95.99	0.00108	0.00005	-95.81
Colonial relationship	0.00108	0.00105	-2.53	0.00108	0.00106	-1.87
Common legislation	0.00082	0.00159	92.99	0.00083	0.00159	92.72
Common language	0.00087	0.00151	73.13	0.00088	0.00152	72.39
Time difference	0.00077	0.00081	4.58	0.00078	0.00089	14.96
Regional trade agreement	0.00124	0.00057	-54.06	0.00124	0.00057	-53.81
GATT membership	0.00083	0.00114	37.13	0.00083	0.00114	37.13
European Union membership	0.00092	0.00206	123.93	0.00092	0.00207	124.59
Log of # of employees				0.00108	0.00116	7.88
Log of labor productivity				0.00108	0.0012	11.07
Log of age of the firm				0.00108	0.00111	3.12
Dummy for being an LLC				0.00185	0.00102	-45.08
R&D engagement				0.00106	0.00112	5.86

The baseline probabilities are calculated at the mean value of continuous variables and at zero for discrete variables. The probability of creation shows the change in export probability when a continuous variable deviates from its mean by 10% and when a discrete variable takes the value of 1. Finally, % change in probability columns show the percentage changes in baseline probabilities depending on these deviations.

Table 1.4: Firm-level Exports: OLS, PPML and Tobit

	(1) OLS	(2) OLS	(3) PPML (T>0)	(4) PPML (T>0)	(5) PPML	(6) PPML	(7) Tobit	(8) Tobit
Dependent Variable	Log of Exports	Log of Exports	Exports	Exports	Exports	Exports	Exports	Exports
Log of GDP partner	0.262***	0.281***	0.229***	0.289***	0.616***	0.628***	0.252***	0.167***
	(9.42)	(10.40)	(4.94)	(6.47)	(15.14)	(15.37)	(4.75)	(6.58)
Log of GDPPC partner	0.0978***	0.108***	0.354***	0.415***	0.516***	0.549***	0.102***	0.068***
	(2.68)	(2.81)	(2.92)	(4.33)	(3.59)	(4.36)	(4.00)	(4.48)
Log of distance	-0.375***	-0.413***	-0.192	-0.275*	-0.569***	-0.625***	-0.187**	-0.126***
	(-5.61)	(-5.85)	(-0.99)	(-1.81)	(-2.74)	(-3.39)	(-2.96)	(-3.41)
Colonial relationship	0.294***	0.366***	-0.931	-0.721	-0.347	-0.319	0.230**	0.158***
	(2.59)	(3.39)	(-1.61)	(-1.52)	(-1.15)	(-0.98)	(2.42)	(2.67)
Common legislation	0.0237	0.0638	0.308**	0.371*	0.732***	0.673***	0.236**	0.152**
	(0.25)	(0.67)	(1.46)	(1.70)	(3.48)	(2.93)	(2.43)	(2.52)
Common language	0.0428	0.0178	1.228**	1.005**	0.866***	0.858***	0.052	0.034
	(0.50)	(0.22)	(2.07)	(2.20)	(3.00)	(2.79)	(1.03)	(1.04)
Time difference	-0.0214	-0.0220	-0.119	-0.112	-0.0265	-0.0212	0.012	0.008
	(-0.71)	(-0.74)	(-1.46)	(-1.48)	(-0.44)	(-0.34)	(0.96)	(0.96)
Regional trade agreement	-0.383**	-0.368**	-0.657	-0.572	0.0435	-0.00777	0.221**	0.141*
	(-1.89)	(-2.18)	(-1.59)	(-1.45)	(0.12)	(-0.02)	(1.97)	(1.94)
GATT membership	-0.380*	-0.402**	-1.154***	-1.345**	-0.910**	-1.006***	0.066**	0.041
	(-1.89)	(-1.99)	(-3.23)	(-3.85)	(-2.41)	(-2.60)	(0.96)	(0.93)
European Union membership	-0.258*	-0.311**	-0.222	-0.490**	-0.0754	-0.248	0.121	0.077
	(-1.82)	(-2.11)	(-0.57)	(-1.40)	(-0.14)	(-0.51)	(1.30)	(1.24)
Log of # of employees		0.379***		0.507***		0.617***		0.070***
		(24.84)		(15.65)		(15.48)		(6.32)
Log of labor productivity		0.490***		0.610***		0.755***		0.112***
		(32.77)		(27.23)		(19.65)		(6.35)
Log of age of the firm		-0.327***		-0.321***		-0.360***		0.043
		(-10.76)		(-5.72)		(-7.67)		(4.55)
Dummy for being an LLC		0.741***		0.872***		0.119		-0.290***
		(13.85)		(7.05)		(1.01)		(-5.05)
R&D engagement		0.150***		0.281***		0.367***		0.024
		(4.07)		(3.30)		(3.10)		(1.48)
Constant	4.717***	0.982	4.506**	-1.296	-3.470	-9.241***		
	(6.96)	(1.37)	(2.12)	(-0.72)	(-1.55)	(-4.53)		
N	16,252	15,726	16,252	15,726	15,148,899	14,608,164	15,148,899	14,608,164
R-squared	0.072	0.173	0.009	0.078	0.002	0.001	0.060	0.067
RESET(p-values)	0.000	0.000	0.000	**0.0476**	**0.8146**	**0.0199**	0.0169	0.0021

The dependent variable is the value of service exports incurred by each firm. The log of exports is used in OLS estimations. t-statistics (from OLS) and z-statistics (from PPML and Tobit) in parentheses are calculated based on country clustered robust standard errors. Pseudo R-squared in Tobit regressions. p-values of RESET test for the model in each column is provided in the last row. Column 7 and 8 provide the marginal effects (marginal effects on $E(y|X)$) from Tobit regressions. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1.5: Firm-level Exports Analyses with Firm-by-service Type Fixed Effects

	(1) FE w/o firm variables	(2) FE w/ firm variables	(3) Poisson T>0 w/o firm variables	(4) Poisson T>0 w/ firm variables	(5) Poisson w/o firm variables	(6) Poisson w/ firm variables
Dependent Variable	Log of Exports	Log of Exports	Exports	Exports	Exports	Exports
Log of GDP partner	0.289***	0.286***	0.243***	0.287***	0.616***	0.628***
	(22.03)	(21.40)	(4.20)	(7.11)	(16.39)	(16.83)
Log of GDPPC partner	0.105***	0.110***	0.239***	0.246***	0.516***	0.549***
	(5.85)	(6.01)	(3.63)	(4.56)	(4.06)	(5.38)
Log of distance	-0.412***	-0.409***	-0.255	-0.296***	-0.569***	-0.625***
	(-12.28)	(-12.10)	(-1.34)	(-2.86)	(-2.97)	(-4.89)
Colonial relationship	0.414***	0.417***	-0.226	-0.148	-0.347	-0.319
	(5.41)	(5.39)	(-1.00)	(-0.75)	(-0.80)	(-0.68)
Common legislation	0.162***	0.154**	0.355*	0.248	0.732***	0.673***
	(2.63)	(2.47)	(1.91)	(1.37)	(5.31)	(4.39)
Common language	0.0369	0.0342	0.478**	0.443**	0.866*	0.858
	(0.67)	(0.62)	(2.20)	(2.17)	(1.67)	(1.53)
Time difference	-0.0126	-0.0125	-0.0611**	-0.0781***	-0.0265	-0.0212
	(-1.11)	(-1.08)	(-1.96)	(-2.94)	(-0.60)	(-0.49)
Regional trade agreement	-0.274***	-0.268***	-0.368**	-0.505***	0.0435	-0.00777
	(-4.11)	(-3.92)	(-1.99)	(-2.79)	(0.22)	(-0.04)
GATT membership	-0.242***	-0.261***	-0.939***	-0.892***	-0.910***	-1.006***
	(-3.58)	(-3.80)	(-5.07)	(-4.86)	(-3.16)	(-3.51)
EU membership	-0.115**	-0.123**	0.0383	-0.219	-0.0754	-0.248
	(-2.38)	(-2.48)	(0.12)	(-1.19)	(-0.26)	(-1.08)
N	16,252	15,726	15,360	14,868	422,145	406,923
RESET (p-values)	0.000	0.000	0.0768	0.0052	0.6680	0.3229

In order to produce these results, a panel dataset is created based on countries and panel ids that are generated by grouping each firm by each service type then firm-by-service type FE included in all models. The dependent variable is the value of service exports incurred by each firm. The log of exports is used in OLS estimations. t-statistics (from OLS) and z-statistics (from PPML) in parentheses are calculated based on heteroskedasticity robust standard errors. p-values of RESET test for the model in each column is provided in the last row. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1.6: Firm-level Imports: LPM

Dependent Variable	without firm variables Import dummy	with firm variables Import dummy
Log of GDP partner	0.000544***	0.000528***
	(3.46)	(3.49)
Log of GDPPC partner	-0.0000139	-0.0000139
	(-0.21)	(-0.22)
Log of distance	-0.00152***	-0.00147***
	(-4.16)	(-4.13)
Colonial relationship	0.00000106	0.00000465
	(0.00)	(0.02)
Common legislation	0.000664***	0.000637***
	(2.02)	(2.01)
Common language	0.000728**	0.000702**
	(2.16)	(2.17)
Time difference	0.000134**	0.000129**
	(2.58)	(2.56)
Regional trade agreement	-0.00121**	-0.00119**
	(-2.47)	(-2.50)
GATT membership	0.000437**	0.000423**
	(2.07)	(2.06)
European Union membership	0.001000*	0.001000*
	(1.84)	(1.87)
Log of # of employees		0.000187***
		(5.33)
Log of labor productivity		0.000278***
		(5.96)
Log of age of the firm		-0.0000253
		(-0.75)
Dummy for being an LLC		-0.000634***
		(-7.65)
R&D engagement		0.000242***
		(3.66)
Constant	0.0111***	0.00928***
	(3.83)	(3.48)
N	16,219,700	15,528,800
R-squared	0.003	0.003
RESET (p-values)	0.000	0.000

The dependent variable is a dummy variable which takes value of 1 if a firm carries out positive imports with a particular country in a particular service type. t-statistics in parentheses are calculated based on country clustered robust standard errors. P-values of RESET test for the model in each column is provided in the last row. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1.7: Baseline Probabilities for Firm-level Imports

	Without firm variables			With firm variables		
	Baseline probability	probability of creation	% change in probability	Baseline probability	probability of creation	% change in probability
Log of GDP partner	0.00086	0.00103	19.31	0.00084	0.001	19.3
Log of GDPPC partner	0.00086	0.00085	-1.31	0.00084	0.00083	-1.34
Log of distance	0.00086	**-0.00042**	-148.73	0.00084	**-0.00041**	-149.01
Colonial relationship	0.00086	0.00086	0.12	0.00084	0.00084	0.56
Common legislation	0.00065	0.00131	102.1	0.00063	0.00127	100.56
Common language	0.00064	0.00137	113.3	0.00063	0.00133	112.33
Time difference	0.00053	0.00067	25.07	0.00052	0.00065	24.98
Regional trade agreement	0.00117	**-0.00005**	-103.86	0.00114	**-0.00005**	-104.34
GATT membership	0.00051	0.00095	85.33	0.0005	0.00092	84.63
European Union membership	0.00073	0.00173	138.05	0.0007	0.0017	142.69
Log of # of employees				0.00084	0.00093	11.14
Log of labor productivity				0.00084	0.00095	13.32
Log of age of the firm				0.00084	0.00083	-0.86
Dummy for being an LLC				0.00145	0.00081	-43.82
R&D engagement				0.00076	0.00101	31.66

The baseline probabilities are calculated at the mean value of continuous variables and at zero for discrete variables. The probability of creation shows the change in import probability when a continuous variable deviates from its mean by 10% and when a discrete variable takes the value of 1. Finally, % change in probability columns show the percentage changes in baseline probabilities depending on these deviations.

Table 1.8: Firm-level Imports: OLS, PPML and Tobit

	(1) OLS	(2) OLS	(3) PPML(T>0)	(4) PPML(T>0)	(5) PPML	(6) PPML	(7) Tobit	(8) Tobit
Dependent Variable	Log of Imports	Log of Imports	Imports	Imports	Imports	Imports	Imports	Imports
Log of GDP partner	0.209***	0.225***	0.196***	0.288***	0.809***	0.878***	0.076***	0.061***
	(14.49)	(15.08)	(3.58)	(8.83)	(11.80)	(23.60)	(4.72)	(4.32)
Log of GDPPC partner	0.0411	0.0353	0.215***	0.198***	0.341***	0.314***	0.016***	0.013***
	(1.31)	(1.03)	(3.39)	(3.49)	(3.87)	(3.92)	(2.67)	(2.63)
Log of distance	-0.240***	-0.247***	-0.307**	-0.323**	-0.966***	-1.017***	-0.076***	-0.060***
	(-4.98)	(-5.07)	(-2.58)	(-2.75)	(-6.81)	(-7.69)	(-4.07)	(-3.83)
Colonial relationship	0.125	0.163	0.473	0.636	0.944**	1.167***	0.069**	0.059**
	(0.73)	(0.90)	(1.12)	(1.38)	(2.33)	(2.68)	(2.19)	(2.30)
Common legislation	0.0347	-0.0292	0.0714	0.0182	0.475	0.371	0.051*	0.037
	(0.22)	(-0.18)	(0.22)	(0.05)	(1.37)	(1.05)	(1.70)	(1.60)
Common language	-0.00300	-0.00677	-0.0561	-0.130	-0.166	-0.276	0.009	0.006
	(-0.03)	(-0.07)	(-0.24)	(-0.62)	(-0.65)	(-1.28)	(0.56)	(0.43)
Time difference	-0.00417	-0.0109	-0.00482	-0.0592	0.112*	0.0696	0.076*	0.006*
	(-0.17)	(-0.44)	(-0.08)	(-1.15)	(1.66)	(1.16)	(1.92)	(1.82)
Regional trade agreement	-0.144	-0.219*	-0.150	-0.259	0.540	0.418	0.042	0.033
	(-1.00)	(-1.57)	(-0.55)	(-1.03)	(1.33)	(1.05)	(1.33)	(1.29)
GATT membership	-0.0285	0.00939	-0.0636	-0.165	0.433	0.408	0.043***	0.032**
	(-0.14)	(0.05)	(-0.16)	(-0.45)	(1.29)	(1.13)	(2.80)	(2.58)
European Union membership	-0.229	-0.203	-0.226	-0.194	-0.229	-0.286	0.019	0.017
	(-1.59)	(-1.23)	(-1.15)	(-1.05)	(-0.60)	(-0.80)	(0.73)	(0.77)
Log of # of employees		0.179***		0.387***		0.607***		0.025***
		(11.08)		(12.65)		(20.63)		(4.16)
Log of labor productivity		0.271***		0.466***		0.772***		0.035***
		(14.89)		(14.96)		(22.22)		(4.28)
Log of age of the firm		-0.0230		-0.0341		-0.105		-0.002
		(-0.34)		(-0.21)		(-0.77)		(-0.55)
Dummy for being an LLC		0.883***		1.451***		1.064***		-0.097***
		(11.87)		(10.41)		(7.74)		(-3.86)
R&D engagement		-0.126**		0.170		0.535**		0.032***
		(-2.50)		(1.26)		(3.17)		(2.82)
Constant	3.414***	0.583	4.678***	-1.119	-2.701*	-10.05***		
	(6.57)	(1.00)	(3.80)	(-0.81)	(-1.93)	(-6.91)		
N	13,988	13,012	13,988	13,012	16,219,700	15,528,800	16,219,700	15,528,800
R-squared	0.039	0.078	0.004	0.020	0.0002	0.001	0.089	0.096
RESET (p-values)	0.0007	0.000	**0.7460**	**0. 1494**	**0.8098**	**0.4565**	0.0024	0.0398

The dependent variable is the value of service imports incurred by each firm. The log of imports is used in OLS estimations. t-statistics (from OLS) and z-statistics (from PPML and Tobit) in parentheses are calculated based on country clustered robust standard errors. Pseudo R-squared in Tobit regressions. p-values of RESET test for the model in each column is provided in the last row. Column 7 and 8 provide the marginal effects (marginal effects on E(y—X)) from Tobit regressions. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1.9: Firm-level Imports Analyses with Firm-by-service Type Fixed Effects

	(1) FE w/o firm variables	(2) FE w/ firm variables	(3) Poisson (T>0) w/o firm variables	(4) Poisson (T>0) w/ firm variables	(5) Poisson w/o firm variables	(6) Poisson w/ firm variables
Dependent Variable	Log of Imports	Log of Imports	Imports	Imports	Imports	Imports
Log of GDP partner	0.290***	0.290***	0.375***	0.482***	0.809***	0.878***
	(15.84)	(14.78)	(2.73)	(4.41)	(12.42)	(21.20)
Log of GDPPC partner	0.0343	0.0361	0.268***	0.216**	0.341***	0.314***
	(1.42)	(1.44)	(3.05)	(2.50)	(5.35)	(5.43)
Log of distance	-0.208***	-0.203***	-0.464***	-0.519***	-0.966***	-1.017***
	(-5.39)	(-5.01)	(-3.41)	(-3.55)	(-6.34)	(-6.18)
Colonial relationship	0.319***	0.398***	0.708*	0.879**	0.944***	1.167***
	(2.80)	(3.48)	(1.80)	(2.13)	(2.65)	(2.88)
Common legislation	0.177*	0.111	0.283	0.231	0.475***	0.371**
	(1.65)	(1.06)	(1.29)	(1.01)	(3.05)	(2.42)
Common language	0.00344	-0.0326	-0.0564	-0.107	-0.166	-0.276
	(0.05)	(-0.43)	(-0.25)	(-0.47)	(-0.62)	(-0.86)
Time difference	-0.00562	-0.00890	0.0176	-0.0328	0.112**	0.0696
	(-0.38)	(-0.56)	(0.31)	(-0.77)	(2.24)	(1.63)
Regional trade agreement	0.00832	-0.0118	-0.0356	-0.125	0.540***	0.418***
	(0.10)	(-0.13)	(-0.17)	(-0.65)	(4.02)	(3.07)
GATT membership	-0.272**	-0.249**	-0.474	-0.471	0.433*	0.408*
	(-2.55)	(-2.24)	(-1.53)	(-1.54)	(1.85)	(1.87)
EU membership	-0.0904	-0.0797	-0.182	-0.302	-0.229	-0.286
	(-1.49)	(-1.27)	(-0.75)	(-1.53)	(-1.23)	(-1.63)
N	13,988	13,012	10,879	10,067	884,275	832,475
RESET (p-values)	0.0529	0.1238	0.8904	0.3728	0.6762	0.4605

In order to produce these results, a panel dataset is created based countries and panel ids that are generated by grouping each firm by each service type then firm-by-service type FE included in all models. The dependent variable is the value of service imports incurred by each firm. The log of imports is used in OLS estimations. t-statistics (from OLS) and z-statistics (from PPML) in parentheses are calculated based on heteroskedasticity robust standard errors. p-values of RESET test for the model in each column is provided in the last row. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1.10: Firm-level Exports Analyses: Service Type Aggregated Firm Exports

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	LPM	LPM	OLS	OLS	PPML (T>0)	PPML (T>0)	PPML	PPML	Tobit	Tobit
Log of GDP partner	0.0209***	0.0209***	0.276***	0.301***	0.249***	0.316***	0.616***	0.628***	15.878***	10.207***
	(6.83)	(6.88)	(8.93)	(9.74)	(5.22)	(6.67)	(15.14)	(15.37)	(4.71)	(6.52)
Log of GDPPC partner	0.00258	0.00261	0.0976***	0.108***	0.357***	0.409***	0.516***	0.549***	6.334***	4.067***
	(1.23)	(1.24)	(2.62)	(2.73)	(2.90)	(4.09)	(3.59)	(4.36)	(4.01)	(4.75)
Log of distance	-0.0486***	-0.0488***	-0.426***	-0.459***	-0.201	-0.275*	-0.569***	-0.625***	-13.016***	-8.671***
	(-4.15)	(-4.13)	(-5.86)	(-5.90)	(-1.02)	(-1.79)	(-2.74)	(-3.39)	(-3.39)	(-4.03)
Colonial relationship	-0.000618	-0.000330	0.389***	0.432***	-0.931	-0.774*	-0.347	-0.319	13.908**	9.225**
	(-0.08)	(-0.04)	(3.22)	(3.70)	(-1.61)	(-1.69)	(-1.15)	(-0.98)	(2.40)	(2.58)
Common legislation	0.0319***	0.0320***	0.00324	0.0576	0.292	0.366	0.732***	0.673***	15.918**	9.929***
	(3.46)	(3.46)	(0.03)	(0.54)	(1.35)	(1.56)	(3.48)	(2.93)	(2.56)	(2.63)
Common language	0.0261***	0.0260***	0.0249	0.00471	1.241**	1.039**	0.866***	0.858***	6.744**	4.372**
	(2.91)	(2.89)	(0.27)	(0.05)	(2.11)	(2.44)	(3.00)	(2.79)	(2.04)	(2.19)
Time difference	0.00464***	0.00465***	-0.0204	-0.0207	-0.118	-0.107	-0.0265	-0.0212	0.501	0.328
	(2.76)	(2.75)	(-0.66)	(-0.66)	(-1.43)	(-1.45)	(-0.44)	(-0.34)	(0.79)	(0.81)
Regional trade agreement	-0.0254**	-0.0253*	-0.420**	-0.402**	-0.643	-0.540	0.0435	-0.00777	8.693	4.992
	(-1.99)	(-1.97)	(-2.36)	(-2.23)	(-1.53)	(-1.36)	(0.12)	(-0.02)	(1.54)	(1.42)
GATT membership	0.0123*	0.0124*	-0.396*	-0.410**	-1.143***	-1.295***	-0.910**	-1.006***	2.594	1.507
	(1.73)	(1.74)	(-1.95)	(-1.98)	(-3.13)	(-3.67)	(-2.41)	(-2.60)	(0.67)	(0.61)
European Union membership	0.0445**	0.0448**	-0.275*	-0.303**	-0.209	-0.442	-0.0754	-0.248	7.302	4.148
	(2.53)	(2.54)	(-1.97)	(-2.06)	(-0.52)	(-1.18)	(-0.14)	(-0.51)	(1.34)	(1.19)
Log of # of employees		0.00601***		0.404***		0.604***		0.617***		4.276***
		(9.32)		(22.61)		(17.09)		(15.48)		(6.26)
Log of labor productivity		0.0119***		0.515***		0.664***		0.755***		7.557***
		(12.14)		(29.63)		(28.58)		(19.65)		(6.56)
Log of age of the firm		0.00630***		-0.301***		-0.415***		-0.360***		2.936***
		(9.06)		(-10.31)		(-7.16)		(-7.67)		(5.07)
Dummy for being an LLC		-0.0366***		0.739***		0.887***		0.119		-17.480***
		(-7.30)		(13.48)		(7.21)		(1.01)		(-5.11)
R&D engagement		-0.000107		0.170***		0.388***		0.367***		0.303
		(-0.08)		(3.50)		(4.87)		(3.10)		(0.40)
Constant	0.329***	0.268***	5.133***	1.005	4.508**	-1.926	0.380	-5.391***		
	(3.37)	(2.72)	(7.04)	(1.28)	(2.09)	(-1.06)	(0.17)	(-2.65)		
N	322,317	310,812	14,570	14,105	14,570	14,105	322,317	310,812	322,317	310,812
R-squared	0.107	0.114	0.081	0.185	0.010	0.105	0.007	0.020	0.068	0.079
Reset (p values)	0.000	0.000	0.000	0.000	0.000	0.0107	0.8146	0.0199	0.3525	0.0419

The dependent variable in the LPM regressions is a dummy variable which takes value of 1 if a firm carries out positive imports with a particular country in a particular service type. The dependent variable in the OLS, PPML and Tobit regressions is the value of service exports incurred by each firm. The log of exports is used in OLS estimations. t-statistics (from OLS) and z-statistics (from PPML and Tobit) in parentheses are calculated based on country clustered robust standard errors. Pseudo R-squared in Tobit regressions. p-values of RESET test for the model in each column is provided in the last row. Column 7 and 8 provide the marginal effects (marginal effects on$E(y|X)$) from Tobit regressions. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1.11: Firm-level Imports Analyses: Service Type Aggregated Firm Imports

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	LPM	LPM	OLS	OLS	PPML (T>0)	PPML (T>0)	PPML	PPML	Tobit	Tobit
Log of GDP partner	0.0162***	0.0160***	0.312***	0.352***	0.289***	0.430***	0.809***	0.878***	5.195***	4.074***
	(4.67)	(4.68)	(11.90)	(12.64)	(5.15)	(11.81)	(11.80)	(23.60)	(4.34)	(3.95)
Log of GDPPC partner	-0.000285	-0.000279	0.0664	0.0583	0.242***	0.238***	0.341***	0.314***	0.951**	.731**
	(-0.17)	(-0.16)	(1.48)	(1.13)	(4.00)	(4.44)	(3.87)	(3.92)	(2.51)	(2.45)
Log of distance	-0.0408***	-0.0404***	-0.354***	-0.363***	-0.446***	-0.485***	-0.966***	-1.017***	-4.822***	-3.676***
	(-4.25)	(-4.21)	(-5.98)	(-5.48)	(-3.91)	(-4.71)	(-6.81)	(-7.69)	(-3.93)	(-3.70)
Colonial relationship	-0.000694	-0.000549	0.364*	0.395*	0.650	0.935*	0.944**	1.167***	4.174**	3.540**
	(-0.09)	(-0.07)	(1.78)	(1.96)	(1.52)	(1.90)	(2.13)	(2.68)	(2.07)	(2.14)
Common legislation	0.0200**	0.0197**	0.0180	-0.0137	0.0547	-0.0369	0.475	0.371	3.972*	2.905*
	(2.29)	(2.28)	(0.10)	(-0.08)	(0.17)	(-0.10)	(1.37)	(1.05)	(1.89)	(1.78)
Common language	0.0199**	0.0195**	0.0518	0.0754	-0.0766	-0.211	-0.166	-0.276	1.429	0.958
	(2.44)	(2.43)	(0.41)	(0.63)	(-0.32)	(-0.92)	(-0.65)	(-1.28)	(1.20)	(1.09)
Time difference	0.00360**	0.00354**	-0.00891	-0.0185	0.0166	-0.0300	0.112*	0.0696	0.407*	0.277
	(2.60)	(2.56)	(-0.29)	(-0.58)	(0.26)	(-0.50)	(1.66)	(1.16)	(1.71)	(1.49)
Regional trade agreement	-0.0292**	-0.0289**	-0.359**	-0.411**	-0.122	-0.189	0.540	0.418	2.268	1.754
	(-2.49)	(-2.49)	(-2.05)	(-2.26)	(-0.36)	(-0.53)	(1.33)	(1.05)	(1.24)	(1.19)
GATT membership	0.0126**	0.0124**	-0.144	-0.158	-0.0462	-0.200	0.433	0.408	2.711**	1.979**
	(2.14)	(2.12)	(-0.59)	(-0.64)	(-0.10)	(-0.45)	(1.29)	(1.13)	(2.58)	(2.37)
European Union membership	0.0354**	0.0357**	-0.142	-0.0900	-0.300	-0.255	-0.229	-0.286	2.543	2.074
	(2.33)	(2.36)	(-1.04)	(-0.58)	(-1.41)	(-1.48)	(-0.60)	(-0.80)	(1.28)	(1.30)
Log of # of employees		0.00462***		0.275***		0.508***		0.607***		1.562***
		(7.35)		(9.32)		(9.93)		(20.63)		(4.11)
Log of labor productivity		0.00771***		0.413***		0.567***		0.772***		2.443***
		(9.21)		(18.49)		(14.32)		(22.22)		(4.18)
Log of age of the firm		0.00208***		-0.0856**		-0.142		-0.105		0.555**
		(5.42)		(-2.08)		(-1.00)		(-0.77)		(2.54)
Dummy for being an LLC		-0.0288***		0.865***		1.573***		1.064***		-10.569***
		(-9.33)		(10.36)		(11.18)		(7.74)		(-3.73)
R&D engagement		0.00582***		0.0274		0.274*		0.535***		2.053***
		(5.11)		(0.48)		(1.91)		(3.17)		(2.84)
Constant	0.294***	0.256***	3.882***	-0.0136	5.107***	-1.937	1.149	-6.199***		
	(3.78)	(3.35)	(5.35)	(-0.02)	(4.40)	(-1.46)	(0.82)	(-4.26)		
N	345,100	330,400	9,878	9,345	9,878	9,345	345,100	330,400	345,100	330,400
R-squared	0.089	0.093	0.086	0.157	0.010	0.061	0.009	0.044	0.089	0.098
RESET (p values)	0.000	0.000	0.000	0.000	0.5549	0.0008	0.8098	0.4565	0.000	0.0001

The dependent variable in the LPM regressions is a dummy variable which takes value of 1 if a firm carries out positive imports with a particular country in a particular service type. The dependent variable in the OLS, PPML and Tobit regressions is the value of service exports incurred by each firm. The log of imports is used in OLS estimations. t-statistics (from OLS) and z-statistics (from PPML and Tobit) in parentheses are calculated based on country clustered robust standard errors. Pseudo R-squared in Tobit regressions. p-values of RESET test for the model in each column is provided in the last row. Column 7 and 8 provide the marginal effects (marginal effects on$E(y|X)$) from Tobit regressions. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1.12: Aggregate Exports and Imports

	Export				Import			
	(1) OLS	(2) OLS	(3) PPML	(4) PPML	(5) OLS	(6) OLS	(7) PPML	(8) PPML
Log of GDP partner	0.989***	0.936***	0.612***	0.607***	1.045***	0.961***	0.808***	0.773***
	(16.10)	(16.84)	(14.78)	(12.74)	(20.10)	(19.06)	(11.78)	(9.40)
Log of GDPPC partner	0.397***	0.260**	0.516***	0.512***	0.143	0.0285	0.340***	0.338***
	(3.80)	(2.20)	(3.62)	(3.78)	(1.62)	(0.33)	(3.87)	(4.14)
Log of distance	0.0576	-0.0509	-0.569***	-0.614***	-0.848***	-0.845***	-0.968***	-0.939***
	(0.17)	(-0.17)	(-2.75)	(-3.03)	(-3.08)	(-3.20)	(-6.82)	(-7.26)
Colonial relationship	0.641**	0.346	-0.351	-0.414	0.793*	0.365	0.941**	1.023**
	(2.40)	(1.19)	(-1.16)	(-1.54)	(1.91)	(0.78)	(2.13)	(2.42)
Common legislation	0.381	0.354	0.740***	0.744***	0.925**	0.797*	0.472	0.417
	(1.47)	(1.22)	(3.50)	(3.60)	(2.19)	(1.81)	(1.36)	(1.28)
Common language	0.737***	0.836***	0.862***	0.909***	0.542	0.605*	-0.163	-0.250
	(3.16)	(4.06)	(3.00)	(3.90)	(1.50)	(1.97)	(-0.63)	(-0.97)
Time difference	-0.202***	-0.173***	-0.0232	0.00368	-0.0906*	-0.0789	0.112*	0.119*
	(-3.48)	(-3.12)	(-0.38)	(0.06)	(-1.74)	(-1.65)	(1.66)	(1.65)
Regional trade agreement	0.322	0.115	0.0466	0.0612	0.216	-0.195	0.529	0.559
	(0.88)	(0.36)	(0.13)	(0.17)	(0.69)	(-0.64)	(1.30)	(1.39)
GATT membership	-0.805***	-0.750**	-0.901**	-0.806**	-0.0300	0.0148	0.436	0.553*
	(-2.64)	(-2.54)	(-2.39)	(-2.20)	(-0.08)	(0.05)	(1.30)	(1.70)
European Union membership	0.547	0.754**	-0.0704	0.0167	0.385	0.622*	-0.229	-0.256
	(1.56)	(1.99)	(-0.14)	(0.03)	(1.27)	(1.75)	(-0.60)	(-0.73)
Log of avg. labor productivity		0.221***		0.105		0.192***		-0.140**
		(3.66)		(1.58)		(4.40)		(-2.16)
Log of avg. # of employees		0.187**		-0.210**		0.360***		0.0499
		(2.13)		(-2.06)		(3.21)		(0.27)
Constant	1.642	0.977	7.895***	8.652***	8.754***	6.588***	8.783***	9.394***
	(0.58)	(0.37)	(3.54)	(3.90)	(3.44)	(2.63)	(6.30)	(5.69)
N	171	170	171	170	165	161	165	161
R-squared	0.804	0.830	0.918	0.924	0.813	0.850	0.981	0.982
RESET (p values)	0.6821	0.1293	0.8360	0.6419	0.7951	0.1142	0.7567	0.7895

The dependent variables are the total exports and imports in services. The log of dependent variable is used in OLS estimations. t-statistics (from OLS) and z-statistics (from PPML) in parentheses are calculated based on heteroskedasticity robust standard errors. p-values of RESET test for the model in each column is provided in the last row. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1.13: Extensive and Intensive Margins of Exports (Simple)

Panel A		OLS				
	(1) Log of Total Exports	(2) Log of Extensive Margin	(3) Log of Intensive Margin			
Log of Total Export	1.000	0.552***	0.448***			
		(31.29)	(25.39)			
R-squared	1.00	0.85	0.79			
Panel B		OLS			PPML	
	(1) Log of Total Exports	(2) Log of Extensive Margin	(3) Log of Intensive Margin	(1) Total Exports	(2) Extensive Margin	(3) Intensive Margin
Log of GDP partner	0.989***	0.618***	0.371***	0.755***	0.521***	0.277***
	(18.14)	(21.19)	(9.67)	(6.82)	(26.55)	(8.72)
Log of distance	-0.701***	-0.395***	-0.305***	-0.544***	-0.436***	-0.0118
	(-4.31)	(-4.98)	(-2.87)	(-3.40)	(-6.71)	(-0.06)
Constant	10.69***	4.576***	6.116***	11.41***	5.647***	4.923**
	(7.24)	(6.38)	(6.27)	(6.61)	(10.31)	(3.33)
N	171	171	171	171	171	171
R-squared	0.695	0.742	0.402	0.625	0.864	0.020

Total service exports, number of firms and average service exports per firm are the dependent variables in column 1, 2 and 3 respectively. The log of dependent variable is used in OLS estimations. t-statistics (from OLS) and z-statistics (from PPML) in parentheses are calculated based on heteroskedasticity robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1.14: Extensive and Intensive Margins of Imports (Simple)

Panel A		OLS				
	(1) Log of Total Imports	(2) Log of Extensive Margin	(3) Log of Intensive Margin			
Log of Total Imports	1.000	0.549 ***	0.451 ***			
		(29.42)	(24.20)			
R-squared	1.00	0.84	0.78			
Panel B		OLS			PPML	
	(1) Log of Total Imports	(2) Log of Extensive Margin	(3) Log of Intensive Margin	(1) Total Imports	(2) Extensive Margin	(3) Intensive Margin
Log of GDP partner	1.004***	0.660***	0.345***	0.996***	0.635***	0.252***
	(17.23)	(20.73)	(8.41)	(10.01)	(24.95)	(4.69)
Log of distance	-0.972***	-0.420***	-0.552***	-0.665***	-0.517***	-0.294***
	(-6.77)	(-5.02)	(-5.64)	(-4.99)	(-8.27)	(-3.08)
Constant	11.64***	3.965***	7.672***	10.02***	5.204***	6.567***
	(3.07)	(5.20)	(8.93)	(6.97)	(9.61)	(7.19)
N	165	165	165	165	165	165
R-squared	0.711	0.764	0.408	0.817	0.910	0.162

Total service imports, number of firms and average service imports per firm are the dependent variables in column 1, 2 and 3 respectively. The log of dependent variable is used in OLS estimations. t-statistics (from OLS) and z-statistics (from PPML) in parentheses are calculated based on heteroskedasticity robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1.15: Extensive and Intensive Margins of Exports (OLS-Augmented)

	(1) Total Exports	(2) Total Exports	(3) Extensive Margin	(4) Extensive Margin	(5) Intensive Margin	(6) Intensive Margin
Log of GDP partner	0.989***	0.936***	0.572***	0.519***	0.418***	0.417***
	(16.10)	(16.84)	(20.87)	(20.31)	(8.80)	(9.05)
Log of GDPPC partner	0.397***	0.260**	0.215***	0.131***	0.181**	0.128
	(3.80)	(2.20)	(4.98)	(2.92)	(2.18)	(1.45)
Log of distance	0.0576	-0.0509	-0.146	-0.211*	0.204	0.161
	(0.17)	(-0.17)	(-1.21)	(-1.78)	(0.75)	(0.65)
Colonial relationship	0.641**	0.346	0.521***	0.391**	0.120	-0.0454
	(2.40)	(1.19)	(2.82)	(2.27)	(0.44)	(-0.16)
Common legislation	0.381	0.354	0.468***	0.467***	-0.0874	-0.113
	(1.47)	(1.22)	(2.64)	(2.85)	(-0.38)	(-0.45)
Common language	0.737***	0.836***	0.274*	0.302**	0.462*	0.534**
	(3.16)	(4.06)	(1.91)	(2.26)	(1.89)	(2.31)
Time difference	-0.202***	-0.173***	-0.0246	-0.0178	-0.178***	-0.155***
	(-3.48)	(-3.12)	(-0.99)	(-0.74)	(-3.91)	(-3.64)
Regional trade agreement	0.322	0.115	0.530***	0.407***	-0.208	-0.292
	(0.88)	(0.36)	(3.32)	(2.77)	(-0.73)	(-1.18)
GATT membership	-0.805***	-0.750**	-0.0471	0.0144	-0.758***	-0.765***
	(-2.64)	(-2.54)	(-0.31)	(0.10)	(-2.86)	(-3.02)
European Union membership	0.547	0.754**	0.345**	0.389**	0.203	0.365
	(1.56)	(1.99)	(2.30)	(2.43)	(0.73)	(1.26)
Log of avg. labor productivity		0.221***		0.0749***		0.147***
		(3.66)		(3.12)		(3.11)
Log of avg. # of employees		0.187**		0.263***		-0.0755
		(2.13)		(6.24)		(-1.10)
Constant	1.642	0.977	0.367	-0.417	1.275	1.394
	(0.58)	(0.37)	(0.35)	(-0.40)	(0.53)	(0.64)
N	171	170	171	170	171	170
R-squared	0.804	0.830	0.889	0.912	0.508	0.555

Total service exports, number of firms (extensive margin) and average service exports per firm (intensive margin) are the dependent variables. The dependent variables are in logs. t-statistics in parentheses are calculated based on heteroskedasticity robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1.16: Extensive and Intensive Margins of Imports (OLS-Augmented)

	(1) Total Imports	(2) Total Imports	(3) Extensive Margin	(4) Extensive Margin	(5) Intensive Margin	(6) Intensive Margin
Log of GDP partner	1.045***	0.961***	0.620***	0.560***	0.425***	0.402***
	(20.10)	(19.06)	(25.72)	(30.14)	(9.86)	(8.23)
Log of GDPPC partner	0.143	0.0285	0.122***	0.0688**	0.0217	-0.0403
	(1.62)	(0.33)	(2.98)	(2.07)	(0.30)	(-0.55)
Log of distance	-0.848***	-0.845***	-0.196	-0.265**	-0.652***	-0.580**
	(-3.08)	(-3.20)	(-1.43)	(-2.17)	(-2.65)	(-2.57)
Colonial relationship	0.793*	0.365	0.285	0.145	0.508	0.220
	(1.91)	(0.78)	(1.55)	(0.96)	(1.15)	(0.45)
Common legislation	0.925**	0.797*	0.559***	0.492***	0.366	0.305
	(2.19)	(1.81)	(3.13)	(3.22)	(1.00)	(0.79)
Common language	0.542	0.605*	0.390**	0.388***	0.152	0.217
	(1.50)	(1.97)	(2.39)	(3.26)	(0.53)	(0.79)
Time difference	-0.0906*	-0.0789	0.00600	0.0343	-0.0966*	-0.113**
	(-1.74)	(-1.65)	(0.23)	(1.50)	(-1.92)	(-2.39)
Regional trade agreement	0.216	-0.195	0.618***	0.423***	-0.402	-0.618**
	(0.69)	(-0.64)	(3.65)	(2.78)	(-1.30)	(-2.07)
GATT membership	-0.0300	0.0148	0.267*	0.326**	-0.297	-0.311
	(-0.08)	(0.05)	(1.71)	(2.46)	(-1.00)	(-1.09)
European Union membership	0.385	0.622*	0.516***	0.528***	-0.131	0.0943
	(1.27)	(1.75)	(2.88)	(2.72)	(-0.53)	(0.37)
Log of avg. labor productivity		0.192***		0.0663***		0.126***
		(4.40)		(3.82)		(3.21)
Log of avg. # of employees		0.360***		0.282***		0.0775
		(3.21)		(8.09)		(0.75)
Constant	8.754***	6.588***	0.314	-0.659	8.440***	7.247***
	(3.44)	(2.63)	(0.25)	(-0.61)	(3.74)	(3.27)
N	165	161	165	161	165	161
R-squared	0.813	0.850	0.898	0.932	0.497	0.535

Total service imports, number of firms (extensive margin) and average service imports per firm (intensive margin) are the dependent variables. The dependent variables are in logs. t-statistics in parentheses are calculated based on heteroskedasticity robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Appendix 1.A Additional Tables

Table 1A.1: Extensive and Intensive Margins of Exports (PPML-Augmented)

	(1) Total Exports	(2) Total Exports	(3) Extensive Margin	(4) Extensive Margin	(5) Intensive Margin	(6) Intensive Margin
Log of GDP partner	0.612***	0.607***	0.430***	0.440***	0.419***	0.417***
	(14.78)	(12.74)	(17.67)	(20.83)	(6.56)	(7.61)
Log of GDPPC partner	0.516***	0.512***	0.192***	0.187***	0.421***	0.359***
	(3.62)	(3.78)	(5.69)	(5.61)	(4.21)	(3.86)
Log of distance	-0.569***	-0.614***	-0.285***	-0.284***	0.535**	0.250
	(-2.75)	(-3.03)	(-3.27)	(-2.96)	(2.03)	(1.11)
Colonial relationship	-0.351	-0.414	0.379***	0.376***	-0.619	-0.696
	(-1.16)	(-1.54)	(2.67)	(2.90)	(-0.89)	(-1.07)
Common legislation	0.740***	0.744***	0.392***	0.415***	-0.669	-0.303
	(3.50)	(3.60)	(2.82)	(3.20)	(-1.39)	(-0.65)
Common language	0.862***	0.909***	0.0184	0.0335	1.727***	1.680***
	(3.00)	(3.90)	(0.19)	(0.35)	(4.58)	(5.49)
Time difference	-0.0232	0.00368	0.0268	0.0132	-0.292***	-0.205***
	(-0.38)	(0.06)	(1.08)	(0.51)	(-4.63)	(-3.59)
Regional trade agreement	0.0466	0.0612	0.496***	0.460***	-1.066**	-0.800***
	(0.13)	(0.17)	(3.16)	(2.95)	(-2.35)	(-3.00)
GATT membership	-0.901**	-0.806**	0.166	0.126	-1.823***	-1.697***
	(-2.39)	(-2.20)	(1.03)	(0.76)	(-4.88)	(-5.59)
European Union membership	-0.0704	0.0167	0.171	0.140	0.813	0.757
	(-0.14)	(0.03)	(1.29)	(0.93)	(1.44)	(1.57)
Log of avg. labor productivity		0.105		0.0248		0.283***
		(1.58)		(0.86)		(4.36)
Log of avg. # of employees		-0.210**		0.149***		-0.169*
		(-2.06)		(3.42)		(-1.76)
Constant	7.895***	8.652***	2.325***	1.239	-1.875	-0.726
	(3.54)	(3.90)	(2.84)	(1.39)	(-0.82)	(-0.35)
N	171	170	171	170	171	170
R-squared	0.918	0.924	0.939	0.942	0.891	0.929

Total service exports, number of firms (extensive margin) and average service exports per firm (intensive margin) are the dependent variables. The dependent variables are in levels. z-statistics in parentheses are calculated based on heteroskedasticity robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1A.2: Extensive and Intensive Margins of Imports (PPML-Augmented)

	(1) Total Imports	(2) Total Exports	(3) Extensive Margin	(4) Extensive Margin	(5) Intensive Margin	(6) Intensive Margin
Log of GDP partner	0.808***	0.773***	0.544***	0.549***	0.321***	0.367***
	(11.78)	(9.40)	(24.86)	(24.45)	(5.56)	(6.52)
Log of GDPPC partner	0.340***	0.338***	0.110***	0.121***	0.0243	0.0352
	(3.87)	(4.14)	(2.69)	(3.33)	(0.34)	(0.54)
Log of distance	-0.968***	-0.939***	-0.467***	-0.479***	-0.738***	-0.623***
	(-6.82)	(-7.26)	(-4.84)	(-5.05)	(-3.03)	(-3.66)
Colonial relationship	0.941**	1.023**	0.356**	0.403***	1.506*	1.451**
	(2.13)	(2.42)	(2.41)	(2.84)	(1.93)	(2.01)
Common legislation	0.472	0.417	0.386**	0.319**	-0.460	-0.386
	(1.36)	(1.28)	(2.50)	(2.11)	(-0.84)	(-0.77)
Common language	-0.163	-0.250	0.0357	0.0161	-0.373	-0.257
	(-0.63)	(-0.97)	(0.35)	(0.15)	(-1.08)	(-0.76)
Time difference	0.112*	0.119*	0.0627**	0.0552*	-0.0120	-0.0330
	(1.66)	(1.65)	(2.05)	(1.72)	(-0.21)	(-0.59)
Regional trade agreement	0.529	0.559	0.510**	0.436**	-0.601	-0.417
	(1.30)	(1.39)	(2.52)	(2.14)	(-1.41)	(-1.32)
GATT membership	0.436	0.553*	0.459**	0.402**	-0.513	-0.597**
	(1.30)	(1.70)	(2.50)	(2.35)	(-1.29)	(-2.02)
European Union membership	-0.229	-0.256	0.208	0.175	-0.342	-0.251
	(-0.60)	(-0.73)	(1.12)	(0.97)	(-1.24)	(-0.97)
Log of avg. labor productivity		-0.140**		0.0199		-0.0119
		(-2.16)		(0.79)		(-0.18)
Log of avg. # of employees		0.0499		0.155***		-0.270**
		(0.27)		(3.04)		(-2.33)
Constant	8.783***	9.394***	3.047***	2.007**	10.13***	10.63***
	(6.30)	(5.69)	(3.39)	(2.31)	(4.38)	(5.78)
N	165	161	165	161	165	161
R-squared	0.981	0.982	0.960	0.960	0.379	0.468

Total service imports, number of firms (extensive margin) and average service imports per firm (intensive margin) are the dependent variables. The dependent variables are in levels. z-statistics in parentheses are calculated based on heteroskedasticity robust standard errors. . * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1A.3: Explanation of the Variables used in the Estimations

	Explanations	Variable	Sources	Expected Sign
Dependent Variables	UK firm-level exports to the trading partners (£'000)	Export	ITIS	
	UK firm-level imports from the trading partners (£'000)	Import	ITIS	
	UK firm total exports/imports to/from the trading partners	Total export/import		
	Number of firms exporting and importing	Number of firms		
	Average exports/imports value per firm	Average export/import		
Explanatory Variables	GDP of trading partner (current mn US$)	GDP partner	CEPII	+
	GDP per capita of trading partner (current mn US$)	GDPPC partner	CEPII	+
	Population-weighted great circle distance between large cities of the UK and her trading partners	Distance	CEPII	-
	Number of hours difference between the UK and her trading partner	Time difference	CEPII	+/-
	Dummy variable for colonial relationship; 1 if the UK and her trading partner ever in colonial relationship	Colonial relationship	CEPII	+
	Dummy variable for common legislation; 1 if the UK and her trading partner have common legal origin	Common legislation	CEPII	+
	Dummy variable for Common language; 1 if a language is spoken by at least 9% of the population in the UK and her trading partner	Common language	CEPII	+
	Dummy variable for regional trade agreement; 1 for regional trade agreement in force between the UK and her trading partner	Regional trade agreement	CEPII	+
	Dummy variable for GATT/WTO membership; 1 if the UK and her trading partner are members of GATT/WTO	GATT membership	CEPII	+
	Dummy variable for EU membership; 1 if the UK and her trading partner are members of EU			
	Total number of employees, point in time	# of employees	ARD	+
	Gross value added per employee	Labor productivity	ARD	+
	Research and development engagement dummy: 1 if the firm is engaged in R&D activities	R&D engagement	ARD	+
	Age of the firm	Age of the firm	BSD	+/-
	Dummy for legal status of the firm; 1 is the firm is an LLC	LLC	BSD	+

Table 1A.4: The List of Service Types

Code	Name	Heading
01	Agricultural services	Agricultural, Mining and On-Site Processing Services
02	Mining services	Agricultural, Mining and On-Site Processing Services
03	Waste treatment and depollution	Agricultural, Mining and On-Site Processing Services
04	Other on-site maintenance	Agricultural, mining and on-site processing services
05	Accounting, auditing, bookkeeping, and consulting services	Business and Professional Services
06	Advertising	Business and Professional Services
07	Management consulting	Business and Professional Services/ Business management, consulting...etc
08	Public relations services	
09	Recruitment	Business and Professional Services/ Business management, consulting...etc
10	Other business management services	
11	Legal services	Business and Professional Services
12	Market research and public opinion polling	Business and Professional Services
13	Operational leasing services	Business and Professional Services
14	Procurement	Business and Professional Services
15	Property management	Business and Professional Services
16	Research and development	Business and Professional Services
17	Services between related enterprises	Business and Professional Services
18	Other business and professional services	Business and Professional Services
19	Postal and courier services	Communication Services
20	Telecommunications services	Communication Services
21	Computer services	Computer and Information Services
22	News agency services	Computer and Information Services/Information Services
23	Publishing services	Computer and Information Services
24	Other information provision services	Computer and Information Services
25	Construction in the UK	Construction Good and Services
26	Construction outside the UK	
27	Financial services	Financial Services
28	Auxiliary services	Insurance services
29	Freight Insurance: Claims	Insurance Services
30	Freight Insurance: Premiums	
31	Life Insurance and pension funding: Claims	
32	Life Insurance and pension funding: Premiums	
33	Reinsurance: Claims	
34	Reinsurance: Premiums	
35	Other direct insurance: Claims	
36	Other direct insurance: Premiums	
37	Merchanting	Merchanting and Other Trade- related Services
38	Other trade-related services	Merchanting and Other Trade- related Services
39	Audio-visual and related services	Personal, Cultural and Recreational Services
40	Health services	Personal, Cultural and Recreational Services
41	Training and educational services	Personal, Cultural and Recreational Services
42	Other personal, cultural and recreational services	Personal, Cultural and Recreational Services
43	Use of franchises and similar rights fees	Royalties and Licenses
44	Other royalties and licence fees	Royalties and Licenses
45	Purchase and sales of franchises and similar rights	Royalties and Licenses
46	Purchase and sales of other royalties and licences	Royalties and Licenses
47	Architectural	Technical Services
48	Engineering	Technical Services
49	Surveying	Technical Services
50	Other technical services	Technical Services
51	Other trade in services	Other Trade in Services

Service codes that are not exported in 2005: 30, 31, 32, 34 and 36.
Service codes that are not imported in 2005: 29, 31, 33, 35 and 37.

Table 1A.5: Comparison between Firm-level and Country-level Analyses (without firm characteristics)

	Exports				Imports			
	(1) Firm-level OLS	(2) Country-level OLS	(3) Firm-level PPML	(4) Country-level PPML	(5) Firm-level OLS	(6) Country-level OLS	(7) Firm-level PPML	(8) Country-level PPML
Log of GDP partner	0.262***	0.989***	0.616***	0.612***	0.209***	1.045***	0.809***	0.808***
	(9.42)	(16.10)	(15.14)	(14.78)	(14.49)	(20.10)	(11.80)	(11.78)
Log of GDPPC partner	0.0978***	0.397***	0.516***	0.516***	0.0411	0.143	0.341***	0.340***
	(2.68)	(3.80)	(3.59)	(3.62)	(1.31)	(1.62)	(3.87)	(3.87)
Log of distance	-0.375***	0.0576	-0.569***	-0.569***	-0.240***	-0.848***	-0.966***	-0.968***
	(-5.61)	(0.17)	(-2.74)	(-2.75)	(-4.98)	(-3.08)	(-6.81)	(-6.82)
Colonial relationship	0.294***	0.641**	-0.347	-0.351	0.125	0.793*	0.944**	0.941**
	(2.59)	(2.40)	(-1.15)	(-1.16)	(0.73)	(1.91)	(2.33)	(2.13)
Common legislation	0.0237	0.381	0.732***	0.740***	0.0347	0.925**	0.475	0.472
	(0.25)	(1.47)	(3.48)	(3.50)	(0.22)	(2.19)	(1.37)	(1.36)
Common language	0.0428	0.737***	0.866***	0.862***	-0.00300	0.542	-0.166	-0.163
	(0.50)	(3.16)	(3.00)	(3.00)	(-0.03)	(1.50)	(-0.65)	(-0.63)
Time difference	-0.0214	-0.202***	-0.0265	-0.0232	-0.00417	-0.0906*	0.112*	0.112*
	(-0.71)	(-3.48)	(-0.44)	(-0.38)	(-0.17)	(-1.74)	(1.66)	(1.66)
Regional trade agreement	-0.383**	0.322	0.0435	0.0466	-0.144	0.216	0.540	0.529
	(-1.89)	(0.88)	(0.12)	(0.13)	(-1.00)	(0.69)	(1.33)	(1.30)
GATT membership	-0.380*	-0.805***	-0.910**	-0.901**	-0.0285	-0.0300	0.433	0.436
	(-1.89)	(-2.64)	(-2.41)	(-2.39)	(-0.14)	(-0.08)	(1.29)	(1.30)
European Union membership	-0.258*	0.547	-0.0754	-0.0704	-0.229	0.385	-0.229	-0.229
	(-1.82)	(1.56)	(-0.14)	(-0.14)	(-1.59)	(1.27)	(-0.60)	(-0.60)
Constant	4.717***	1.642	-3.470	7.895***	3.414***	8.754***	-2.701*	8.783***
	(6.96)	(0.58)	(-1.55)	(3.54)	(6.57)	(3.44)	(-1.93)	(6.30)
N	16252	171	15148899	171	13988	165	16219700	165
R2	0.072	0.804	0.002	0.918	0.039	0.813	0.0002	0.981
RESET (p values)	0.000	0.6821	0.8146	0.8360	0.0007	0.7951	0.8098	0.7567

The table is produced from the results given in Table 1.4, Table 1.8 and Table 1.12. Only country-level determinants are considered. The dependent variables are the firm-level and country-level service exports and imports. The log of dependent variable is used in OLS estimations. t-statistics (from OLS) and z-statistics (from PPML) in parentheses are calculated based on heteroskedasticity robust standard errors. p-values of RESET test for the model in each column is provided in the last row. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 1A.6: Comparison between Firm-level and Country-level Analyses (with firm characteristics)

	Exports				Imports			
	(1) Firm-level OLS	(2) Country-level OLS	(3) Firm-level PPML	(4) Country-level PPML	(5) Firm-level OLS	(6) Country-level OLS	(7) Firm-level PPML	(8) Country-level PPML
Log of GDP partner	0.281***	0.936***	0.628***	0.607***	0.225***	0.961***	0.878***	0.773***
	(10.40)	(16.84)	(15.37)	(12.74)	(15.08)	(19.06)	(23.60)	(9.40)
Log of GDPPC partner	0.108***	0.260**	0.549***	0.512***	0.0353	0.0285	0.314***	0.338***
	(2.81)	(2.20)	(4.36)	(3.78)	(1.03)	(0.33)	(3.92)	(4.14)
Log of distance	-0.413***	-0.0509	-0.625***	-0.614***	-0.247***	-0.845***	-1.017***	-0.939***
	(-5.85)	(-0.17)	(-3.39)	(-3.03)	(-5.07)	(-3.20)	(-7.69)	(-7.26)
Colonial relationship	0.366***	0.346	-0.319	-0.414	0.163	0.365	1.167***	1.023**
	(3.39)	(1.19)	(-0.98)	(-1.54)	(0.90)	(0.78)	(2.68)	(2.42)
Common legislation	0.0638	0.354	0.673***	0.744***	-0.0292	0.797*	0.371	0.417
	(0.67)	(1.22)	(2.93)	(3.60)	(-0.18)	(1.81)	(1.05)	(1.28)
Common language	0.0178	0.836***	0.858***	0.909***	-0.00677	0.605*	-0.276	-0.250
	(0.22)	(4.06)	(2.79)	(3.90)	(-0.07)	(1.97)	(-1.28)	(-0.97)
Time difference	-0.0220	-0.173***	-0.0212	0.00368	-0.0109	-0.0789	0.0696	0.119*
	(-0.74)	(-3.12)	(-0.34)	(0.06)	(-0.44)	(-1.65)	(1.16)	(1.65)
Regional trade agreement	-0.368**	0.115	-0.00777	0.0612	-0.219*	-0.195	0.418	0.559
	(-2.18)	(0.36)	(-0.02)	(0.17)	(-1.57)	(-0.64)	(1.05)	(1.39)
GATT membership	-0.402**	-0.750**	-1.006***	-0.806**	0.00939	0.0148	0.408	0.553*
	(-1.99)	(-2.54)	(-2.60)	(-2.20)	(0.05)	(0.05)	(1.13)	(1.70)
European Union membership	-0.311**	0.754**	-0.248	0.0167	-0.203	0.622*	-0.286	-0.256
	(-2.11)	(1.99)	(-0.51)	(0.03)	(-1.23)	(1.75)	(-0.80)	(-0.73)
Log of # of employees	0.379***		0.617***		0.179***		0.607***	
	(24.84)		(15.48)		(11.08)		(20.63)	
Log of labor productivity	0.490***		0.755***		0.271***		0.772***	
	(32.77)		(19.65)		(14.89)		(22.22)	
Log of avg. # of employees		0.187**		-0.210**		0.360***		0.0499
		(2.13)		(-2.06)		(3.21)		(0.27)
Log of avg. labor productivity		0.221***		0.105		0.192***		-0.140**
		(3.66)		(1.58)		(4.40)		(-2.16)
Constant	0.982	0.977	-9.241***	8.652***	0.583	6.588***	-10.05***	9.394***
	(1.37)	(0.37)	(-4.53)	(3.90)	(1.00)	(2.63)	(-6.91)	(5.69)
N	15726	170	14608164	170	13012	161	15528800	161
R2	0.173	0.830	0.001	0.924	0.078	0.850	0.001	0.982
RESET (p values)	0.000	0.1293	0.0199	0.6419	0.000	0.1142	0.4565	0.7895

The table is produced from the results given in Table 1.4, Table 1.8 and Table 1.12. The country-level determinants as well as two firm-level determinants (firm size and productivity) are considered. The average values of firm characteristics are included in the aggregated analyses. The dependent variables are the firm-level and country-level service exports and imports. The log of dependent variable is used in OLS estimations. t-statistics (from OLS) and z-statistics (from PPML) in parentheses are calculated based on heteroskedasticity robust standard errors. p-values of RESET test for the model in each column is provided in the last row. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Chapter 2

Coefficient Heterogeneity in Gravity Equations for Services: Evidence from Quantile and Interaction Regressions[1]

2.1 Introduction

Recent literature in international trade focuses on how the heterogeneity among firms affects their trade decisions. Melitz (2003) combines heterogeneous firm models with international trade theories to explain why international trade induces reallocations of resources among firms in an industry. Expanding Melitz's theoretical model, Chaney (2008) proposes that exporting firms have different characteristics to export to different foreign markets and extensive and intensive margins of bilateral trade flows between countries are affected differently by changing trade costs. The number of firm-level studies has increased in international trade literature in last two decades starting with the pioneering study by Bernard and Jensen (1994) which analyse the role of exporters in manufacturing by comparing their characteristics with non-exporters. Those studies show that although exporting firms have a lower share among all other firms and their exports are highly concentrated in a few markets and on a few products, they are larger and more productive, use more capital-intensive production processes and employ a more highly skilled workforce (Bernard et al., 2007; Wagner, 2007). More recently, Breinlich and Criscuolo (2011), Kelle and Kleinert (2010) and Federico and Tosti (2012) have provided similar stylized facts for firms engaging in service trade.

However, when we consider firms with different characteristics, two types of coefficient heterogeneity in the gravity equation might arise. First, different firm characteristics might cause heterogeneity in

[1]This work was based on data from the International Trade in Services Survey, Annual Respondents Database and Business Structure Database, produced by the Office for National Statistics (ONS) and supplied by the Secure Data Service at the UK Data Archive. The data are Crown Copyright and reproduced with the permission of the controller of HMSO and Queen's Printer for Scotland. The use of the data in this work does not imply the endorsement of ONS or the Secure Data Service at the UK Data Archive in relation to the interpretation or analysis of the data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

which these different characteristics might change the effects of standard gravity variables in the mean of the distribution. In other words, the effect of certain gravity variables would depend on some firm characteristics such as firm size and labour productivity. Second, if firms have different characteristics from lower to higher tail of distribution of trade value, the effects of different variables explaining the trade values by firms alter through the distribution of trade. In other words, if each firm is different from the others throughout the distribution of trade value, then a certain trade determinant would have a different impact on different firms. The coefficient heterogeneity due to different firm characteristics can be determined by interaction regressions. The coefficient heterogeneity across the distribution of exports and imports can be analysed by quantile regressions. Because point estimates such as OLS assume that the conditional distribution of a dependent variable can be explained by only the centre of the distribution for a given set of explanatory variables, in which case it is not possible to observe firm heterogeneity. In international trade literature, there are a limited number of studies which investigate possible parameter heterogeneity in gravity framework. However, especially in service trade literature, there is no study which investigates how the determinants of trade vary along the distribution of trade, or whether firm-level characteristics influence the impact of typical gravity variables. Therefore, in this chapter we first use the interaction terms in order to determine how certain firm characteristics such as firm size and labour productivity affect the impact of different country-level variables such as GDP and distance then employ quantile regression in order to examine the impacts of different country- and firm-level variables at different points of conditional distribution of UK's firm-level service exports and imports. Policies relying on standard trade estimations would be misleading if it is true that each coefficient estimate of gravity variables varies throughout the trade distribution and is influenced by firm characteristics.

Furthermore, international service trade has increased dramatically in the last two decades eliciting analysis of -the similarities and differences between services trade and goods trade-the former resulting in faster growth than the latter. On one hand, according to World Trade Organization (WTO) statistics, world exports in commercial services (services excluding governmental services) stood at 3.7 billion USD in 2010 with an average annual growth rate of more than 15% over the past 20 years. Moreover, this is of significance not only in international trade but also in all economic activities. Nearly 71% of global value added in 2010 was generated in the services sector with a 3% average annual growth rate from 1990 to 2010, and around 45% of total employment originates via service sectors WDI (2011). On the other hand, the UK is one of the leading countries in services trade. According to the WTO (2011), the UK is the third largest exporter and fourth largest importer of commercial services. Besides, the UK Office for National Statistics (ONS) provides a very well established database of firm-level services trade. Therefore, the UK has been chosen for analysis.

The main purpose of this study is to analyse how the firm-level characteristics influence the impact of typical gravity variables and how the determinants of services trade alter along the distribution of trade value in the gravity framework. To this end, the gravity model is estimated by OLS and quantile regression. Possible parameter heterogeneity across the distribution of firm-level exports and imports is investigated by means of quantile regression for five quantiles (10th, 25th, 50th, 75th, and 90th quantiles) while OLS is used as a benchmark estimation. Quantile regressions used for firm-level service exports and imports are applied on margins of service exports and imports as well in order to investigate how the effects of different determinants of exports and imports may alter across the distribution of extensive margin (number of firms) and intensive margin (average trade per firm). In the interaction analysis, OLS estimations with the interaction terms are provided. This enables us to control for size and labour productivity levels of the firms, factors which might influence the impact of different country-level variables such as GDP and distance.

The OLS regressions with interaction terms show that the effects of GDP and distance depend on only firm size in export analysis while both firm size and productivity change the effect of GDP and distance on firm-level imports. According to quantile regression results, the magnitude and significance level of each coefficient are different in each quantile as well as in OLS estimations in both export and import analyses. The findings show that the positive effect of GDP and the negative effect of distance on firm-level service exports and imports become stronger in higher quantiles, showing that firms in higher exports and imports quantiles are affected more by changes in GDP and distance. The results from margins of trade analysis show that the effect of GDP and distance weaken from lower to higher quantiles in the analyses for both exports and imports and their intensive and extensive margins.

The rest of the chapter is organized as follows: Section 2 provides a literature review on gravity equation and quantile regressions as well as their implications on international trade. The methodology and details of the datasets used in the analyses are given in Sections 3 and 4, respectively. Section 5 gives the analysis results from the empirical models. Finally, Section 6 concludes.

2.2 Literature Review

Following the pioneering studies by Timbergen (1962) and Poyhonen (1963), the gravity framework has become one of the most popular models in the international trade literature due to the simplicity of the model. Its high explanatory power and sound theoretical background make it fit the available

data well and provide econometric estimations for the determinants of trade flows. The most basic form of the gravity equation explains bilateral trade flows between any two countries as a function of their economic size and the distance between them. Many studies have improved the model both theoretically and empirically (Anderson, 1979; Anderson and van Wincoop, 2003; Bergstrand, 1989; Deardorff, 1995; Feenstra, 2003; Helpman and Krugman, 1985). There are numerous goods trade studies and a limited but growing number of service trade studies that apply the gravity framework in different countries [2].

Further, the mounting of heterogeneous firm models into the trade models led researchers to focus on firm-level data in both the goods and services trade. Accordingly, firms have different characteristics which determine their trade decisions. Melitz (2003) explains that international trade induces reallocations of resources among firms because of the existence of heterogeneous firms in an industry. In his analyses for 169 countries over the period 1980-1997, Chaney (2005) concludes that market structure differences and firm heterogeneity decrease the effect of trade barriers on export flows. Bernard et al. (2007) and Wagner (2007) are examples of empirical analyses which support the theory showing that exporting firms are larger and more productive, use more capital intensive production processes and employ a more highly-skilled workforce. These analyses have also been applied to trade in services and similar results have been obtained (Ariu, 2010; Breinlich and Criscuolo, 2011; Federico and Tosti, 2012; Kelle and Kleinert, 2010; McCann and Toubal, 2011). The first three of these studies also applies the gravity equation to estimate the determinants of the services trade in Belgium, the UK and Italy, respectively.

Most of the existing studies employ point estimators such as OLS, Tobit or PPML to estimate trade determinants in the gravity framework. Nevertheless, none of them considers possible parameter heterogeneity which might arise due to different firm characteristics or due to the distribution of the trade value. In other words, the existing literature does not fully focus on how the firm-level characteristics influence the impact of typical gravity variables and how the determinants of services trade alter along the distribution of trade value in the gravity framework. On one hand, it might be the case that the effect of certain gravity variables would depend on some firm characteristics such as firm size and labour productivity, which would result different coefficients in the mean of the distribution. Therefore, in this chapter, the determinants of the services trade is estimated by OLS and the effects of firm size and productivity are controlled by including interaction terms in the model. In trade literature, we are aware of two studies which focus on the heterogeneity in the mean of the trade distribution in a gravity context. The first one is Navas et al. (2013) which analyses

[2] See Francois and Hoekman (2010); Freund and Weinhold (2002); Grunfeld and Moxnes (2003); Head et al. (2009); Kandilov and Grennes (2010, 2012); Kimura and Lee (2006); Mirza and Nicoletti (2004); Tharakan et al. (2005); Walsh (2006) for trade in services.

the exports of final goods for Italian firms over the period 1998-2003. They find that firm-level goods exports are more responsive to distance if the effects of imports in intermediate inputs are considered. The second one, by Minondo Uribe-Etxeberria (2010), focuses on the effects on firm size and productivity. However, he tests the hypothesis that trade by larger, more productive and more skill-intensive firms are less impacted by border effects since these firms are more able to cope with the cost of trade. Due to the lack of firm-level data, he uses industry-level goods trade data from EU countries and analyses whether the average industrial firm size, productivity and skill content of the labour force change the impact of the border effect. Results confirm lower coefficients for border effects in the presence of firm characteristics.

On the other hand, if the firms in the lower tail of the distribution are different from the firms in the higher tail, the effects of different variables explaining the trade values by firms alter through the distribution of trade. Point estimates assume that the conditional distribution of a dependent variable can be explained by only the central location of the distribution for a given set of explanatory variables. In this case, it is not possible to observe firm heterogeneity due to the distribution of trade. Therefore, in this chapter we employ a quantile regression approach which enables us to examine the impacts of different country- and firm-level variables at different points of conditional distribution of the UK's firm-level service exports and imports. In the existing micro-level literature, there are studies which consider the effect of trading (mostly exporting) on different firm characteristics such as productivity, wage and size by using quantile regression approach (Dimelis and Louri, 2002; Haller, 2012; Hijzen et al., 2011; Powell and Wagner, 2011; Serti and Tomasi, 2009; Shevtsova, 2010; Trofimenko, 2008; Velucchi and Viviani, 2011; Yasar and Morrison Paul, 2007; Yasar et al., 2006). However, there are only one country-level study and one plant-level study which employ the quantile regression to explain the determinants of trade flows. Wagner (2006) employs quantile regression to examine the impact of plant characteristics on the export intensity of German manufacturing. Moelders (2011) uses quantile regression in the gravity framework in order to show potential heterogeneous effects along the trade volume levels. However, the main aim of the study is to reveal the high level of heterogeneity of the trade-creating effect of trade agreements along the trade volume and per-capita income distributions.

In particular, in the service trade literature, there is no study (to the best of our knowledge) which investigates the possible parameter heterogeneity in gravity frameworks. This is the first study which considers the parameter heterogeneity due to the distribution of the services trade and different firm characteristics. Taking into account this deficiency in the existing literature, this study contributes to the literature by applying quantile and interaction regressions to detect possible parameter heterogeneity. It analyses firm-level service exports and imports in the UK taking

into account both country and firm-level factors. The quantile regressions allow us to explore how the determinants of services trade alter along the distribution of trade value while the interaction regressions enable us to investigate how the firm-level characteristics influence the impact of typical gravity variables. Given that the UK is among the largest service traders in world trade and the ONS provides very well-established datasets in firm-level, the UK has been chosen for the analyses.

2.3 Empirical Framework

In this study, an augmented version of the gravity equation is used in the analyses:

$$\ln T_{ids} = \beta_0 + \beta_1 \ln GDP_d + \beta_2 \ln dist_{id} + \sum_{f=1}^{m} \gamma_f \ln F_i + \sum_{j=1}^{k} \ln D_{id,j}^{\beta_j} + \epsilon_{ids} \tag{2.1}$$

Equation (2.1) defines the export (import) flows by firm i to (from) the destination (the origin) country d in service type s (T_{ids}) as a function of commonly used gravity equation variables and some firm characteristics. In the right-hand side of the equation, the second and third terms are standard gravity variables. F_i is the set of firm variables including firm size and productivity. Finally, $D_{id,j}^{\beta_j}$ is the set of dummy variables for certain country and firm characteristics such as common language, common legislation, colonial relationship, research and development (R&D) activities, and legal status of the firm. The details of the variables that are used to estimate the determinants of the firm-level trade flows are given in Section 4.

Equation (2.1) is estimated by both OLS and quantile regressions. In OLS regressions, we include interaction terms between firm-level variables (i.e. firm size and labour productivity) and standard gravity variables such as GDP and distance. This enables us to discover the changing impact of GDP and distance on firm-level exports and imports when the firms are different from each other in terms of size and labour productivity. In quantile regressions, the main purpose is to examine the impacts of different country- and firm-level variables at different points of conditional distribution of the UK's firm-level service exports and imports. If the impacts of certain variables are heterogeneous throughout the distribution of the trade value, then the results from the conditional mean analyses might provide misleading predictions. The traditional point estimates assume that the conditional distribution of a dependent variable can be explained by the centre of the distribution for a given set of explanatory variables. In this case, it is not possible to observe firm heterogeneity. However, the quantile regressions enable us to examine how the determinants of service trade alter along the distribution of trade value. Quantile regressions are used for both firm-level service exports

and firm-level service imports as well as margins of service exports and imports. Estimation of trade margins with quantile regression facilitates our investigation of how the effects of different determinants of exports and imports may alter across the distribution of different margins.

In the following subsections, we give the details of the quantile regression and the above mentioned estimations.

2.3.1 Quantile Regression

Most of the empirical studies focus on average causal effects. Under certain assumptions, the conditional mean models are easy to apply and interpretation of the estimates is straighforward.

However, the mean cannot explain the entire distribution of a dependent variable unless it is a dummy variable. For non-dummy dependent variables, the conditional mean framework has certain drawbacks. Firstly, it does not provide information for the non-central location of the data. Nonetheless, in dealing with imports and exports incurred by a large set of firms, a point estimate such as OLS may not be representative of the whole distribution. Secondly, the assumptions for the conditional mean framework might be violated in most of the cases. In our case, trade values vary from nil to infinity. Therefore, the homoskedacticity assumption in particular might be violated. The conditional mean is misleading and inappropriate in the presence of outliers. Finally, the distribution of a variable cannot be characterized by the central location alone. The scale, the skewness and other higher-order properties should be considered as well (Hao and Naiman, 2007). In order to model the entire distribution, quantile regression is a powerful tool. It models conditional quantiles as a function of explanatory variables and specifies the change in the conditional quantile associated with a change in the explanatory variables. It has been introduced by Koenker and Bassett (1978) and used in social sciences in many different subjects such as wage inequality, the quality of schooling and public health. In the case of trade, we believe that certain characteristics of firms determine the level of exports and imports incurred by each firm, therefore it is of great importance to consider different points across the distribution of exports and imports.

Suppose we are interested in the distribution of a continuous random variable, y_i (in our case, trade values), which is explained by a vector of regressors, X_i where it includes all explanatory variables defined in equation (2.1):

$$y_i = X_i'\beta_\tau + \epsilon_{\tau i} \tag{2.2}$$

where β_τ is the vector of parameters to be estimated, and $\epsilon_{\tau i}$ is a vector of residuals. In order to explain the entire distribution, equation (2.2) is defined as a quantile regression model by Koenker and Bassett (1978) as follows:

$$Q_{y_i}(\tau \mid X_i) = X_i'\beta_\tau \tag{2.3}$$

In equation (2.3), $Q_{y_i}(\tau \mid X_i)$ is the τth conditional quantile of y given X. For the τth quantile and for $0 < \tau < 1$, the quantile regression solves the following problem:

$$Q_{y_i}(\tau \mid X_i) = \arg\min_b E[\rho_\tau(y_i - X_i'b)] \tag{2.4}$$

where $\rho_\tau(u) = (\tau - 1(u \leq 0))u$ is called the "check function". It asymmetrically weights positive and negative terms to generate a minimization process that picks out conditional quantiles: $\rho_\tau(u) = 1(u > 0) \cdot \tau|u| + 1(u \leq 0) \cdot (1 - \tau)|u|$ (Angrist and Pischke, 2009).

The quantile regression parameter, β_τ, gives the change in a certain quantile of dependent variable by a one unit change in the explanatory variable. This allows us to see how some of the percentiles of the dependent variable might be more affected by the determinants than the other percentiles. If equation (2.1) is estimated by a point estimator and then there is unobserved heterogeneity, then the parameters estimated might not be representative of the entire distribution of trade values (Dimelis and Louri, 2002). In the context of the determinants of firm-level services trade, the unobserved heterogeneity may arise from some firm characteristics such as initial endowments and skills of employees that we do not observe in our data. In the presence of unobserved heterogeneity, quantile regression performs better. Moreover it provides robust estimators with outliers and heavy-tailed distribution. The estimator is invariant to outliers of the dependent variable that tend to $\pm\infty$. Compared to OLS, more robust estimators are obtained when the normality assumption is violated (Bartelsman et al., 2014). Neither firm-level exports nor firm-level imports in the UK are normally distributed in the context of this study. Figures 2.1 and 2.2 demonstrate histograms of exports and imports in logs with both normal and Kernel density plots. The deviations from normality is bigger for exports and imports in levels (not presented here). Additionally, the quantile regression relaxes the identically distributed error terms assumption. Error terms can be different at different points of the conditional distribution. This also allows us to control for individual heterogeneity since we obtain different parameters for different quantiles of the conditional distribution (Velucchi and Viviani, 2011).

Considering that quantile regression provides more information about the distribution of trade values, in the current study the quantile regression approach has been used [3]. However, OLS is used as a benchmark estimation. In order to consider firm heterogeneity and to examine how the effects of different determinants of firm-level exports and imports may vary throughout the distribution, we estimate equation (2.1) by quantile regression.

2.3.2 Interaction Terms

Although most of the studies in firm-level trade literature analyse the impact of exporting/importing on firm size and productivity, there are some studies which consider the reverse relation [4]. These studies confirm that firm size and productivity levels has significant and positive impact on firm-level trade (Eickelpasch and Vogel, 2009; Love and Mansury, 2009). Accordingly, larger and more productive firms are more export oriented showing the self-selection effects of more successful firms into exporting. As found by Bernard et al. (2007) and Wagner (2007), if the exporting firms are larger and more productive, it is important to examine how firm size and productivity affect the impact of other variables on trade values. To this end, interaction terms have been added to the OLS estimations. The main explanatory variables of the gravity equation (GDP and distance) are interacted with the number of employees variable and the labour productivity variable in order to control for firm size and firm productivity, respectively. It is expected that the positive effect of GDP becomes larger as firm size and productivity increases since those firms are able to provide more product varieties. On the other hand, the negative effect of distance is expected to shrink for larger and more productive firms because they are better able to handle increasing trade costs as they access more distant destinations. The main purpose of these analyses is to support the results obtained from quantile regressions. Therefore, Table 2A.1 is constructed to show how the firms in each (unconditional) quantile differ from each other in terms of size and productivity. The table provides the employment and productivity levels of firms in each quantile of exports and imports. According to Table 2A.1, from lower to upper quantiles of exports and imports, labour productivity increases. Although the employment level changes in each quantile, we observe that average employment in the 90th quantile is four times larger than in the 10th quantile for exports and it is two times larger for imports.

[3] The STATA module *qreg2* by Machado et al. (2011) has been used to perform quantile regression with robust and clustered standard errors.

[4] The current study does not investigate the direction of the causality. It only focuses on the effects of firm characteristics on services trade.

2.3.3 Margins of Trade

This part of the study investigates how the effects of different determinants of exports and imports may alter across the distribution of different margins. There are different definitions of margins of trade in the trade literature. Following Bernard et al. (2009), the existing firm-level services trade studies mostly decompose total trade into *the number of firms* and *the number of traded products* as extensive margins and *average export or import value per firm per product* as intensive margin (Ariu (2010) [5]; Federico and Tosti (2012); Breinlich and Criscuolo (2011)). Following these studies, we also analyse country variations for UK services trade. To this end, we aggregate UK firm-level service exports and imports up to the country-level and decompose the effects of explanatory variables into the extensive and intensive margins. However, we define the extensive margin only as *number of firms* considering the estimation problems related to *the number of products* stated in Silva et al. (2014). According to Silva et al. (2014), extensive margins such as *number of sectors* or *number of products* are bounded and, when they are used as the dependent variable, the partial effects of the explanatory variables on the conditional mean of the dependent variable is not constant and they approach zero as the dependent variable approaches the bounds. In such cases, conducting estimation approaches such as those given above would yield misleading estimates. In the context of service trade, there are 46 service types that the UK exports and imports with her trading partners. With some countries such as Germany, the UK might trade in all service types, which results in the aforementioned problem. Therefore we decompose total exports (imports) to (from) country d into *the number of firms* (n_d) trading with that country (extensive margin) and *the average export (import) value per firm* ($\bar{t}_d$) (intensive margin): $T_d = n_d * \bar{t}_d$. We estimate equation (2.1) for each margin of exports (imports) by OLS and quantile regression.

In the first part of the analyses, we estimate the gravity equation for firm-level exports in the UK by OLS and quantile regressions. In the OLS analysis, we add interaction terms to investigate how the effects of GDP and distance vary depending on firm size and productivity. In order to detect possible coefficient heterogeneity across the distribution of firm-level export as well as margins of exports, quantile regressions have been used in a gravity framework. Estimating the gravity equation with both datasets allows us to look at how the potential parameter heterogeneity in aggregate data might differ from the potential parameter heterogeneity in firm-level data. This is because the policies relying on aggregate data would be misleading if the trading firms have different characteristics. The estimations have been repeated for 5 quantiles (10th, 25th, 50th, 75th, and 90th quantiles) and OLS is used as a benchmark estimation. In order to deal with correlated residuals across countries,

[5] Ariu (2010) considers three extensive margins (number of service types, number of transactions and number of firms).

country clusters are used to obtain cluster corrected standard errors in all firm-level analyses. In the second part of the analyses, we repeat all the analyses mentioned above for firm-level imports in the UK. Finally, the last part of the analyses contains the margins of trade analysis.

2.4 Data [6]

In this part of the study, we provide information of the databases, followed by the data management process. Then, we present detailed description of the variables that are used in the analyses.

2.4.1 Data Sources

This study considers both country- and firm-level factors in order to detect the heterogeneous impacts of different variables on the firm-level services trade in a gravity framework. To this end, several data sources are used. The main data sources are surveys on the UK private sector companies conducted by the ONS. Each survey contains Inter-Departmental Business Register (IDBR) reference numbers which are anonymous but unique reference numbers assigned to the business organizations. This allows us to combine different surveys.

The main data source used in this study is the UK's International Trade in Services Inquiry (ITIS). ITIS data is collected from a number of different surveys and administrative sources. The sample size of the survey is roughly 20,000 firms (from 2001 onwards, prior to which it was approximately 10,000). However, when the nil returns (the firms which do not report international transactions) are considered, the data provides service exports and imports figures of around 5,000 firms for 46 different types of services classified by country of origin and destination for over the period 1996-2005. The companies with over 10 employees have been included in the inquiry. ITIS provides information on producer services and excludes travel and transport, some banking, financial and legal services, higher education and film and television companies. Since the firms included in surveys change every year and the highest number of firms was covered in 2005, this study focuses on the data from 2005 only.

Firm specific variables are obtained from the Annual Respondent Database (ARD) and the Business Structure Database (BSD). The ARD provides structural variables for firms. It is constructed from a compulsory business survey which is based on the Annual Business Inquiry (ABI) from 1998 onwards. This dataset is created for the Economic Analysis and Satellite Accounts Division for

[6] This section of the study mostly benefits from the first chapter of my dissertation (Determinants of Trade in Services: Evidence from UK Firm-Level Data using a Gravity Equation Approach).

research purposes. To create the ARD, the other surveys are converted into a single consistent format linked by the IDBR reference over time. The data encompasses many variables such as employment, turnover/output, capital expenditure, intermediate consumption, gross value added (derived), postcodes, industrial classification, owner nationality, acquisitions and disposals of capital goods for both smaller and larger businesses (depending on the year, firms with more than 100 or 250 employees). To control for firm specific characteristics, variables for firm size, productivity and research and development (R&D) engagement have been used in the analyses from the ARD. On the other hand, other firm characteristics such as firm age and legal status are obtained from the BSD. The BSD contains a small number of variables for almost all business organisations in the UK for the period 1997-2010. The purpose of the BSD is to create a version of the IDBR for research use, reflecting a wide variety of firm demographics. Specifically, the BSD aims to embody the following characteristics: record the life span of enterprises; takeovers and mergers; account for restructuring/changes in enterprises; identify accurately births and deaths and improve demography statistics and allow historical analysis. As additional firm characteristics, the firm age variable has been generated from *birth* and *death* variables and being a Limited Liability Company (LLC) dummy is generated from the *legal status* variable provided by the BSD.

The last data source that is used in this study is the CEPII Gravity Database. This is a freely available dataset generated by Head et al. (2010). In order to analyze the country- and firm-level determinants of trade in services for the UK using the gravity equation, data sources providing country-level data are combined with the firm-level datasets given above. All country-level variables except dummy variables for European Union (EU) membership (GDP and GDP per capita of the trading partner; distance and time differences between the countries; dummies for colonial relationship; common language; common legislation; regional trade agreement; and GATT (WTO) membership) are obtained from the CEPII Gravity database.

2.4.2 Data Management Process

The ITIS covers almost all service traders with over 10 employees. Those firms are trading with 213 countries in 46 service types in 2005. For the same year, the ARD reports variables for firm characteristics for over 50,000 observations. Each observation resembles an individual business that returns the questionnaries sent out by the ONS. These firms operate under 8 different sectors classified according to the UK Standard Industrial Classification of Economic Activities 1992 (SIC92): catering, construction, motor trades, production, property, retail, other services, and wholesale. After merging these two databases as well as the gravity dataset, we obtained exports and imports

datasets: 1,754 firms exporting to 181 countries in 46 service types and 1,909 firms importing from 177 countries in 46 service types.

In order to estimate firm-level services trade determinants throughout its distribution, we combine country-level data with firm-level data. In other words, we investigate the effects of country characteristics on firm-level exports and imports. With such data, the true inference can be obtained if and only if the random disturbances in the regression are independent within the groups. If the disturbances are correlated within the groups (countries, in our case) that is used to merge firm-level data with country-level data, then even small levels of correlation can cause poor inference because of the downward biased standard errors (Moulton, 1990). In the case of within-group correlation, cluster corrected standard errors can be used to improve the inference (Angrist and Pischke, 2009). In our case, the dependent variables are firm-level exports and imports while the main explanatory variables of interest vary only at country level. It is expected that firms trading with a certain country might share some unobservable characteristics which would lead the regression disturbances to be correlated. Therefore country-cluster corrected standard errors are used in all models.

2.4.3 Variable Description

To examine the possible heterogeneity in the impacts of certain determinants of service exports and imports in the UK, the transaction values (1,000 £) of exports and imports have been used as dependent variables. To explain variations in firm-level exports and imports, the followings have been employed as explanatory variables: GDP and GDP per capita of trading partner, distance and time differences between the countries, dummies for colonial relationship, common language, common legislation, regional trade agreement and GATT membership, firm size, firm age, productivity of firms, legal status indicator and a dummy for R&D engagement. The details of all the variables including the expected sign of the explanatory variables are given in Table 2A.2. In this section, we discuss the main gravity variables and the expected changes in their signs in different quantiles of exports and imports.

GDP and GDP per capita of trading partners are the proxies of economic size and development level. GDP of partners is expected to have a positive impact on UK firm-level exports and imports because it refers to the potential demand and production in a country. The changing coefficient for GDP across the distribution of trade would inform us of the composition of firms and service types in each quantile. For example, if a service type that is exported to a country is specific to the consumers in that country, then changes in GDP of the partner would not affect exports. Therefore, a quantile which includes this type of services will have a flatter slope than the others.

A positive sign is also expected for GDP per capita of the partner country. Helpman and Krugman (1985) suggest that higher GDP per capita corresponds to higher capital intensity in a country, showing that it is a developed country. Thus, it is expected that a country with higher GDP per capita has higher imports and exports. Bergstrand (1990) investigates the effect of GDP per capita on exports and imports separately. According to Bergstrand (1990), GDP per capita of exporter is a proxy for the capital-labour ratio but it represents per capita income for the importer country. Therefore, if a trading partner of the UK has higher GDP per capita income, then imports in the UK would be higher due to a higher capital-labour ratio in the exporting country and exports in the UK would be higher due to demand for greater variety in the importing country. Moreover, the Linder hypothesis suggests that GDP per capita is an important determinant of tastes and that trade volumes are larger across countries with similar income levels. Fieler (2011) predicts that as GDP per capita increases in a country, the consumers tend to consume higher quality goods and the producers tend to produce higher quality goods. High-quality goods are mostly more differentiated, therefore, if a trading partner of the UK has higher GDP per capita income, then it is expected that they will trade more differentiated goods. Therefore, if the coefficient of GDP per capita varies throughout the distribution of the trade values, this would enlighten us about the development level of the trading partner compared to the UK. In a certain quantile, if the impact of GDP per capita is stronger, then this would tell us that this quantile might consist of mostly countries with similar income levels to the UK.

Finally, as in goods trade literature, distance variable is also expected to have negative impact on service trade. However, we expect to obtain a stronger negative relationship between distance and service exports/imports than the relationship with goods exports and imports because of the non-storability property of services which required physical proximity between service producer and consumer. The population-weighted great circle distance between large cities of the UK and her trading partners has been used as a proxy of transportation cost for trade following Mayer and Zignano (2006). To see the net effect of geographical distance, we eliminate the effects of other factors that affect firm-level services trade. To this end, we include dummies for common language, common legislation, regional trade agreement and GATT membership, and colonial relationship. We also add time differences between the UK and her trading partner as a proxy for trade cost. In quantile regressions, we expect different coefficients in different quantiles since each quantile consists of different firms. Again, the coefficient of distance would tell us about the service type. In quantiles with more homogeneous services, a higher coefficient for the distance variable is expected because, for such services, small price changes would lead higher changes in trade.

2.4.4 What do data say?

In Tables 2A.3 and 2A.4, the number of observations is sorted according to export and import quantiles. Then, for each quantile, the number of firms, the number of countries, average GDP of partner countries, and average distance between the UK and the partner countries are presented. Finally, the last two rows in the tables provide the share of observations exporting (importing) to (from) the countries; in the first line, the distance is less than 2,000 km whereas in the second line it is more than 10,000 km. Table 2A.3 shows that both the average GDP of partner countries and the average distance to the partner countries increase from lower to higher quantiles. For importing firms (Table 2A.4), the average distance to the partner countries decrease from lower to higher quantiles. The average GDP of importing countries does not have an increasing or decreasing pattern, however it is 50% higher in the 90th quantile than in the 10th quantile. The share of observations that are trading with close countries is almost the same in each quantile for both exports and imports, however, unexpectedly, the share of observations that are trading with distant countries decreases from lower to higher quantiles.

Figures 2.6 to 2.8 are constructed based on unconditional quantiles of service exports and imports. Firms in each quantile have been classified according to their size. Small firms are those that have fewer than 50 employees. Medium-sized firms have between 50-250 employees. Finally, large firms have more than 250 employees. The figures show that the share of large firms is higher in higher quantiles of service exports and imports, and those firms trade with few countries which are relatively closer. Panel A of Figure 2.6 shows the number of different sized firms in each quantile. According to the figure, the number of exporting firms is lower in the 10th and 90th quantiles on the one hand, and, on the other hand, the higher quantiles mostly contain medium and large firms. The share of small firms in the lowest quantile is higher than the share of small firms in the highest quantile. As shown in Figure 2.7 panel A, the average distance to the destination countries depicts decreases from lower to higher quantiles. This is more obvious for the large firms. Large firms in higher quantiles prefer to export to relatively closer destinations. Finally, firms in the higher quantiles export to fewer countries, as shown in Figure 2.8 panel A. Each graph's Panel B repeats the same analysis for importing firms. Accordingly, the number of importing firms is higher in the middle quantiles and, in addition, all the quantiles mostly contain medium and large firms as in the higher export quantiles. Panel B of Figure 2.7 shows that the average distance to the origin countries does not change. However, the data tells us that, in the 90th quantile, small firms import from more distant countries. Finally, as found for exporting firms, the number of destinations that firms import from decrease from lower to higher quantiles as shown in Figure 2.8 Panel B (except the small firms).

2.5 Analysis

In order to examine the effects of different determinants of the services trade at different points of the conditional distribution of trade values, and to show how these effects are changing depending on firm size and productivity, we employ quantile regression and OLS regressions with interaction terms. In the first part of the analyses, we estimate the gravity equation for firm-level exports in the UK by OLS and quantile regression. In the OLS analysis, we add interaction terms to investigate how the effects of GDP and distance change depending on firm size and productivity. Quantile regression has been used in order to detect possible parameter heterogeneity across the distribution of firm-level exports. Quantile estimations have been repeated for five quantiles (10th, 25th, 50th, 75th, and 90th quantiles) and OLS is used for benchmark estimation [7]. Country clusters are used to obtain cluster corrected standard errors in all firm-level analyses [8]. In the second part of the analyses, we repeat the aforementioned analyses for the firm-level imports in the UK. In the last part of the analyses, the quantile regressions applied to firm-level service exports and imports are repeated for margins of service exports and imports to investigate how the effects of different determinants of exports and imports may alter across the distribution of different margins.

2.5.1 Firm-level Export and Import Analysis

In this part of the study we present the results from quantile regression and OLS with interaction terms from firm-level exports and imports analyses. Results will be given for exports and imports respectively.

2.5.1.1 Export Analysis

To interpret the coefficients obtained from export analyses, it would be helpful to use a standard firm-level revenue equation derived from a CES demand system under the assumption of monopolistic competition [9]:

[7] We are aware that the OLS results and quantile results are not fully comparable because the OLS estimation of log-linearized form of gravity equation suffers from Jensen's inequality (Silva and Tenreyro, 2006). However, because of the computational problems regarding the quantile regressions with excess numbers of zeros in our dataset, we exclude zeros and instead of PPML, we use OLS as benchmark model.

[8] Our dataset consists of approximately 16,000 observations for more than 1,700 service trading firms. If the firm fixed effects are added into the models, there would be more than 1,700 parameters to be estimated. The literature on the incidental parameters problem suggests that an estimator of the p parameters can only have an asymptotically normal distribution if $\lim_{N\to\infty} \frac{p^2}{N} = 0$. (Hahn and Newey, 2004; Portnoy, 1988). In our case, $\frac{p^2}{N} \cong 180$, which means that the number of observation per firm is not enough to estimate more than 1,700 parameters according to the size of our dataset. Therefore, we do not include firm fixed effects in regressions.

[9] The derivation of the equation is given in Appendix B

$$X_{ids} = (\frac{\sigma}{\sigma-1})^{1-\sigma}(dist_{id}^{\alpha_0} \times e^{\sum_{j=1}^{k} D_{id,j}^{\beta_j}})^{1-\sigma} w_i^{1-\sigma} \gamma_i^{\sigma-1} PE \tag{2.5}$$

The equation (2.5) defines the export flows by firm i to the destination country d in service type s (X_{ids}) as a function of commonly used gravity equation variables and some firm characteristics (i.e. wages, productivity). In the log-linear form of the equation (given in equation (2.4)) for trade flows), the GDP of the trading partners is used as the proxy of the total expenditures ($E = wL$) and the CES price index ($P = \sum_{i=1}^{n} p_i^{1-\sigma}$). The equation suggests that the impact of the distance variable depends on two parameters: the elasticity of substitution (σ) and the distance elasticity of trade costs (α_0) [10]. This implies that even though the distance elasticity of trade cost is low, the impact of distance might still be very high if the service type is not differentiated. Within the OLS models with interaction terms, the equation helps us to determine the type of services traded by smaller or larger firms. If the coefficient of distance variable increases as firms become larger, this might suggest that larger firms are producing mostly homogeneous services, therefore σ is higher and the coefficient of the variable is expected to become larger.

Before the results from quantile regressions, we present the results from OLS regression with interaction terms in order to show how the coefficients of certain determinants might change depending on the size and productivity level of firms. The main gravity variables (GDP and distance variables) have been interacted with number of employees and labour productivity variables to this end. In fact, Table 2A.1 shows that employment and productivity level vary in each quantile of exports and imports. According to Table 2A.1, from lower to upper quantiles of exports and imports, labour productivity increases. Although the employment level changes in each quantile, we observe that average employment in the 90th quantile is four times larger than in the10th quantile for exports and two times larger for imports.

Table 2.1 presents OLS regressions with interaction terms for firm-level exports. These analyses are repeated with additional firm characteristics and shown in Table 2.3. Each table consists of seven columns. The first column presents OLS results without interaction terms. In columns 2-4, the distance variable is interacted with number of employees and labour productivity to control for size and productivity, while, in the last three columns, GDP variable is interacted with size and productivity. According to Table 2.1, only the interaction terms with firm size have significant effects, showing that the effects of GDP and distance on firm-level service exports depend on value of firm size but labour productivity has no any significant effect. The negative impact of distance and

[10] The dataset provides a "gross wages and salaries" variable. It has been used as a proxy of "wages" in equation (2.5). However, the coefficients are insignificant and negligible in all quantiles. Excluding this variable did not affect the impact of other variables.

the positive impact of GDP grow across levels of firm size. In terms of GDP, the growing coefficient suggests that large firms can have access to more markets with different service types. The dispersion in market access brings GDP into prominence. In terms of distance, the growing coefficient might imply that large firms are mostly mass-producers. They are exposed to more competition due to the higher elasticity of substitution which makes the impact of distance stronger. On the other hand, smaller firms are exporting to small markets in which a specific service type is focused. Therefore, the coefficient of the distance variable is smaller due to the exports of more differentiated service types by small firms. These findings regarding the effect of firm size on the impact of distance are in line with the revenue equation which suggests that the impact of the distance variable is explained by not only the distance elasticity of trade cost but also the elasticity of substitution. As firms become larger it is expected they will find it easier to handle trade costs, however, this does not guarantee that the impact of distance will be lower. Depending on how differentiated the service type is, the result may vary. In Table 2.3, additional firm characteristics have been added to the models. Accordingly, when we control for the firm characteristics, similar to the results from analysis without firm characteristics, the negative effect of distance and the positive effect of GDP become stronger as firm size increases. However, productivity does not have a significant impact on the effects of GDP and distance in all models except in column 3. The model that only controls for the productivity level of the firm suggests that more productive firms are affected less by increasing distance.

Quantile regressions for firm-level exports are given in Table 2.5 where Figure 2.3 displays the changes in coefficients of significant variables throughout the distribution of exports. In the table, Column 1 and 2 provide OLS estimations with and without firm-level variables. According to Table 2.5, the positive effect of GDP and the negative effect of distance on firm-level service exports vary over the quantiles in estimations both with and without firm-level variables (see Figure 2.3). In the models without firm-level variables, the effect of GDP exhibits increases through the higher quantiles while the effect of distance reaches its maximum in the median. However, the effect in higher quantiles is still higher than the lower quantiles. This suggests that firms in higher quantiles are more affected by changes in GDP and slightly more affected by changes in distance. One possible reason for the flatter slope for GDP in the lower quantiles can be the type of services exported by the firms in these quantiles. If these services are very specific and demanded by a certain type of consumers in each country, their demand would not vary much by changes in GDP. On the other hand, the stronger response of firms to the changing GDP in higher quantiles might be explained by the composition of service types. As shown in Table 2A.3, the market size of trading partner grows where the average GDP increases from lower to higher quantiles (unconditional quantiles). Since the average GDP of the partners is higher in the higher quantiles, those firms not only export many types of services but also start to export new service types because of increasing demand. The coefficient of GDP exhibits

a similar pattern in models with additional firm-level variables. The coefficient estimated by OLS in these models is higher than the one obtained from OLS estimation without firm-level variables. Quantile regression estimates are different from OLS and higher than quantile regression estimates without firm-level variables above the 25th quantile.

In terms of the distance variable, OLS estimations predict a lower coefficient in the model without firm variables compared to the one with firm variables. In other words, the effect of distance becomes stronger when we control for firm characteristics. As distance increases, firm-level exports decrease, however the upper quantiles are steeper than the lower quantiles showing that the firms in higher quantiles are more harmed from an increase in distance between countries. The increasing impact of distance is clearer in the quantile regressions with firm characteristics (see Figure 2.3). The distribution of export value gets narrower as the distance increases implying that the distance between the UK and her trading partner is decreasing in higher quantiles. One possible explanation would be the composition effects in terms of both firms and service types. First, when distance is very low, almost all firms export and higher quantiles contain better firms with relatively higher export values. If the distance increases, firms in higher quantiles shift down to the lower quantiles with relatively lower exports and the better ones remains in higher quantiles. Therefore, the higher quantiles contain firms which always export. However, as distance goes up, only the better exporting firms survive in the lower quantiles; the ones with lower export value leave the market. Since the change in distance mostly affects the firm composition of lower quantiles, and only better firms manage to survive, the impact of distance in lower quantiles is smaller. Second, it might be the case that firms in higher quantiles are similar to each other while in lower quantiles firms are more heterogeneous in terms of the service types they export. Lower quantile firms tend to export more differentiated services while higher quantile firms export more homogeneous services, therefore those firms in the higher quantile are more affected by changing distance. Small changes in the price of these services cause large decreases in exports. However, as distance increases, they do not leave the market but move to a lower quantile.

Other trade cost variables such as time differences between countries, common language and common legislation are insignificant in all quantiles, as found in OLS estimations. Common legislation and common language variables are significant only in 25th quantile regression with additional firm-level variables although the common language variable has an unexpected sign. The effect of GDP per capita depicts a slight increase from lower to higher quantiles and it has an insignificant effect in the 10th quantile showing that firms in this quantile are not affected by the development level of the trading partners. The Linder hypothesis suggests that the GDP per capita is an important determinant of tastes in countries and trade volumes are larger across countries with similar income

levels. As GDP per capita increases in a country, consumers tend to increase the demand for different varieties (Ramezzana, 2000). The stronger effect of GDP per capita for the firms in higher quantiles might be because of the increasing similarities with the trading partners. The country content that the UK firms are exporting to in the higher quantiles are similar to the UK in terms of income level which leads the firms to export more as GDP per capita increases. Regional trade agreements, EU and WTO membership dummies have significantly negative effects on firm-level exports in all quantiles except the 10th quantile. The negative effects of these variables increase for higher quantiles. Models extended with additional firm-level variables have a similar pattern as in models without firm-level variables. The effects of all firm-level variables except R&D engagement and the LLC dummy are higher for higher quantiles. The effects of firm size and labour productivity become stronger in higher quantiles, however, both reach their maximum in the 75th quantile. Larger and more productive firms exhibit very different levels of exports. Firms in higher quantiles are not affected by R&D engagement and its impact is stronger for lower quantiles. Finally, the effect of being an LLC is changing over different quantiles, and the effect is significantly positive.

2.5.1.2 Import Analysis[11]

The results from OLS regressions with interaction terms for import analyses are given in Table 2.2 and Table 2.4. Each table consists of seven columns. The first column presents OLS results without interaction terms. In columns 2-4, the distance variable is interacted with the number of employees and labour productivity to control for size and productivity while in last three columns, GDP variable is interacted with both size and productivity. According to Table 2.2, all interaction terms except the coefficient of $Size * Distance$ in Column 4 have significant effects showing that the effects of GDP and distance on firm-level imports depend on the value of firm size and productivity. The negative impact of distance grows across levels of firm size and shrinks as labour productivity increase. In column 4, we control for size and productivity together. In this model, firm size does not have any significant impact on the effect of the distance. The impacts of size and productivity are opposite when we consider the GDP variable. The positive impact of GDP grows across levels of firm size while more productive firms are less affected by an increase in the GDP. This implies that as firms becomes larger, GDP and cost of imports matter more but as firms become more productive, distance and GDP matter less. In Table 2.4, additional firm characteristics have been added to the models. The results are in line with the results from analysis without firm characteristics. For larger firms, distance and GDP have a stronger impact whereas for more productive firms, distance and

[11]Most of the literature on import demand models explains imports as a function of GDPs of countries; domestic price index; and import price index (Deyak et al., 1993; Feleke and Kilmer, 2007; Murray and Ginman, 1976; Narayan and Narayan, 2010). Due to the lack of information on prices, we employ equation (2.1) to estimate import flows in the gravity framework.

GDP have weaker effects. Similarly to the analysis without firm characteristics, in column 4, the interaction term between distance and firm size becomes insignificant.

Quantile estimations for firm-level imports are presented in Table 2.6 and Figure 2.4. The first two columns give OLS estimations with and without firm-level variables. As the figures show, all coefficients from statistically significant variables are different in each quantile as well as in OLS estimations. According to Table 2.6, among country-level variables only GDP and distance variables have significant effects on firm-level imports. The effect of GDP becomes stronger for higher quantiles although above median the change in the coefficient is limited. The negative effect of distance is around 2% for the import levels below the median. This effect increases by nearly 60% for the 75th and 90th quantiles, implying that firms in higher quantiles are affected more by increasing trade costs than firms in lower quantiles. As found in the export analysis, the distribution of the import value becomes narrower as distance increases and wider as GDP increases. Firms in higher quantiles are able to import more as the GDP of the partner country increases. One possible explanation is the Armington assumption which explains the degree of elasticity of substitution between domestic and imported products. Firms in higher quantiles are affected by the economic size which is the proxy of the supply capability of the partner country. Countries with a higher GDP supply a different variety of service types which are also different from domestic services and only firms in higher quantiles import these services. Moreover, since the firms in lower quantiles for the low level of distance can be considered as relatively worse compared to the firms in higher quantiles, as the distance increases, only some of these firms can bear the increasing cost of importing [12]. Therefore, distance has a lower coefficient in the lower quantiles. The development level of exporting countries does not have impact in the lower quantiles, as found in OLS estimation. However, its effect becomes significant for the 75th and 90th quantiles: only firms in higher quantiles are influenced by the development level of the trading partners. Models extended with additional firm-level variables have similar patterns for country-level variables as in models without firm-level variables. The effects of all firm-level variables except firm age and R&D engagement are significantly positive and become stronger as the import values of firms increases. The effects of firm size and productivity become particularly prominent for firms with high import values. The firm age variable is insignificant in both OLS and quantile estimations. As found in the OLS estimation, R&D engagement has a negative impact on firm-level imports, however it has significant effects for only the 25th and 50th quantiles.

In Figure 2.5, we compare the coefficients of significant variables from export and import analyses. The first panel of the figure compares the coefficients of GDP from export and import analyses. Both increase throughout the distributions. In both models with and without firm-level variables,

[12]The studies have provided evidence that the presence of fixed costs and the process of self-selection can also be observed in import markets (Castellani et al., 2010; Kasahara and Lapham, 2013).

the impact of GDP is higher for UK firm-level exports. In the second panel, the impact of distance is compared for exporting and importing firms. For both, the impact of distance becomes stronger from lower to higher quantiles. However, the change is bigger for importing firms. In the last two panels, we compare the coefficients of firm size and productivity from exports with those obtained from import analysis. Coefficients from both variables increase from lower to upper quantiles of both imports and exports, and the impacts are higher for exporting firms. The different results from import and export analyses suggest that exporting firms are different from importing firms. Even though the coefficient of each variable is higher in export analysis, the relatively steeper curves in import analysis suggests that importing firms are more sensitive to changes in distance, firm size and productivity.

2.5.2 Margins of Trade [13]

The results from firm-level service exports and imports are repeated for the trade margins. To investigate how the effects of different determinants of exports and imports may alter across the distribution of extensive and intensive margins, we aggregate the UK firm-level service exports and imports up to the country-level and decompose the effects of explanatory variables into the extensive and intensive margins. Tables 2.7 and 2.8 show the OLS and quantile estimations for margins of exports and imports. In these tables, we exclude all country and firm-level variables and run regressions on only GDP and distance in a simple gravity context. The first panel in Table 2.7 gives results from total exports. The coefficients obtained from different quantiles are different from OLS estimations. The results show that the effect of GDP is higher for lower quantiles and lower for higher quantiles. The negative impact of distance becomes weaker from the 10th to 90th quantiles; however, it increases again in the 90th quantile. This pattern was the opposite when we took into account the distribution of firm-level exports. As in OLS estimations, the coefficients obtained for extensive margins are higher than the coefficients from intensive margins. In both margins, the positive impact of GDP decreases from lower tail to upper tail of the distributions. Accordingly, the importance of economic size of the trading partners becomes weaker from the lower to higher quantiles of number of firms and average exports value per firm. On the other hand, the magnitude and significance level of the distance variable change through the distributions of number of exporting firms and average exports per firm. Its effect on the number of exporting firms decrease from the lower to higher quantiles. Moreover, its effect in the 90th quantile is insignificant.

[13] This part of the analyses is closely related to the results obtained from the corresponding section from the first chapter. In the first chapter, UK's total service exports and imports and their margins have been estimated using OLS and PPML. The coefficients obtained from quantile regressions differ from those obtained from OLS and PPML, and vary throughout the distributions of service exports and imports and their margins.

The results obtained for total exports and its margins are valid for total imports and its margins. In Table 2.8, we exclude all country and firm-level variables and run regressions on only GDP and distance. The effect of distance changes through the distributions of number of importing firms and average imports value per firm, both in terms of magnitude and significance level. Its effect on total imports is decreasing from the lower tail to the upper tail of the distribution. The coefficient decreases by almost 60% from the 10th quantile to the 75th quantile. It has insignificant effects in the 10th quantile of number of importing firms and in the 75th and 90th quantiles of average import value per firm. When we compare the results from country-level exports with the ones from country-level imports, we see that GDP matters more for total imports and its extensive margin except in the lowest quantiles. On the other hand, distance matters more for total imports and its margins than total exports and its margins.

These results do not sustain when we add other country- and firm-level variables (see Tables 9-14). In particular, the coefficient of distance variable becomes insignificant in most of the quantiles of total exports and its margins. Furthermore it is insignificant in the lower quantiles of extensive margin of imports when we control for other country- and firm-level variables. In the estimations on total imports and its intensive margin, unlike simple forms of analyses, there are slight changes from quantile to quantile and it depicts an increasing pattern. The decreasing pattern of GDP variable from lower to higher quantiles remains the same in the augmented form of import margins. This finding is also observed in the total export analyses. However, in the extensive margin of export analyses, the coefficient of GDP takes a value of ~ 0.5 in all quantiles as well as in OLS. There is a slight decrease from lower to upper quantiles when we control for average labour productivity and average firm size; it decreases from the 10th to the 90th quantile in intensive margin of export as well. However, in estimations with additional firm-level variables, the coefficient of GDP takes a value of ~ 0.4 after the median.

2.6 Conclusion

During the last two decades, the trade in services has become prominent in the world as well as the UK economy. The UK is one of the leading countries in trade in services. Therefore, it is of great importance to analyse the determinants of service trade flows in this country. Moreover, results based on aggregate trade analysis might be misleading from the policy perspective since firms engaged in international trade are different from not only non-trading firms but also the other trading firms. Hence, in this study we analyse the determinants of firm-level services trade in the UK considering the coefficient heterogeneity due to two possible reasons. First, the effect of certain

gravity variables would depend on some firm characteristics such as firm size and labour productivity resulting in them having effects in the mean of the trade distribution. This type of heterogeneity can be determined by the interaction regressions. Second, if the firms are heterogeneous -leading them to have different trade values- the effects of different variables explaining the trade values by firms may vary through the distribution of trade. To observe the heterogeneity across the distribution of firm-level trade, we employ a quantile regression approach which enables us to examine the impacts of different country- and firm-level variables at different points of the conditional distribution of the UK's firm-level service exports and imports.

To show how the effects of GDP and distance alter depending on firm characteristics, we estimate the gravity equation by OLS. We include their interactions with number of employees and gross value per worker to detect how the effects of GDP and distance on firm-level service exports and imports count on firm size and productivity. The findings from export analysis show that only the interaction terms with firm size have significant effects, further showing that the effects of GDP and distance on firm-level service exports depend on value of firm size but that labour productivity does not have any significant effect. The negative impact of distance and the positive impact of GDP grow across levels of firm size. The results from the import analysis show that all interaction terms have significant effects, this shows that the effects of GDP and distance on firm-level imports depend on both value of firm size and productivity. The negative impact of distance grows across levels of firm size and shrinks as labour productivity increases. The impacts of size and productivity are opposite when we consider the GDP variable. The positive impact of GDP grows across levels of firm size while more productive firms are less affected by an increase in the GDP. This implies that as firms becomes larger, GDP and the cost of imports matter more but, as firms become more productive, distance and GDP matter less.

The findings from quantile regressions show that the magnitude and significance level of each coefficient are different in each quantile as well as in OLS estimations. The positive effect of GDP and the negative effect of distance on firm-level service exports and imports become stronger in higher quantiles, showing that firms with relatively higher levels of exports and imports are affected more by changes in GDP and distance. Possible reasons for the different coefficients in different quantiles can be the heterogeneity in service type and self-selection of the firms into export and import markets. For example, firms in lower export quantiles are less affected by changes in GDP and distance. It might be the case that these firms export more heterogeneous services which are specific to certain countries. Therefore, firm-level exports are not very responsive to the changes in distance and GDP in lower quantiles. On the other hand, the impact of increasing distance is lower for these firms because only some of these firms are able to export to all destinations. There are

some extra costs of exporting including transportation costs, marketing costs (needs for personnel with the relevant skills to manage foreign networks), and production costs (to modify the current domestic products for foreign consumption) which can be borne by only some firms. Therefore, a change in distance variable mostly affects the firm composition of lower quantiles, and only better firms manage to survive, which results in a lower coefficient in lower quantiles. Additional to GDP and distance variables, GDP per capita and colonial relationship, regional trade agreements, EU and WTO membership dummies are also significant in export analyses. The effect of GDP per capita does not vary over different quantiles; however, it has an insignificant effect in the 10th quantile showing that firms with low export levels are not affected by development levels of the trading partners. Regional trade agreements, EU and WTO membership dummies have significantly negative effects on firm-level export for all quantiles except the 10th quantile. The negative effects of these variables increase in the higher quantiles.

These results from firm-level service exports and imports are repeated for the margins of exports and imports. To investigate how the effects of different determinants of exports and imports may alter across the distribution of the different margins, we aggregate the UK firm-level service exports and imports up to the country-level and decompose the effects of explanatory variables into the extensive and intensive margins. The effects of GDP and distance weaken from the lower to higher quantiles for both exports and imports and their respective margins. In the estimations where we include all other variables, the coefficient of the distance variable becomes insignificant in most of the quantiles of total exports and its margins and it is insignificant in the lower quantiles of extensive margin of imports.

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Tables

Table 2.1: Firm-level Exports: The Effects of Firm Size and Productivity

		Distance interacted with...			GDP interacted with...		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log of GDP partner	0.262***	0.262***	0.276***	0.292***	0.0823*	0.272***	0.129**
	(9.42)	(9.25)	(10.23)	(10.25)	(1.89)	(8.66)	(2.39)
Log of GDPPC partner	0.0978***	0.0976***	0.109***	0.107***	0.0997***	0.108***	0.109***
	(2.68)	(2.64)	(2.97)	(2.79)	(2.68)	(2.95)	(2.83)
Log of distance	-0.375***	-0.140	-0.456***	-0.324***	-0.383***	-0.392***	-0.426***
	(-5.61)	(-1.59)	(-4.94)	(-2.80)	(-5.68)	(-5.60)	(-5.94)
Colonial relationship	0.294**	0.310***	0.309***	0.363***	0.320***	0.309***	0.368***
	(2.59)	(2.64)	(3.04)	(3.37)	(2.75)	(3.04)	(3.42)
Common legislation	0.0237	0.0172	0.0328	0.0272	0.0199	0.0323	0.0269
	(0.25)	(0.17)	(0.39)	(0.29)	(0.20)	(0.39)	(0.29)
Common language	0.0428	0.0398	0.0340	0.0303	0.0340	0.0347	0.0280
	(0.50)	(0.46)	(0.40)	(0.36)	(0.39)	(0.41)	(0.33)
Time difference	-0.0214	-0.0225	-0.0133	-0.0185	-0.0243	-0.0136	-0.0197
	(-0.71)	(-0.74)	(-0.44)	(-0.60)	(-0.80)	(-0.45)	(-0.63)
Regional trade agreement	-0.383**	-0.400**	-0.337**	-0.375**	-0.392**	-0.342**	-0.375**
	(-2.29)	(-2.33)	(-2.02)	(-2.14)	(-2.30)	(-2.05)	(-2.14)
GATT membership	-0.380*	-0.385*	-0.389*	-0.381*	-0.402**	-0.388*	-0.393*
	(-1.89)	(-1.91)	(-1.88)	(-1.81)	(-2.01)	(-1.87)	(-1.86)
European Union membership	-0.258*	-0.276*	-0.257*	-0.285**	-0.276*	-0.255*	-0.283**
	(-1.82)	(-1.95)	(-1.82)	(-2.03)	(-1.96)	(-1.81)	(-2.02)
Size*Distance		-0.0472***		-0.0234*			
		(-3.41)		(-1.95)			
LP*Distance			0.0152	0.00429			
			(1.37)	(0.35)			
Size*GDP					0.0352***		0.0227***
					(5.62)		(3.25)
LP*GDP						0.000801	0.0106
						(0.14)	(1.54)
Log of # of employees		0.497***		0.521***	-0.0721*		0.206***
		(4.63)		(5.52)	(-1.74)		(4.41)
Log of labor productivity			0.120	0.435***		0.237***	0.406***
			(1.37)	(4.79)		(8.03)	(10.35)
Constant	4.717***	4.816***	4.566***	4.739***	4.790***	4.648***	4.781***
	(6.96)	(7.00)	(6.58)	(6.57)	(6.95)	(6.64)	(6.50)
N	16,252	16,252	15,726	15,726	16,252	15,726	15726
R-squared	0.0722	0.0845	0.0954	0.148	0.0856	0.0953	0.148
F	45.04	36.58	71.09	114.9	44.61	66.55	137.01

The table presents the OLS regressions with interaction terms. The dependent variable is the log of service exports incurred by each firm. t-statistics in parentheses are calculated based on country clustered robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.2: Firm-level Imports: The Effects of Firm Size and Productivity

		Distance interacted with...			GDP interacted with...		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log of GDP partner	0.209***	0.214***	0.227***	0.238***	-0.0219	0.338***	0.148***
	(14.49)	(14.34)	(16.18)	(16.66)	(-0.42)	(10.15)	(3.66)
Log of GDPPC partner	0.0411	0.0406	0.0530*	0.0485	0.0394	0.0510	0.0472
	(1.31)	(1.29)	(1.68)	(1.50)	(1.23)	(1.59)	(1.44)
Log of distance	-0.240***	-0.0000566	-0.534***	-0.363***	-0.235***	-0.263***	-0.253***
	(-4.98)	(-0.00)	(-6.63)	(-3.00)	(-4.95)	(-5.65)	(-5.40)
Colonial relationship	0.125	0.132	0.202	0.199	0.137	0.194	0.198
	(0.73)	(0.79)	(1.11)	(1.13)	(0.81)	(1.07)	(1.13)
Common legislation	0.0347	0.0212	-0.0395	-0.0560	0.0286	-0.0292	-0.0448
	(0.22)	(0.14)	(-0.23)	(-0.34)	(0.19)	(-0.17)	(-0.27)
Common language	-0.00300	-0.0117	-0.0228	-0.0190	-0.0108	-0.0212	-0.0200
	(-0.03)	(-0.12)	(-0.25)	(-0.20)	(-0.11)	(-0.23)	(-0.22)
Time difference	-0.00417	-0.00680	-0.00302	-0.0109	-0.00513	-0.00127	-0.00812
	(-0.17)	(-0.28)	(-0.12)	(-0.45)	(-0.21)	(-0.05)	(-0.34)
Regional trade agreement	-0.144	-0.155	-0.164	-0.192	-0.139	-0.159	-0.175
	(-1.00)	(-1.07)	(-1.20)	(-1.38)	(-0.97)	(-1.17)	(-1.27)
GATT membership	-0.0285	-0.0496	0.0142	-0.0109	-0.0373	0.0210	-0.00509
	(-0.14)	(-0.25)	(0.07)	(-0.05)	(-0.19)	(0.11)	(-0.03)
European Union membership	-0.229	-0.225	-0.209	-0.202	-0.223	-0.204	-0.197
	(-1.59)	(-1.58)	(-1.28)	(-1.25)	(-1.56)	(-1.24)	(-1.20)
Size*Distance		-0.0416***		-0.0217			
		(-2.70)		(-1.53)			
LP*Distance			0.0644***	0.0548***			
			(4.75)	(3.99)			
Size*GDP					0.0429***		0.0279***
					(5.30)		(5.73)
LP*GDP						-0.0255***	-0.0147**
						(-3.37)	(-2.15)
Log of # of employees		0.398***		0.339***	-0.196***		-0.00711
		(3.71)		(3.33)	(-3.85)		(-0.18)
Log of labor productivity			-0.306***	-0.148		0.347***	0.358***
			(-3.01)	(-1.40)		(7.82)	(8.40)
Constant	3.414***	3.423***	3.304***	3.302***	3.395***	3.349***	3.304***
	(6.57)	(6.51)	(6.64)	(6.47)	(6.48)	(6.59)	(6.40)
N	13,988	13,988	13,012	13,012	13,988	13,012	13,012
R-squared	0.0389	0.0435	0.0572	0.0701	0.0459	0.0565	0.0704
F	50.93	67.00	90.61	88.50	93.10	76.22	94.71

The table presents the OLS regressions with interaction terms. The dependent variable is the log of service imports incurred by each firm. t-statistics in parentheses are calculated based on country clustered robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.3: Firm-Level Exports: The Effects of Firm Size and Productivity, with additional firm-level variables

		Distance interacted with...			GDP interacted with...		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log of GDP partner	0.281***	0.281***	0.281***	0.281***	0.210***	0.291***	0.138**
	(10.40)	(10.51)	(10.40)	(10.46)	(6.67)	(8.76)	(2.60)
Log of GDPPC partner	0.108***	0.108***	0.108***	0.108***	0.109***	0.108***	0.110***
	(2.81)	(2.83)	(2.84)	(2.83)	(2.85)	(2.81)	(2.87)
Log of distance	-0.413***	-0.304***	-0.490***	-0.338***	-0.412***	-0.413***	-0.412***
	(-5.85)	(-4.03)	(-5.37)	(-3.02)	(-5.85)	(-5.85)	(-5.84)
Colonial relationship	0.366***	0.363***	0.365***	0.364***	0.367***	0.365***	0.368***
	(3.39)	(3.38)	(3.39)	(3.38)	(3.42)	(3.39)	(3.41)
Common legislation	0.0638	0.0648	0.0642	0.0648	0.0654	0.0642	0.0642
	(0.67)	(0.68)	(0.67)	(0.68)	(0.69)	(0.67)	(0.68)
Common language	0.0178	0.0184	0.0171	0.0181	0.0160	0.0175	0.0165
	(0.22)	(0.22)	(0.21)	(0.22)	(0.19)	(0.21)	(0.20)
Time difference	-0.0220	-0.0209	-0.0217	-0.0209	-0.0216	-0.0219	-0.0220
	(-0.74)	(-0.70)	(-0.73)	(-0.70)	(-0.73)	(-0.74)	(-0.74)
Regional trade agreement	-0.368**	-0.365**	-0.364**	-0.364**	-0.361**	-0.367**	-0.365**
	(-2.18)	(-2.16)	(-2.16)	(-2.16)	(-2.15)	(-2.17)	(-2.16)
GATT membership	-0.402**	-0.401**	-0.403**	-0.402**	-0.409**	-0.402**	-0.411**
	(-1.99)	(-1.98)	(-2.00)	(-1.99)	(-2.03)	(-1.99)	(-2.04)
European Union membership	-0.311**	-0.312**	-0.313**	-0.313**	-0.312**	-0.312**	-0.311**
	(-2.11)	(-2.12)	(-2.12)	(-2.12)	(-2.12)	(-2.12)	(-2.11)
Log of # of employees	0.379***	0.543***	0.380***	0.527***	0.300***	0.380***	0.269***
	(24.84)	(6.84)	(24.75)	(5.99)	(8.27)	(24.82)	(5.83)
Log of labor productivity	0.490***	0.488***	0.346***	0.444***	0.485***	0.503***	0.427***
	(32.77)	(31.30)	(4.26)	(4.90)	(32.02)	(17.59)	(10.78)
Log of age of the firm	-0.327***	-0.328***	-0.328***	-0.328***	-0.328***	-0.327***	-0.327***
	(-10.76)	(-10.80)	(-10.80)	(-10.80)	(-10.67)	(-10.77)	(-10.60)
Dummy for being an LLC	0.741***	0.737***	0.739***	0.737***	0.736***	0.740***	0.737***
	(13.85)	(13.85)	(13.82)	(13.84)	(13.84)	(13.90)	(13.84)
R&D engagement	0.150***	0.150***	0.150***	0.150***	0.147***	0.150***	0.148***
	(4.07)	(4.07)	(4.04)	(4.06)	(3.95)	(3.99)	(3.96)
Size*Distance		-0.0211**		-0.0190*			
		(-2.13)		(-1.68)			
LP*Distance			0.0182*	0.00556			
			(1.69)	(0.45)			
Size*GDP					0.0137**		0.0189***
					(2.53)		(2.74)
LP*GDP						-0.00234	0.0104
						(-0.43)	(1.47)
Constant	0.982	0.139	1.579*	0.407	1.402*	0.927	1.810**
	(1.37)	(0.19)	(1.95)	(0.45)	(1.86)	(1.30)	(2.24)
N	15,726	15,726	15,726	15,726	15,726	15,726	15,726
R-squared	0.173	0.173	0.173	0.173	0.173	0.173	0.173
F	138.0	126.1	154.4	133.5	139.5	126.9	149.0

The table presents the OLS regressions with interaction terms. Firm characteristics are also included in the regressions. The dependent variable is the log of service exports incurred by each firm. t-statistics in parentheses are calculated based on country clustered robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.4: Firm-Level Imports: The Effects of Firm Size and Productivity, with additional firm-level variables

		Distance interacted with...			GDP interacted with...		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log of GDP partner	0.225***	0.225***	0.227***	0.227***	0.0144	0.364***	0.122***
	(15.08)	(15.27)	(15.53)	(15.52)	(0.32)	(10.50)	(2.91)
Log of GDPPC partner	0.0353	0.0358	0.0350	0.0354	0.0352	0.0324	0.0339
	(1.03)	(1.06)	(1.04)	(1.05)	(1.04)	(0.95)	(1.00)
Log of distance	-0.247***	-0.00915	-0.532***	-0.352***	-0.247***	-0.248***	-0.248***
	(-5.07)	(-0.10)	(-6.01)	(-3.02)	(-5.16)	(-5.10)	(-5.16)
Colonial relationship	0.163	0.169	0.157	0.162	0.171	0.146	0.161
	(0.90)	(0.94)	(0.87)	(0.89)	(0.94)	(0.81)	(0.89)
Common legislation	-0.0292	-0.0327	-0.0282	-0.0303	-0.0238	-0.0158	-0.0186
	(-0.18)	(-0.20)	(-0.17)	(-0.18)	(-0.14)	(-0.09)	(-0.11)
Common language	-0.00677	-0.0148	-0.00441	-0.00921	-0.0142	-0.00181	-0.0104
	(-0.07)	(-0.15)	(-0.04)	(-0.09)	(-0.14)	(-0.02)	(-0.11)
Time difference	-0.0109	-0.00875	-0.0112	-0.00997	-0.00697	-0.00920	-0.00698
	(-0.44)	(-0.36)	(-0.46)	(-0.41)	(-0.29)	(-0.38)	(-0.29)
Regional trade agreement	-0.219	-0.211	-0.209	-0.206	-0.191	-0.201	-0.188
	(-1.57)	(-1.52)	(-1.50)	(-1.49)	(-1.39)	(-1.46)	(-1.37)
GATT membership	0.00939	0.0117	0.0116	0.0125	0.0150	0.0201	0.0189
	(0.05)	(0.06)	(0.06)	(0.06)	(0.07)	(0.10)	(0.09)
European Union membership	-0.203	-0.198	-0.210	-0.206	-0.198	-0.205	-0.200
	(-1.23)	(-1.21)	(-1.28)	(-1.26)	(-1.20)	(-1.24)	(-1.21)
Log of # of employees	0.179***	0.503***	0.180***	0.358***	-0.0700	0.183***	-0.0175
	(11.08)	(4.57)	(11.39)	(3.46)	(-1.55)	(11.48)	(-0.45)
Log of labor productivity	0.271***	0.268***	-0.252**	-0.163	0.257***	0.460***	0.349***
	(14.89)	(14.56)	(-2.18)	(-1.47)	(15.02)	(9.73)	(7.57)
Log of age of the firm	-0.0230	-0.0256	-0.0321	-0.0319	-0.0271	-0.0316	-0.0303
	(-0.34)	(-0.38)	(-0.46)	(-0.46)	(-0.40)	(-0.46)	(-0.45)
Dummy for being an LLC	0.883***	0.885***	0.881***	0.882***	0.894***	0.879***	0.889***
	(11.87)	(11.98)	(11.70)	(11.79)	(12.21)	(11.59)	(12.02)
R&D engagement	-0.126**	-0.130**	-0.131**	-0.133***	-0.135***	-0.140***	-0.139***
	(-2.50)	(-2.58)	(-2.60)	(-2.62)	(-2.68)	(-2.76)	(-2.76)
Size*Distance		-0.0424***		-0.0233			
		(-2.74)		(-1.65)			
LP*Distance			0.0674***	0.0558***			
			(4.28)	(3.82)			
Size*GDP					0.0384***		0.0306***
					(5.39)		(5.90)
LP*GDP						-0.0312***	-0.0146**
						(-3.80)	(-2.01)
Constant	0.583	-1.239*	2.802***	1.418	1.973***	-0.247	1.303**
	(1.00)	(-1.92)	(3.16)	(1.52)	(2.89)	(-0.46)	(2.16)
N	13,012	13,012	13,012	13,012	13,012	13,012	13,012
R-squared	0.0781	0.0793	0.0802	0.0805	0.0808	0.0798	0.0811
F	66.71	76.32	79.07	76.03	93.84	57.06	90.15

The table presents the OLS regressions with interaction terms. Firm characteristics are also included in the regressions. The dependent variable is the log of service imports incurred by each firm. t-statistics in parentheses are calculated based on country clustered robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.5: Firm-level Exports - Quantile Estimations

	(1) OLS	(2) OLS	(3) q10	(4) q10	(5) q25	(6) q25	(7) q50	(8) q50	(9) q75	(10) q75	(11) q90	(12) q90
Log of GDP partner	0.262***	0.281***	0.164***	0.172***	0.274***	0.276***	0.299***	0.320***	0.286***	0.317***	0.321***	0.323***
	(9.42)	(10.40)	(8.91)	(9.41)	(13.04)	(12.34)	(10.46)	(10.11)	(7.73)	(8.62)	(8.72)	(8.66)
Log of GDPPC partner	0.0978***	0.108***	0.0148	0.0352	0.0730**	0.0745**	0.109***	0.112**	0.124**	0.117**	0.122**	0.137***
	(2.68)	(2.81)	(0.50)	(1.45)	(2.24)	(2.31)	(2.89)	(2.24)	(2.38)	(2.53)	(2.25)	(2.71)
Log of distance	-0.375***	-0.413***	-0.354***	-0.266***	-0.393***	-0.352***	-0.411***	-0.446***	-0.409***	-0.497***	-0.389***	-0.494***
	(-5.61)	(-5.85)	(-4.49)	(-6.68)	(-7.31)	(-6.28)	(-4.84)	(-5.52)	(-4.16)	(-4.73)	(-3.88)	(-4.83)
Colonial relationship	0.294**	0.366***	0.318	0.366***	0.278**	0.480***	0.435***	0.517***	0.313	0.321***	0.213	0.161
	(2.59)	(3.39)	(1.63)	(3.29)	(2.39)	(4.28)	(3.39)	(3.66)	(1.60)	(2.75)	(0.85)	(0.63)
Common legislation	0.0237	0.0638	0.0134	0.0658	0.128	0.170**	0.0294	-0.00198	-0.118	0.0283	-0.175	0.0833
	(0.25)	(0.67)	(0.09)	(0.88)	(1.34)	(1.99)	(0.24)	(-0.01)	(-0.75)	(0.30)	(-0.84)	(0.38)
Common language	0.0428	0.0178	0.0465	-0.00515	-0.0213	-0.150*	-0.128	-0.0587	0.133	0.0763	0.218	0.153
	(0.50)	(0.22)	(0.36)	(-0.06)	(-0.22)	(-1.70)	(-1.25)	(-0.61)	(1.23)	(0.74)	(1.49)	(1.17)
Time difference	-0.0214	-0.0220	0.0140	0.0000395	-0.00718	-0.0131	-0.0150	-0.0129	-0.0408	-0.0303	-0.0706*	-0.0618
	(-0.71)	(-0.74)	(0.63)	(0.00)	(-0.28)	(-0.62)	(-0.44)	(-0.32)	(-0.95)	(-0.78)	(-1.73)	(-1.41)
Regional trade agreement	-0.383**	-0.368**	-0.150	-0.157**	-0.301**	-0.202*	-0.433**	-0.393	-0.560**	-0.436**	-0.684***	-0.666***
	(-2.29)	(-2.18)	(-1.20)	(-1.97)	(-2.23)	(-1.77)	(-2.09)	(-1.59)	(-2.35)	(-2.15)	(-3.12)	(-2.78)
GATT membership	-0.380*	-0.402**	-0.175	-0.181	-0.267*	-0.378**	-0.346*	-0.416*	-0.496*	-0.402	-0.478*	-0.525*
	(-1.89)	(-1.99)	(-1.14)	(-1.41)	(-1.85)	(-2.37)	(-1.65)	(-1.87)	(-1.68)	(-1.43)	(-1.90)	(-1.93)
European Union membership	-0.258*	-0.311**	-0.140	-0.0130	-0.183**	-0.161	-0.245*	-0.249*	-0.357*	-0.521***	-0.483*	-0.620***
	(-1.82)	(-2.11)	(-1.58)	(-0.22)	(-2.03)	(-1.55)	(-1.75)	(-1.66)	(-1.87)	(-2.82)	(-1.81)	(-2.81)
Log of # of employees		0.379***		0.238***		0.339***		0.398***		0.464***		0.455***
		(24.84)		(13.33)		(18.10)		(20.90)		(26.97)		(19.68)
Log of labor productivity		0.490***		0.289***		0.420***		0.519***		0.599***		0.555***
		(32.77)		(11.39)		(15.57)		(28.15)		(44.70)		(25.11)
Log of age of the firm		-0.327***		-0.205***		-0.279***		-0.292***		-0.380***		-0.501***
		(-10.76)		(-6.25)		(-6.62)		(-7.29)		(-8.65)		(-8.82)
Dummy for being an LLC		0.741***		0.579***		0.826***		0.795***		0.806***		0.682***
		(13.85)		(12.47)		(12.44)		(9.76)		(10.61)		(7.85)
R&D engagement		0.150***		0.267***		0.258***		0.133***		0.0115		0.0524
		(4.07)		(4.68)		(5.40)		(2.74)		(0.22)		(0.88)
Constant	4.717***	0.982	2.590***	-0.684	3.185***	-0.588	4.553***	0.510	6.377***	2.143**	7.668***	4.238***
	(6.96)	(1.37)	(3.58)	(-1.36)	(5.69)	(-1.04)	(5.31)	(0.60)	(6.46)	(2.03)	(7.71)	(3.94)
N	16,252	15,726	16,252	15,726	16,252	15,726	16,252	15,726	16,252	15,726	16,252	15,726
R-squared	0.0722	0.173	0.0692	0.165	0.0714	0.169	0.0717	0.172	0.0715	0.171	0.0695	0.168

The table presents the quantile regression results for firm-level exports. The first two column shows the results from OLS regression. The dependent variables in all the models are in logs. t-statistics in parentheses are calculated based on country clustered robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.6: Firm-level Imports - Quantile Estimations

	(1) OLS	(2) OLS	(3) q10	(4) q10	(5) q25	(6) q25	(7) q50	(8) q50	(9) q75	(10) q75	(11) q90	(12) q90
Log of GDP partner	0.209***	0.225***	0.106**	0.117***	0.203***	0.197***	0.241***	0.243***	0.243***	0.269***	0.249***	0.281***
	(14.49)	(15.08)	(2.44)	(9.42)	(13.47)	(12.47)	(14.60)	(13.37)	(10.22)	(11.34)	(9.01)	(11.75)
Log of GDPPC partner	0.0411	0.0353	-0.0148	-0.00377	-0.0363	-0.0209	0.0387	0.0383	0.0864*	0.0713	0.0967*	0.0569
	(1.31)	(1.03)	(-0.41)	(-0.15)	(-0.77)	(-0.51)	(0.90)	(0.88)	(1.84)	(1.27)	(1.81)	(0.96)
Log of distance	-0.240***	-0.247***	-0.200**	-0.105**	-0.199***	-0.204***	-0.208***	-0.212***	-0.347***	-0.380***	-0.340***	-0.443***
	(-4.98)	(-5.07)	(-2.52)	(-1.97)	(-4.18)	(-4.04)	(-3.47)	(-3.00)	(-5.39)	(-4.55)	(-3.82)	(-4.22)
Colonial relationship	0.125	0.163	0.130	0.00830	0.0990	0.233*	0.246	0.422*	0.0240	0.147	-0.0970	0.0663
	(0.73)	(0.90)	(0.97)	(0.08)	(0.63)	(1.83)	(1.17)	(1.93)	(0.07)	(0.60)	(-0.21)	(0.12)
Common legislation	0.0347	-0.0292	-0.00216	0.0219	0.0631	-0.100	-0.0956	-0.165	0.0392	-0.0337	0.349	0.0769
	(0.22)	(-0.18)	(-0.03)	(0.28)	(0.45)	(-0.84)	(-0.53)	(-0.78)	(0.12)	(-0.15)	(0.93)	(0.14)
Common language	-0.00300	-0.00677	0.0286	0.120	0.0629	0.00242	-0.00109	-0.144	0.0658	-0.0626	-0.0428	0.0724
	(-0.03)	(-0.07)	(0.29)	(1.43)	(0.57)	(0.03)	(-0.01)	(-1.17)	(0.42)	(-0.43)	(-0.19)	(0.41)
Time difference	-0.00417	-0.0109	0.000612	-0.00693	0.0166	0.00673	0.00180	-0.00791	-0.0140	0.000585	-0.0555	-0.0292
	(-0.17)	(-0.44)	(0.03)	(-0.43)	(0.76)	(0.30)	(0.06)	(-0.27)	(-0.40)	(0.02)	(-1.10)	(-0.65)
Regional trade agreement	-0.144	-0.219	-0.167*	-0.0701	0.0328	-0.0936	-0.123	-0.200	-0.295	-0.321	-0.253	-0.439
	(-1.00)	(-1.57)	(-1.74)	(-0.89)	(0.26)	(-0.69)	(-0.72)	(-1.25)	(-1.38)	(-1.47)	(-0.83)	(-1.41)
GATT membership	-0.0285	0.00939	-0.107	0.0228	-0.0850	-0.0128	-0.123	-0.0415	0.176	0.0462	-0.0246	0.198
	(-0.14)	(0.05)	(-0.84)	(0.26)	(-0.73)	(-0.08)	(-0.52)	(-0.23)	(0.49)	(0.16)	(-0.04)	(0.66)
European Union membership	-0.229	-0.203	0.0546	0.0125	-0.112	-0.166	-0.174	-0.195	-0.380	-0.255	-0.545***	-0.265
	(-1.59)	(-1.23)	(0.24)	(0.11)	(-0.73)	(-1.43)	(-1.05)	(-0.93)	(-1.61)	(-0.72)	(-2.66)	(-1.09)
Log of # of employees		0.179***		0.0321**		0.0935***		0.154***		0.262***		0.360***
		(11.08)		(2.23)		(4.36)		(6.41)		(10.94)		(13.58)
Log of labor productivity		0.271***		0.0576***		0.116***		0.247***		0.423***		0.473***
		(14.89)		(2.84)		(3.60)		(8.94)		(14.03)		(20.91)
Log of age of the firm		-0.0230		0.0751		0.0222		0.00631		-0.0573		-0.123
		(-0.34)		(1.15)		(0.37)		(0.10)		(-0.72)		(-1.42)
Dummy for being an LLC		0.883***		0.435***		0.788***		0.931***		0.997***		0.968***
		(11.87)		(5.81)		(7.34)		(8.53)		(8.69)		(6.24)
R&D engagement		-0.126**		-0.0643		-0.204***		-0.204***		-0.121		-0.0922
		(-2.50)		(-1.17)		(-3.92)		(-2.97)		(-1.46)		(-1.10)
Constant	3.414***	0.583	1.565**	-0.468	2.069***	0.384	2.831***	0.166	4.991***	1.341*	6.649***	2.672**
	(6.57)	(1.00)	(2.39)	(-0.76)	(3.85)	(0.57)	(4.26)	(0.21)	(6.80)	(1.67)	(5.56)	(2.43)
N	13,988	13,012	13,988	13,012	13,988	13,012	13,988	13,012	13,988	13,012	13,988	13,012
R-squared	0.0389	0.0781	0.0325	0.0657	0.0376	0.0713	0.0385	0.0768	0.0384	0.0765	0.0370	0.0738

The table presents the quantile regression results for firm-level imports. The first two column shows the results from OLS regression. The dependent variables in all the models are in logs. t-statistics in parentheses are calculated based on country clustered robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.7: Margins of Exports - Quantile Estimations

		(1) OLS	(2) Q10	(3) Q25	(4) Q50	(5) Q75	(6) Q90
Total Export	Log of GDP partner	0.989***	1.235***	1.018***	0.896***	0.855***	0.857***
		(18.14)	(11.39)	(16.12)	(13.26)	(13.84)	(15.68)
	Log of distance	-0.701***	-0.827***	-0.801***	-0.720***	-0.580**	-0.811***
		(-4.31)	(-3.02)	(-5.44)	(-3.69)	(-2.49)	(-4.05)
	Constant	10.69***	9.040***	10.58***	11.17***	11.22***	13.88***
		(7.24)	(3.44)	(8.01)	(6.35)	(5.39)	(7.71)
	R2	0.695	0.695	0.695	0.695	0.695	0.963
Number of Firms	Log of GDP partner	0.618***	0.735***	0.691***	0.616***	0.539***	0.555***
		(21.19)	(19.24)	(20.20)	(16.03)	(13.62)	(14.38)
	Log of distance	-0.395***	-0.547***	-0.535***	-0.493***	-0.356***	-0.167
		(-4.98)	(-4.35)	(-6.26)	(-5.89)	(-2.79)	(-1.53)
	Constant	4.576***	4.468***	4.911***	5.389***	5.157***	3.920***
		(6.38)	(4.01)	(6.76)	(7.11)	(4.55)	(3.91)
	R2	0.742	0.742	0.741	0.741	0.742	0.735
Average Export	Log of GDP partner	0.371***	0.550***	0.394***	0.336***	0.302***	0.299***
		(9.68)	(6.33)	(7.31)	(9.51)	(7.50)	(6.43)
	Log of distance	-0.305***	-0.286*	-0.335***	-0.242**	-0.483***	-0.386***
		(-2.83)	(-1.69)	(-2.87)	(-2.26)	(-4.03)	(-3.88)
	Constant	6.116***	4.012**	5.658***	5.749***	8.406***	8.259***
		(6.27)	(2.36)	(5.43)	(5.98)	(7.93)	(9.36)
	R2	0.402	0.399	0.402	0.402	0.389	0.397

The table presents the quantile regression results from margins of exports in the simple gravity form. The first column provides the name of the dependent variable for the corresponding three rows. The dependent variables are in logs. t-statistics in parentheses are calculated based on country clustered robust standard errors. Number of observations=171. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.8: Margins of Imports - Quantile Estimations

		(1) OLS	(2) Q10	(3) Q25	(4) Q50	(5) Q75	(6) Q90
Total Import	Log of GDP partner	1.004***	1.179***	1.099***	1.046***	0.926***	0.902***
		(17.23)	(13.93)	(16.09)	(12.49)	(14.05)	(10.57)
	Log of distance	-0.972***	-1.570***	-1.257***	-0.909***	-0.643***	-0.730***
		(-6.77)	(-7.51)	(-7.14)	(-5.11)	(-3.41)	(-3.30)
	Constant	11.64***	14.29***	12.84***	11.05***	10.16***	11.91***
		(9.14)	(7.61)	(8.18)	(6.90)	(6.10)	(5.91)
	R2	0.711	0.706	0.710	0.711	0.707	0.710
Number of Firms	Log of GDP partner	0.660***	0.779***	0.761***	0.674***	0.584***	0.626***
		(20.73)	(9.98)	(18.71)	(14.10)	(14.40)	(13.34)
	Log of distance	-0.420***	-0.399	-0.597***	-0.573***	-0.464***	-0.245*
		(-5.02)	(-0.83)	(-5.07)	(-6.84)	(-4.39)	(-1.92)
	Constant	3.965***	2.282	4.586***	5.232***	5.226***	3.734***
		(5.20)	(0.54)	(4.30)	(6.86)	(5.41)	(3.27)
	R2	0.764	0.763	0.763	0.761	0.762	0.760
Average Import	Log of GDP partner	0.345***	0.513***	0.438***	0.357***	0.290***	0.226***
		(8.41)	(8.08)	(9.19)	(7.57)	(3.87)	(3.26)
	Log of distance	-0.552***	-0.752***	-0.590***	-0.472***	-0.265	-0.245
		(-5.64)	(-4.33)	(-5.46)	(-4.34)	(-1.60)	(-1.34)
	Constant	7.672***	7.436***	7.055***	6.875***	6.053***	7.003***
		(8.93)	(4.66)	(7.74)	(7.23)	(3.98)	(4.46)
	R2	0.408	0.408	0.407	0.407	0.398	0.403

The table presents the quantile regression results from margins of imports in the simple gravity form. The first column provides the name of the dependent variable for the corresponding three rows. The dependent variables are in logs. t-statistics in parentheses are calculated based on country clustered robust standard errors. Number of observations=165. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.9: Total Exports (augmented)

	(1) OLS	(2) OLS	(3) q10	(4) q10	(5) q25	(6) q25	(7) q50	(8) q50	(9) q75	(10) q75	(11) q90	(12) q90
Log of GDP partner	0.989***	0.936***	1.160***	1.100***	0.949***	0.978***	0.937***	0.909***	0.919***	0.843***	0.839***	0.811***
	(16.10)	(16.84)	(10.95)	(10.01)	(10.32)	(16.60)	(13.49)	(15.26)	(11.84)	(13.81)	(10.85)	(12.14)
Log of GDPPC partner	0.397***	0.260**	0.270	0.213	0.468***	0.281*	0.348***	0.276***	0.446***	0.312***	0.489***	0.391***
	(3.80)	(2.20)	(1.08)	(1.02)	(3.54)	(1.75)	(3.72)	(2.72)	(5.14)	(3.32)	(3.20)	(3.07)
Log of distance	0.0576	-0.0509	0.190	0.0704	-0.0253	-0.244	-0.438*	-0.281	-0.260	-0.340	-0.658	-0.775*
	(0.17)	(-0.17)	(0.26)	(0.16)	(-0.06)	(-0.70)	(-1.67)	(-1.12)	(-1.19)	(-1.41)	(-1.55)	(-1.83)
Colonial relationship	0.641**	0.346	1.829	1.090	1.109**	0.355	0.692*	0.417	0.486	0.581	0.204	-0.00875
	(2.40)	(1.19)	(1.59)	(1.51)	(2.23)	(0.87)	(1.86)	(0.99)	(1.16)	(1.56)	(0.53)	(-0.03)
Common legislation	0.381	0.354	-0.404	-0.281	-0.0616	0.419	0.110	0.489	0.483	0.268	0.418	0.741*
	(1.47)	(1.22)	(-0.65)	(-0.51)	(-0.16)	(0.92)	(0.28)	(1.28)	(1.40)	(0.74)	(0.68)	(1.73)
Common language	0.737***	0.836***	0.518	1.031	0.624	1.128***	0.783**	0.704**	0.253	0.491*	0.719**	0.581**
	(3.16)	(4.06)	(0.50)	(1.37)	(1.18)	(4.11)	(2.55)	(2.35)	(0.94)	(1.87)	(2.05)	(2.34)
Time difference	-0.202***	-0.173***	-0.240*	-0.229*	-0.133	-0.138*	-0.0912	-0.117*	-0.189***	-0.128**	-0.145	-0.158**
	(-3.48)	(-3.12)	(-1.88)	(-1.71)	(-1.18)	(-1.83)	(-1.19)	(-1.76)	(-2.70)	(-2.01)	(-1.65)	(-2.32)
Regional trade agreement	0.322	0.115	0.712	0.722	0.866**	0.168	0.167	0.213	-0.396	-0.319	-0.895**	-0.526
	(0.88)	(0.36)	(1.24)	(1.51)	(2.15)	(0.53)	(0.45)	(0.69)	(-1.11)	(-0.95)	(-2.27)	(-1.15)
GATT membership	-0.805***	-0.750**	-0.652	-0.762	-0.904***	-0.649**	-0.596*	-0.608*	-0.584*	-0.704*	-0.840	-1.065**
	(-2.64)	(-2.54)	(-0.47)	(-1.26)	(-2.68)	(-2.44)	(-1.75)	(-1.92)	(-1.86)	(-1.84)	(-1.34)	(-2.02)
European Union membership	0.547	0.754**	0.592	0.529	0.242	0.556	0.308	0.463	0.142	0.549	0.0967	-0.0906
	(1.56)	(1.99)	(0.38)	(0.89)	(0.50)	(0.95)	(0.75)	(1.30)	(0.40)	(1.65)	(0.20)	(-0.14)
Log of avg. labor productivity		0.221***		0.273*		0.239***		0.138**		0.191***		0.114
		(3.66)		(1.77)		(3.12)		(2.31)		(3.07)		(1.45)
Log of avg. # of employees		0.187**		0.0482		0.232***		0.267***		0.0441		0.137
		(2.13)		(0.32)		(3.02)		(3.26)		(0.41)		(1.22)
Constant	1.642	0.977	-0.620	-1.313	0.969	0.984	6.039**	2.719	5.073**	5.072**	9.239**	9.468***
	(0.58)	(0.37)	(-0.11)	(-0.29)	(0.25)	(0.30)	(2.58)	(1.13)	(2.53)	(2.40)	(2.45)	(2.70)
N	171	170	171	170	171	170	171	170	171	170	171	170
R-squared	0.804	0.830	0.787	0.817	0.795	0.827	0.798	0.823	0.791	0.822	0.773	0.791

The table presents the quantile estimations of the augmented gravity equation. The dependent variable is the log of total exports. The first two columns provide OLS regressions. T-statistics in parentheses are calculated based on robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.10: Extensive Margin of Exports (augmented)

	(1) OLS	(2) OLS	(3) q10	(4) q10	(5) q25	(6) q25	(7) q50	(8) q50	(9) q75	(10) q75	(11) q90	(12) q90
Log of GDP partner	0.572***	0.519***	0.542***	0.554***	0.543***	0.538***	0.586***	0.519***	0.569***	0.479***	0.513***	0.462***
	(20.87)	(20.31)	(7.78)	(13.75)	(14.06)	(18.82)	(19.98)	(13.94)	(11.65)	(20.15)	(18.96)	(18.22)
Log of GDPPC partner	0.215***	0.131***	0.229	0.206**	0.257***	0.137*	0.215***	0.136**	0.195***	0.195***	0.201***	0.178***
	(4.98)	(2.92)	(1.52)	(2.55)	(3.67)	(1.82)	(5.22)	(2.22)	(3.76)	(4.79)	(5.36)	(4.02)
Log of distance	-0.146	-0.211*	-0.0767	-0.138	-0.171	-0.206*	-0.266**	-0.132	-0.171	-0.138	-0.230*	-0.358***
	(-1.21)	(-1.78)	(-0.42)	(-0.61)	(-1.25)	(-1.73)	(-2.41)	(-0.88)	(-1.11)	(-1.13)	(-1.80)	(-3.76)
Colonial relationship	0.521***	0.391**	0.737*	0.446	0.626**	0.438***	0.649***	0.326	0.295	0.176	0.469	0.308*
	(2.82)	(2.27)	(1.80)	(1.12)	(2.58)	(3.65)	(4.09)	(1.20)	(0.79)	(0.82)	(1.65)	(1.82)
Common legislation	0.468***	0.467***	0.464	0.413	0.277	0.512**	0.390**	0.431	0.555	0.539***	0.327	0.347**
	(2.64)	(2.85)	(1.11)	(1.22)	(1.08)	(2.57)	(2.35)	(1.51)	(1.35)	(2.63)	(1.18)	(2.39)
Common language	0.274*	0.302**	-0.00697	0.234	0.0300	0.112	0.271**	0.318*	0.482***	0.401***	0.343*	0.496***
	(1.91)	(2.26)	(-0.03)	(0.85)	(0.10)	(0.74)	(2.04)	(1.74)	(2.69)	(2.75)	(1.85)	(3.29)
Time difference	-0.0246	-0.0178	-0.0155	-0.0388	-0.0331	-0.0326	-0.0336	-0.0394	-0.0268	-0.0311	-0.00883	-0.00543
	(-0.99)	(-0.74)	(-0.25)	(-0.71)	(-1.00)	(-1.12)	(-1.37)	(-1.21)	(-0.66)	(-1.21)	(-0.30)	(-0.24)
Regional trade agreement	0.530***	0.407***	1.073**	0.476*	0.440*	0.215	0.397***	0.321	0.334	0.331*	0.390*	0.254
	(3.32)	(2.77)	(2.24)	(1.67)	(1.90)	(1.40)	(2.86)	(1.36)	(1.31)	(1.81)	(1.77)	(1.63)
GATT membership	-0.0471	0.0144	0.259	0.237	0.265	0.184	0.0346	0.112	-0.185	-0.277	-0.172	-0.119
	(-0.31)	(0.10)	(0.88)	(0.67)	(1.33)	(1.09)	(0.18)	(0.56)	(-0.66)	(-1.63)	(-1.05)	(-0.81)
European Union membership	0.345**	0.389**	0.493	0.512*	0.302	0.572***	0.237	0.495*	0.317	0.276	0.0100	-0.0483
	(2.30)	(2.43)	(1.30)	(1.81)	(1.57)	(3.53)	(1.48)	(1.83)	(1.37)	(1.54)	(0.05)	(-0.32)
Log of avg. labor productivity		0.0749***		0.132**		0.0771**		0.0473		0.0638**		0.0553*
		(3.12)		(2.14)		(2.12)		(1.56)		(2.34)		(1.78)
Log of avg. # of employees		0.263***		0.227***		0.239***		0.275***		0.251***		0.300***
		(6.24)		(4.29)		(5.48)		(4.32)		(3.87)		(4.25)
Constant	0.367	-0.417	-1.448	-2.772	-0.106	-0.743	1.390	-0.936	1.311	-0.539	2.214*	1.306
	(0.35)	(-0.40)	(-0.81)	(-1.38)	(-0.09)	(-0.68)	(1.36)	(-0.67)	(0.97)	(-0.49)	(1.83)	(1.49)
N	171	170	171	170	171	170	171	170	171	170	171	170
R-squared	0.889	0.912	0.870	0.903	0.878	0.907	0.887	0.909	0.883	0.903	0.883	0.899

The table presents the quantile estimations of the augmented gravity equation. The dependent variable is the log of number of exporting firms. The first two columns provide OLS regressions. t-statistics in parentheses are calculated based on robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.11: Intensive Margin of Exports (augmented)

	(1) OLS	(2) OLS	(3) q10	(4) q10	(5) q25	(6) q25	(7) q50	(8) q50	(9) q75	(10) q75	(11) q90	(12) q90
Log of GDP partner	0.418***	0.417***	0.520***	0.523***	0.440***	0.430***	0.352***	0.391***	0.391***	0.368***	0.339***	0.408***
	(8.80)	(9.05)	(5.83)	(6.02)	(3.95)	(7.28)	(8.43)	(6.31)	(10.03)	(6.43)	(7.86)	(6.16)
Log of GDPPC partner	0.181**	0.128	0.0197	0.0896	0.164*	0.181**	0.247***	0.182**	0.128	0.104	0.307**	0.326**
	(2.18)	(1.45)	(0.12)	(0.68)	(1.96)	(2.49)	(3.80)	(2.42)	(1.46)	(0.85)	(2.42)	(2.48)
Log of distance	0.204	0.161	-0.0238	-0.163	-0.137	0.135	0.00236	0.0507	-0.289	-0.251	0.00522	0.0836
	(0.75)	(0.65)	(-0.07)	(-0.50)	(-0.37)	(0.47)	(0.01)	(0.20)	(-1.04)	(-0.85)	(0.02)	(0.28)
Colonial relationship	0.120	-0.0450	0.347	0.197	0.277	-0.613**	-0.119	-0.256	-0.00541	0.0479	0.345	-0.0583
	(0.44)	(-0.16)	(0.60)	(0.32)	(0.68)	(-2.38)	(-0.48)	(-0.99)	(-0.02)	(0.12)	(0.90)	(-0.17)
Common legislation	-0.0874	-0.113	-0.154	-0.102	0.0418	0.585**	0.00382	0.123	0.0648	-0.0844	-0.312	-0.238
	(-0.38)	(-0.45)	(-0.29)	(-0.15)	(0.15)	(2.26)	(0.01)	(0.47)	(0.22)	(-0.22)	(-0.85)	(-0.65)
Common language	0.462*	0.534**	0.587	0.535	0.327	0.509**	0.400*	0.399*	0.261	0.364	0.0442	0.189
	(1.89)	(2.31)	(1.17)	(1.10)	(1.10)	(2.38)	(1.96)	(1.91)	(0.95)	(0.93)	(0.14)	(0.65)
Time difference	-0.178***	-0.155***	-0.132*	-0.0571	-0.101	-0.160***	-0.115**	-0.135**	-0.146***	-0.107*	-0.252***	-0.226***
	(-3.91)	(-3.64)	(-1.75)	(-0.69)	(-0.67)	(-3.42)	(-2.55)	(-2.41)	(-3.24)	(-1.72)	(-4.79)	(-3.01)
Regional trade agreement	-0.208	-0.292	0.328	0.470	-0.0696	-0.242	-0.303	-0.449	-0.931***	-0.864**	-1.255**	-1.350***
	(-0.73)	(-1.18)	(0.85)	(1.18)	(-0.16)	(-0.72)	(-1.07)	(-1.58)	(-3.09)	(-2.59)	(-2.45)	(-3.81)
GATT membership	-0.758***	-0.765***	-0.119	-0.496	-0.451	-0.509*	-0.605**	-0.580**	-0.952**	-0.851**	-1.269***	-1.318***
	(-2.86)	(-3.02)	(-0.25)	(-1.48)	(-1.48)	(-1.76)	(-2.03)	(-2.13)	(-2.38)	(-2.48)	(-3.43)	(-3.28)
European Union membership	0.203	0.365	-0.172	-0.189	-0.252	0.257	0.0495	0.254	-0.0296	0.349	-0.0588	0.423
	(0.73)	(1.26)	(-0.50)	(-0.65)	(-0.56)	(0.95)	(0.15)	(0.84)	(-0.08)	(0.75)	(-0.10)	(1.00)
Log of avg. labor productivity		0.147***		0.259**		0.177***		0.103**		0.141**		0.132
		(3.11)		(2.08)		(2.85)		(1.99)		(2.36)		(1.44)
Log of avg. # of employees		-0.076		-0.175		0.0430		-0.00948		-0.107		-0.269*
		(-1.10)		(-1.08)		(0.26)		(-0.13)		(-0.89)		(-1.73)
Constant	1.275	1.394	2.105	1.821	3.148	-0.575	2.427	1.758	6.901***	6.192**	4.493	4.132
	(0.53)	(0.64)	(0.67)	(0.61)	(0.95)	(-0.21)	(1.18)	(0.74)	(2.85)	(2.35)	(1.59)	(1.53)
N	171	170	171	170	171	170	171	170	171	170	171	170
R-squared	0.508	0.555	0.454	0.509	0.487	0.523	0.491	0.540	0.453	0.525	0.388	0.453

The table presents the quantile estimations of the augmented gravity equation. The dependent variable is the log of average exports per firm. The first two columns provide OLS regressions. T-statistics in parentheses are calculated based on robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.12: Total Imports (augmented)

	(1) OLS	(2) OLS	(3) q10	(4) q10	(5) q25	(6) q25	(7) q50	(8) q50	(9) q75	(10) q75	(11) q90	(12) q90
Log of GDP partner	1.045***	0.961***	1.221***	1.021***	1.133***	1.005***	1.021***	1.006***	0.864***	0.882***	0.780***	0.800***
	(20.10)	(19.06)	(8.45)	(12.96)	(14.40)	(15.02)	(16.74)	(13.82)	(12.97)	(10.22)	(9.40)	(10.31)
Log of GDPPC partner	0.143	0.0285	-0.00403	-0.116	0.0563	-0.00105	0.201	0.0858	0.312***	0.234*	0.431***	0.297**
	(1.62)	(0.33)	(-0.02)	(-0.90)	(0.30)	(-0.01)	(1.57)	(0.68)	(3.24)	(1.82)	(3.69)	(2.50)
Log of distance	-0.848***	-0.845***	-0.867	-0.315	-1.108**	-1.051***	-0.618*	-0.862*	-0.699***	-0.746**	-0.921***	-0.896***
	(-3.08)	(-3.20)	(-1.52)	(-0.83)	(-2.35)	(-3.21)	(-1.85)	(-1.80)	(-2.82)	(-2.57)	(-3.42)	(-3.07)
Colonial relationship	0.793*	0.365	0.252	0.195	0.899**	0.303	0.521	0.239	0.384	0.653	1.308**	0.569
	(1.91)	(0.78)	(0.39)	(0.36)	(2.40)	(0.67)	(0.66)	(0.29)	(0.83)	(0.78)	(2.13)	(0.98)
Common legislation	0.925**	0.797*	1.122**	1.042**	0.800	0.684	0.938	0.760	0.928**	0.523	0.257	1.134**
	(2.19)	(1.81)	(2.38)	(2.56)	(1.41)	(1.58)	(1.32)	(0.89)	(2.54)	(0.79)	(0.80)	(2.46)
Common language	0.542	0.605*	0.855	0.772*	0.657	0.822**	0.383	0.580	0.419	0.472	0.242	0.140
	(1.50)	(1.97)	(1.50)	(1.77)	(1.61)	(2.17)	(0.81)	(1.39)	(0.90)	(0.75)	(0.35)	(0.25)
Time difference	-0.0906*	-0.0789	-0.165	-0.141	-0.0342	0.00122	-0.0846	-0.0686	-0.0416	-0.135**	-0.0770	-0.103
	(-1.74)	(-1.65)	(-1.35)	(-1.33)	(-0.34)	(0.01)	(-1.19)	(-0.85)	(-0.59)	(-2.01)	(-1.16)	(-1.15)
Regional trade agreement	0.216	-0.195	0.427	0.360	0.457	-0.220	0.359	-0.321	-0.00990	-0.633	-0.889**	-0.956**
	(0.69)	(-0.64)	(0.48)	(0.81)	(0.78)	(-0.55)	(0.74)	(-0.45)	(-0.03)	(-1.54)	(-2.15)	(-2.37)
GATT membership	-0.0300	0.0148	0.0757	0.303	0.120	0.0788	-0.0212	0.216	-0.396	-0.147	-0.103	-0.0320
	(-0.08)	(0.05)	(0.08)	(0.55)	(0.23)	(0.16)	(-0.04)	(0.35)	(-0.81)	(-0.37)	(-0.21)	(-0.09)
European Union membership	0.385	0.622*	0.902	1.594***	0.293	1.091**	0.310	0.674	0.218	0.290	-0.303	0.158
	(1.27)	(1.75)	(1.57)	(3.23)	(0.46)	(2.27)	(0.66)	(1.15)	(0.55)	(0.55)	(-0.77)	(0.40)
Log of avg. labor productivity		0.192***		0.314***		0.227***		0.163**		0.179***		0.114*
		(4.40)		(5.10)		(3.51)		(2.30)		(3.04)		(1.89)
Log of avg. # of employees		0.360***		0.412***		0.332		0.307		0.286*		0.235*
		(3.21)		(2.92)		(0.96)		(0.96)		(1.83)		(1.93)
Constant	8.754***	6.588***	8.031	0.0779	10.21**	7.063*	6.579**	6.453	8.002***	6.234**	10.06***	8.371***
	(3.44)	(2.63)	(1.39)	(0.02)	(2.22)	(1.91)	(2.23)	(1.38)	(3.67)	(2.49)	(4.19)	(3.17)
N	165	161	165	161	165	161	165	161	165	161	165	161
R-squared	0.813	0.850	0.799	0.830	0.811	0.845	0.810	0.847	0.798	0.837	0.763	0.816

The table presents the quantile estimations of the augmented gravity equation. The dependent variable is the log of total imports. The first two columns provide OLS regressions. T-statistics in parentheses are calculated based on robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.13: Extensive Margin of Imports (augmented)

	(1) OLS	(2) OLS	(3) q10	(4) q10	(5) q25	(6) q25	(7) q50	(8) q50	(9) q75	(10) q75	(11) q90	(12) q90
Log of GDP partner	0.620***	0.560***	0.736***	0.575***	0.643***	0.558***	0.599***	0.558***	0.605***	0.566***	0.591***	0.554***
	(25.72)	(30.14)	(14.75)	(15.00)	(8.74)	(19.22)	(21.14)	(19.81)	(27.75)	(24.73)	(24.28)	(21.43)
Log of GDPPC partner	0.122***	0.0688**	-0.0202	-0.0388	0.0588	0.0933	0.145***	0.0738*	0.156***	0.0682	0.187***	0.104*
	(2.98)	(2.07)	(-0.28)	(-0.56)	(0.49)	(1.56)	(3.49)	(1.78)	(4.71)	(1.55)	(4.48)	(1.82)
Log of distance	-0.196	-0.265**	-0.0951	-0.438	-0.136	-0.159	-0.245	-0.136	-0.425***	-0.406***	-0.308**	-0.423***
	(-1.43)	(-2.17)	(-0.38)	(-1.28)	(-0.74)	(-0.99)	(-1.54)	(-0.84)	(-3.19)	(-3.15)	(-2.03)	(-3.41)
Colonial relationship	0.285	0.145	0.449**	0.00547	0.293	0.270	0.319	0.279	0.505**	0.297	0.417**	0.160
	(1.55)	(0.96)	(2.03)	(0.03)	(0.37)	(1.24)	(1.42)	(1.14)	(2.48)	(1.22)	(2.24)	(0.82)
Common legislation	0.559***	0.492***	0.294	0.567**	0.545	0.445*	0.719***	0.304*	0.376*	0.482**	0.424***	0.522***
	(3.13)	(3.22)	(1.00)	(2.56)	(0.99)	(1.94)	(2.73)	(1.87)	(1.75)	(2.11)	(2.74)	(2.74)
Common language	0.390**	0.388***	0.786**	0.570***	0.253	0.301	0.279*	0.407*	0.275*	0.339***	0.218	0.327***
	(2.39)	(3.26)	(2.20)	(3.35)	(0.53)	(1.19)	(1.94)	(1.80)	(1.96)	(3.45)	(1.63)	(2.97)
Time difference	0.00600	0.0343	-0.0327	0.0578	-0.00138	0.0144	0.0185	0.0147	0.022	0.0410*	0.0280	0.0493**
	(0.23)	(1.50)	(-0.59)	(1.57)	(-0.03)	(0.42)	(0.59)	(0.32)	(0.90)	(1.91)	(0.87)	(2.06)
Regional trade agreement	0.618***	0.423***	0.405	0.199	0.813***	0.458**	0.656***	0.393*	0.0.205	0.292**	0.239	0.294**
	(3.65)	(2.78)	(0.67)	(0.65)	(4.02)	(2.07)	(3.63)	(1.97)	(1.46)	(2.29)	(1.42)	(2.18)
GATT membership	0.267*	0.326**	0.493*	0.535*	0.362	0.462	0.291	0.325*	0.212	0.0982	0.158	0.172
	(1.71)	(2.46)	(1.71)	(1.86)	(1.13)	(1.20)	(1.58)	(1.69)	(1.37)	(0.70)	(0.87)	(1.35)
European Union membership	0.516***	0.528***	1.311*	0.762**	0.654***	0.631**	0.443**	0.704***	0.273	0.433*	0.315	0.299
	(2.88)	(2.72)	(1.94)	(1.98)	(2.86)	(2.03)	(2.39)	(3.55)	(1.48)	(1.77)	(1.28)	(1.06)
Log of avg. labor productivity		0.0663***		0.108***		0.0769**		0.0797***		0.0268		0.00697
		(3.82)		(2.86)		(2.07)		(3.36)		(1.25)		(0.29)
Log of avg. # of employees		0.282***		0.273***		0.319***		0.273**		0.264***		0.295***
		(8.09)		(6.12)		(4.69)		(2.34)		(3.69)		(4.82)
Constant	0.314	-0.659	-0.851	0.454	-0.123	-2.410	0.596	-1.740	2.599***	1.422	1.624	1.427
	(0.25)	(-0.61)	(-0.39)	(0.16)	(-0.06)	(-1.59)	(0.42)	(-1.05)	(2.28)	(1.35)	(1.28)	(1.30)
N	165	161	165	161	165	161	165	161	165	161	165	161
R-squared	0.898	0.932	0.874	0.922	0.892	0.928	0.896	0.930	0.889	0.924	0.887	0.921

The table presents the quantile estimations of the augmented gravity equation. The dependent variable is the log of number of importing firms. The first two columns provide OLS regressions. t-statistics in parentheses are calculated based on robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 2.14: Intensive Margin of Imports (augmented)

	(1) OLS	(2) OLS	(3) q10	(4) q10	(5) q25	(6) q25	(7) q50	(8) q50	(9) q75	(10) q75	(11) q90	(12) q90
Log of GDP partner	0.425***	0.402***	0.468***	0.505***	0.489***	0.452***	0.419***	0.436***	0.356***	0.352***	0.223**	0.335***
	(9.86)	(8.23)	(5.23)	(10.61)	(13.22)	(10.99)	(7.27)	(8.35)	(5.00)	(5.92)	(2.39)	(4.09)
Log of GDPPC partner	0.0217	-0.403	0.0472	-0.174*	0.0764	-0.0383	0.0324	0.00611	0.0268	0.0537	-0.0149	-0.158
	(0.30)	(-0.55)	(0.49)	(-1.68)	(1.13)	(-0.40)	(0.44)	(0.10)	(0.25)	(0.55)	(-0.11)	(-1.47)
Log of distance	-0.652***	-0.580**	-0.484	-0.693***	-0.419**	-0.347*	-0.472**	-0.351	-0.558**	-0.454*	-0.566**	-0.552**
	(-2.65)	(-2.57)	(-1.59)	(-2.79)	(-2.31)	(-1.89)	(-2.01)	(-1.65)	(-2.10)	(-1.88)	(-2.08)	(-2.58)
Colonial relationship	0.508	0.220	0.826***	0.121	0.260	0.00754	-0.122	-0.409	0.542	0.465	-0.373	-0.0373
	(1.15)	(0.45)	(2.66)	(0.36)	(0.89)	(0.02)	(-0.30)	(-1.15)	(0.80)	(0.80)	(-0.83)	(-0.06)
Common legislation	0.366	0.305	0.577*	0.735***	0.486	0.696*	0.689*	0.646*	0.275	0.249	0.965**	0.526
	(1.00)	(0.79)	(1.76)	(2.87)	(1.65)	(1.86)	(1.68)	(1.76)	(0.64)	(0.69)	(2.39)	(1.09)
Common language	0.152	0.217	-0.0497	0.198	0.316	0.244	0.207	0.297	-0.0843	-0.118	0.0104	0.715
	(0.53)	(0.79)	(-0.17)	(0.48)	(1.38)	(1.04)	(0.82)	(1.37)	(-0.14)	(-0.24)	(0.03)	(1.30)
Time difference	-0.0966*	-0.113**	-0.122**	-0.0788	-0.145**	-0.113**	-0.0865	-0.138***	-0.0319	-0.0560	-0.0118	-0.118*
	(-1.92)	(-2.39)	(-2.34)	(-1.42)	(-2.60)	(-2.34)	(-1.43)	(-2.88)	(-0.39)	(-1.20)	(-0.16)	(-1.85)
Regional trade agreement	-0.402	-0.618**	-0.162	-0.474	-0.0619	-0.125	-0.137	-0.261	-0.412	-0.461	-0.479	-0.218
	(-1.30)	(-2.07)	(-0.26)	(-1.30)	(-0.21)	(-0.34)	(-0.44)	(-0.90)	(-0.85)	(-1.28)	(-1.08)	(-0.62)
GATT membership	-0.297	-0.311	-0.573**	0.145	-0.267	-0.0497	0.0171	-0.0387	-0.879*	-1.093**	-0.864	-0.821*
	(-1.00)	(-1.09)	(-1.99)	(0.44)	(-1.07)	(-0.15)	(0.05)	(-0.15)	(-1.69)	(-2.36)	(-1.32)	(-1.84)
European Union membership	-0.131	0.094	0.756	0.729**	-0.0618	0.505	-0.173	-0.0753	-0.216	-0.0839	-0.370	-0.611**
	(-0.53)	(0.37)	(1.15)	(2.33)	(-0.25)	(1.12)	(-0.60)	(-0.26)	(-0.84)	(-0.24)	(-0.82)	(-2.43)
Log of avg. labor productivity		0.126***		0.185***		0.154**		0.0962**		0.0639		0.176**
		(3.21)		(4.43)		(2.55)		(2.37)		(1.13)		(2.55)
Log of avg. # of employees		0.076		0.0500		0.155*		0.134		0.119		-0.0670
		(0.75)		(0.48)		(1.80)		(1.38)		(0.41)		(-0.50)
Constant	8.440***	7.247***	5.419*	6.806***	5.242***	3.251*	6.522***	4.397**	8.832***	6.789***	10.56***	10.35***
	(3.74)	(3.27)	(1.83)	(2.74)	(3.07)	(1.66)	(3.09)	(2.11)	(3.82)	(3.25)	(4.19)	(6.44)
N	165	161	165	161	165	161	165	161	165	161	165	161
R-squared	0.497	0.535	0.474	0.498	0.486	0.500	0.471	0.500	0.437	0.452	0.285	0.388

The table presents the quantile estimations of the augmented gravity equation. The dependent variable is the log of average imports per firm. The first two columns provide OLS regressions. T-statistics in parentheses are calculated based on robust standard errors. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Figures

Figure 2.1: Histogram and Density Plots of Firm Exports (in logs)

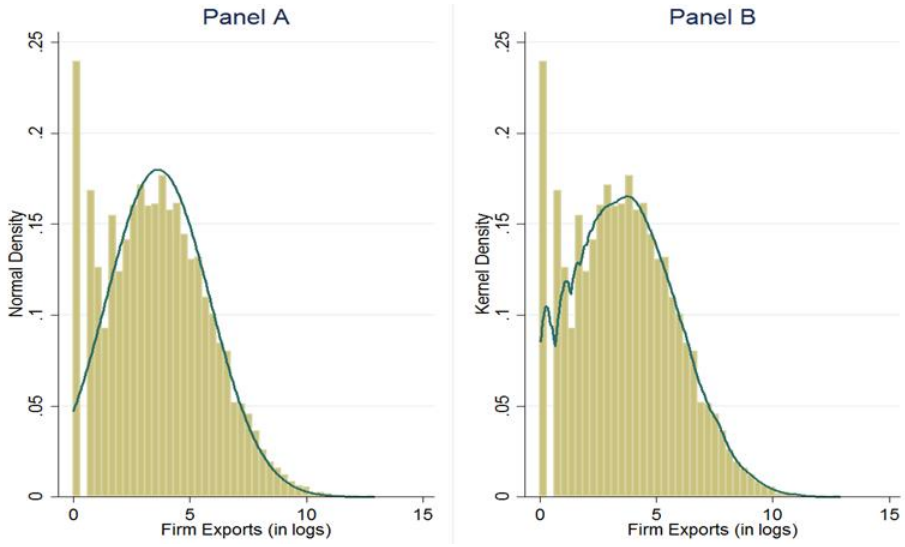


Figure 2.2: Histogram and Density Plots of Firm Imports (in logs)

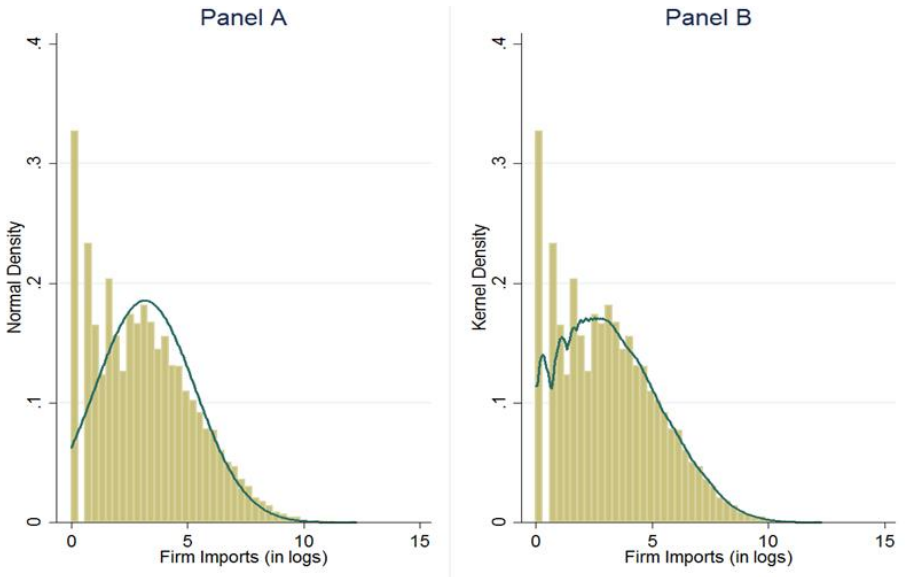


Figure 2.3: The Coefficients of Significant Variables in Export Analysis and the Comparison of QR and OLS for the Country-level Variables

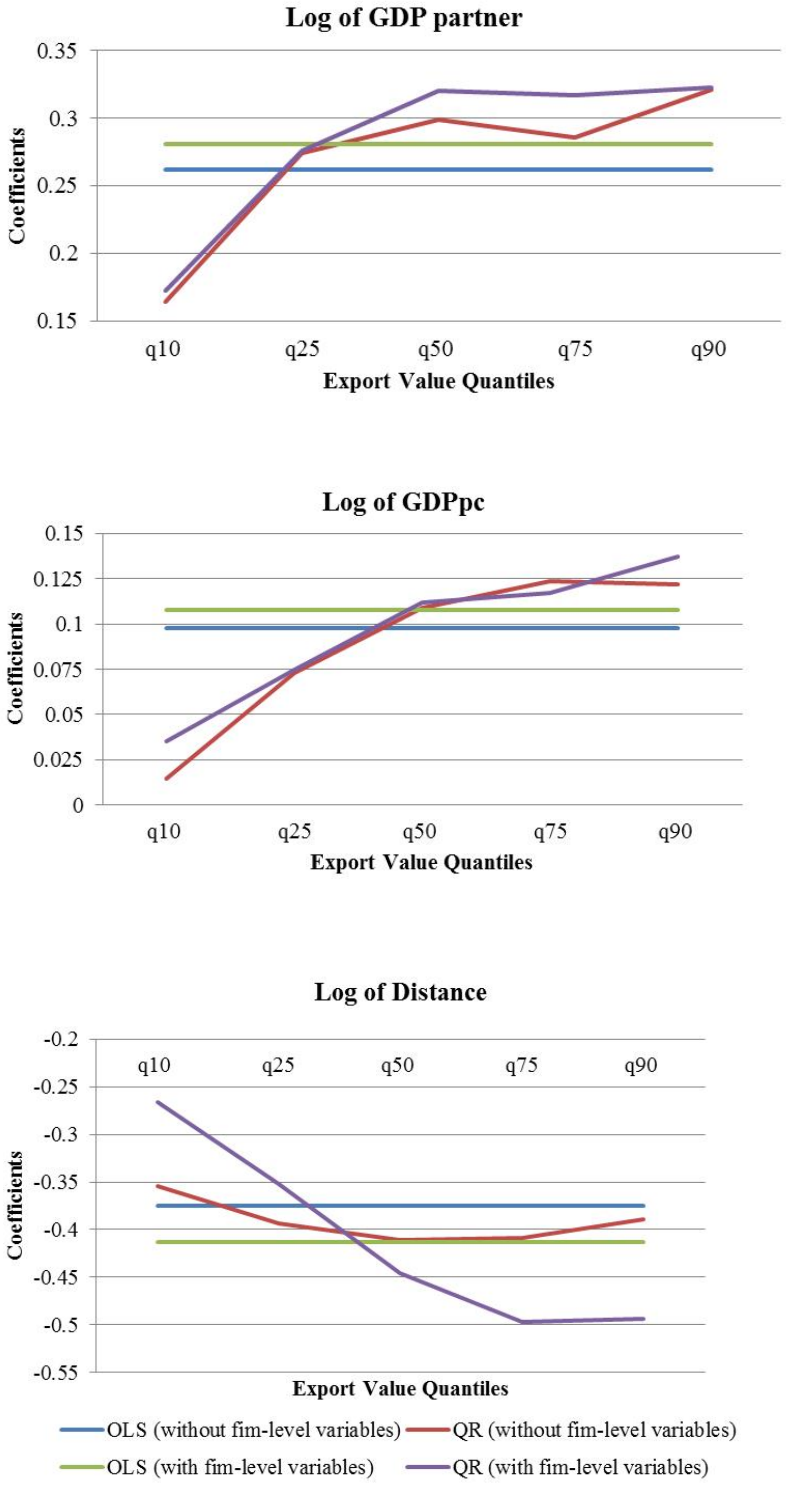
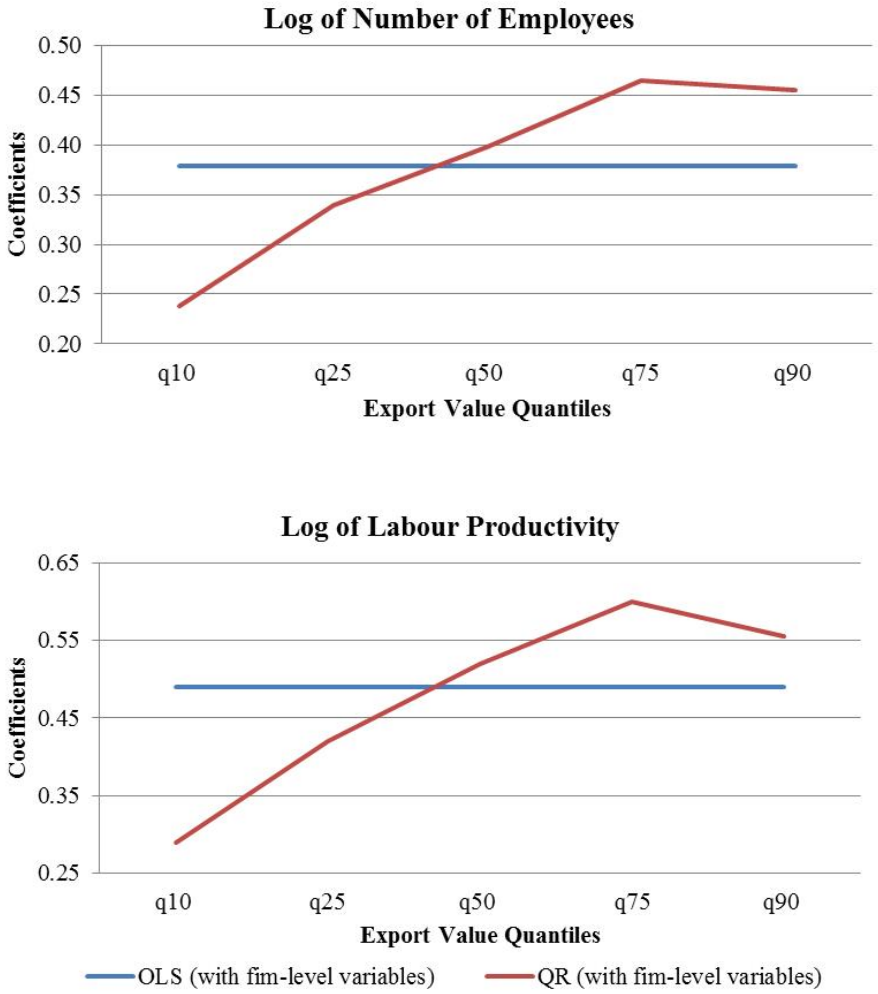


Figure 2.3 cont'd



Coefficients are obtained from the quantile regression from the analysis of firm-level service exports.

Figure 2.4: The Coefficients of Significant Variables in Import Analysis and the Comparison of QR and OLS for the Country-level Variables

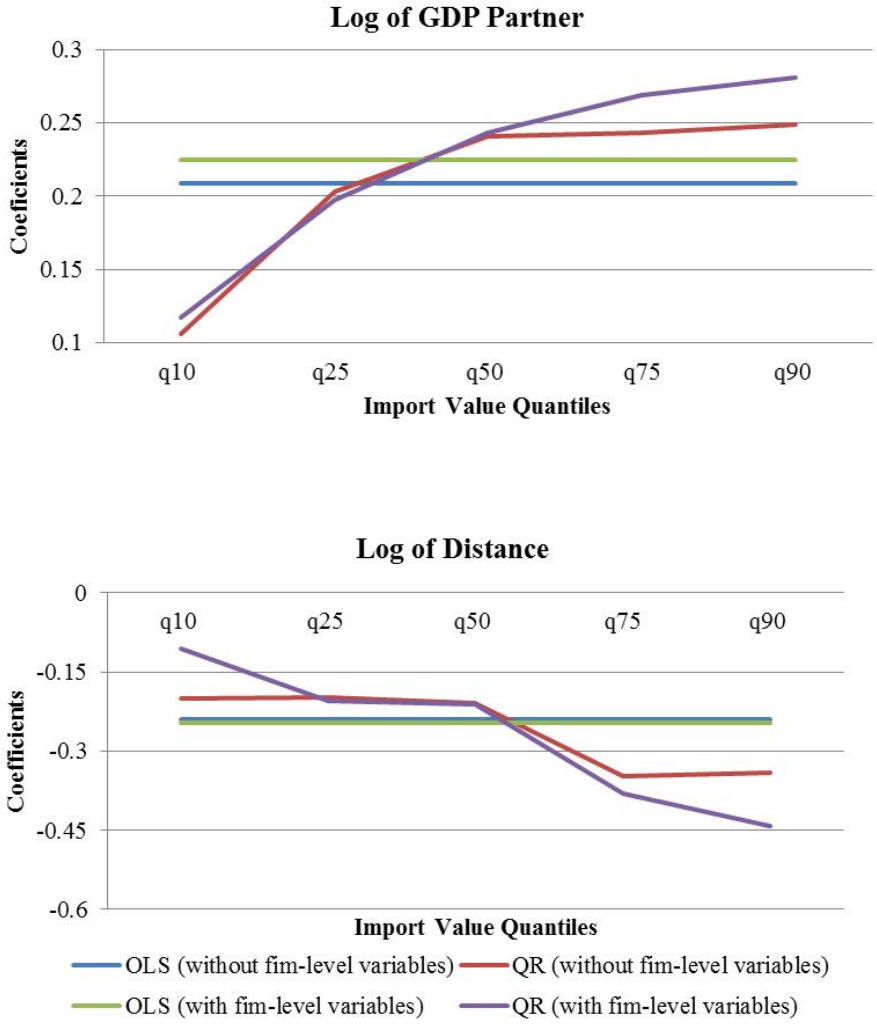
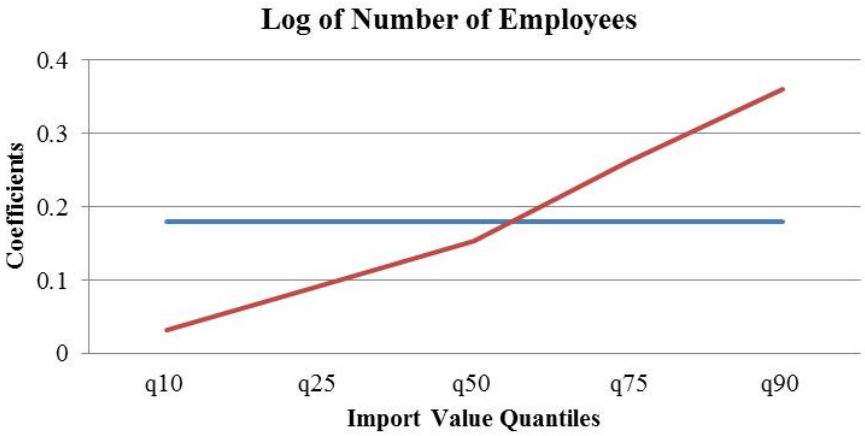
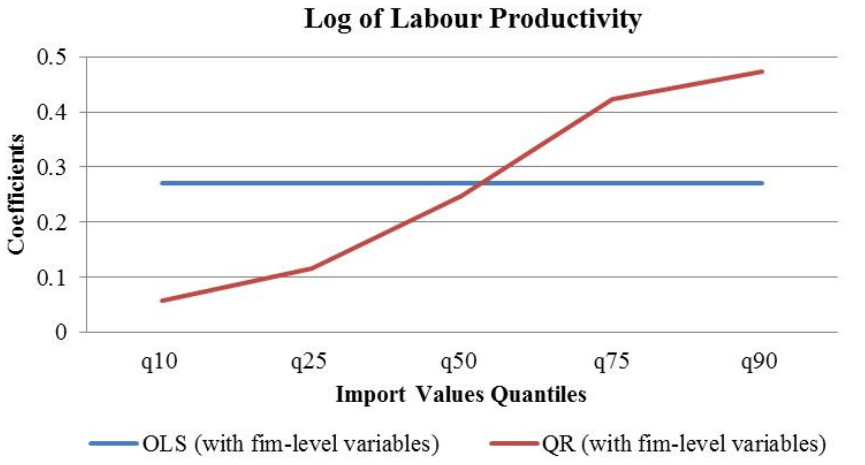


Figure 2.4 cont'd





Coefficients are obtained from the quantile regression from the analysis of firm-level service imports.

Figure 2.5: Coefficients of the Significant Variables - Export Analysis vs. Import Analysis

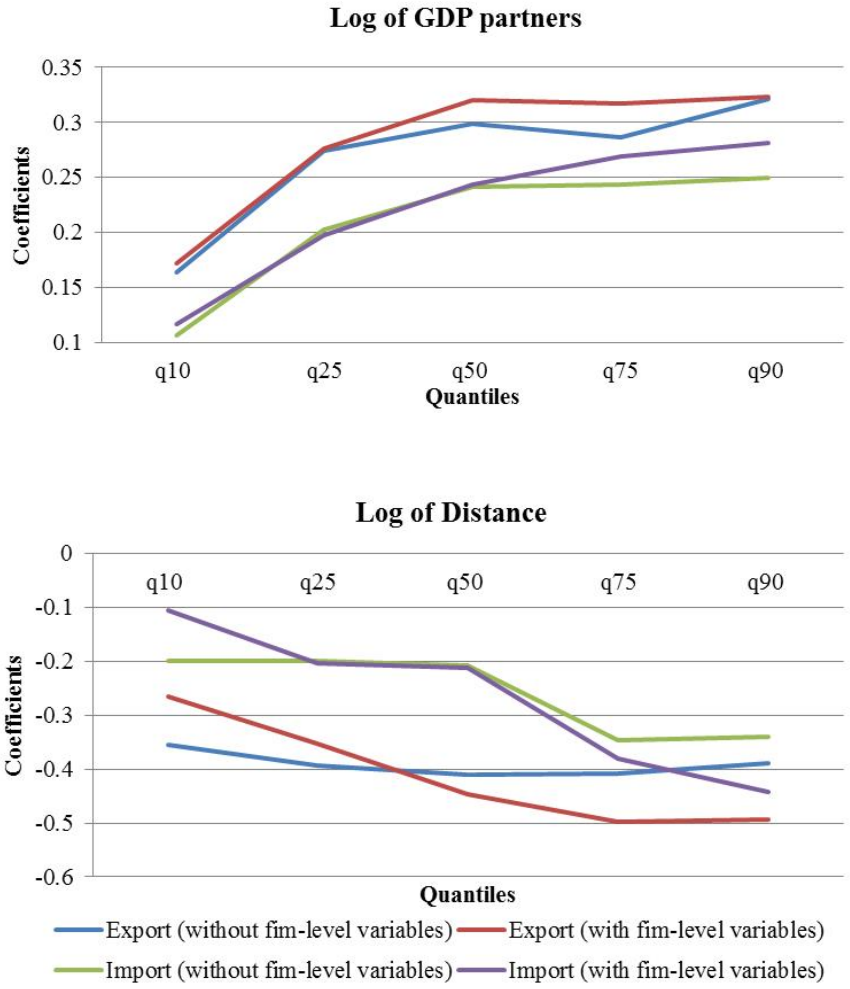
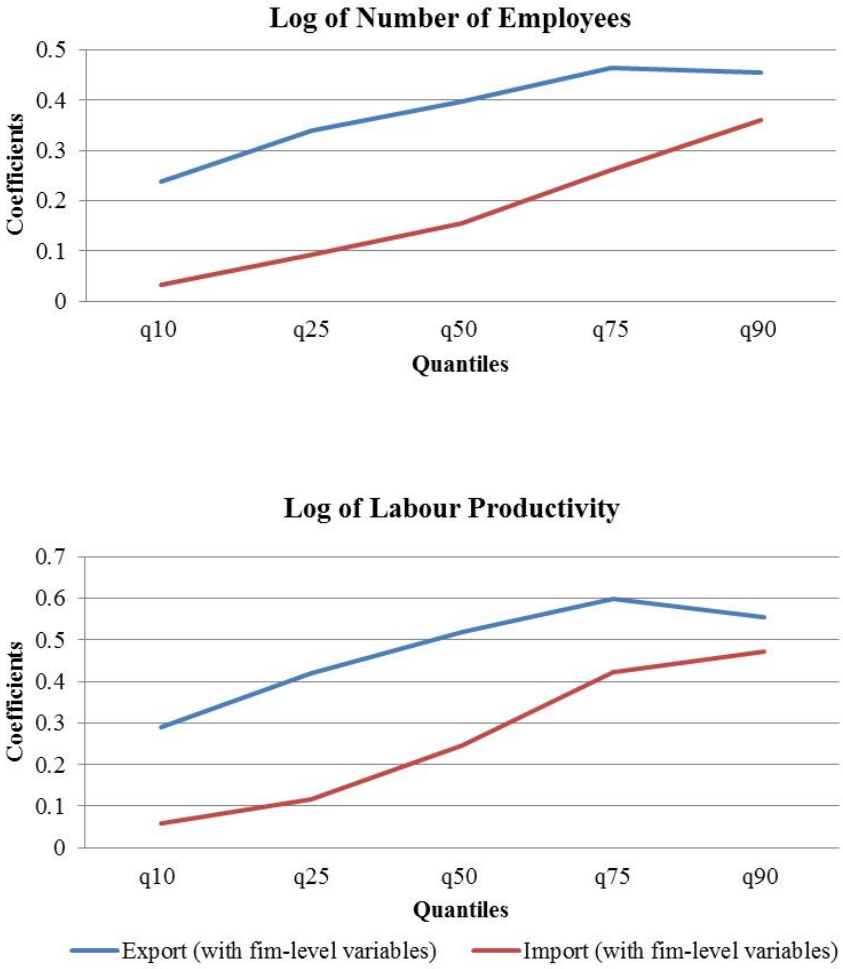


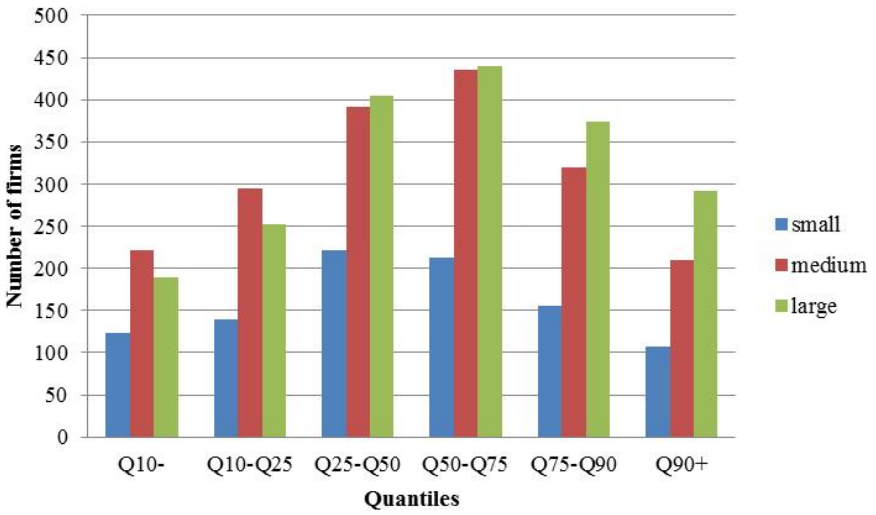
Figure 2.5 cont'd



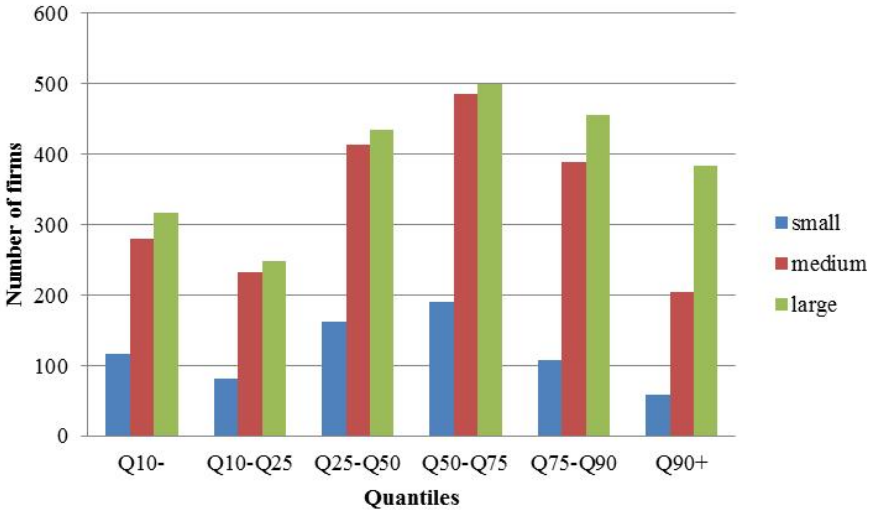
Coefficients are obtained from the quantile regression from the analyses of firm-level service exports and imports.

Figure 2.6: Number of Firms in Each Quantile

Panel A: Exports



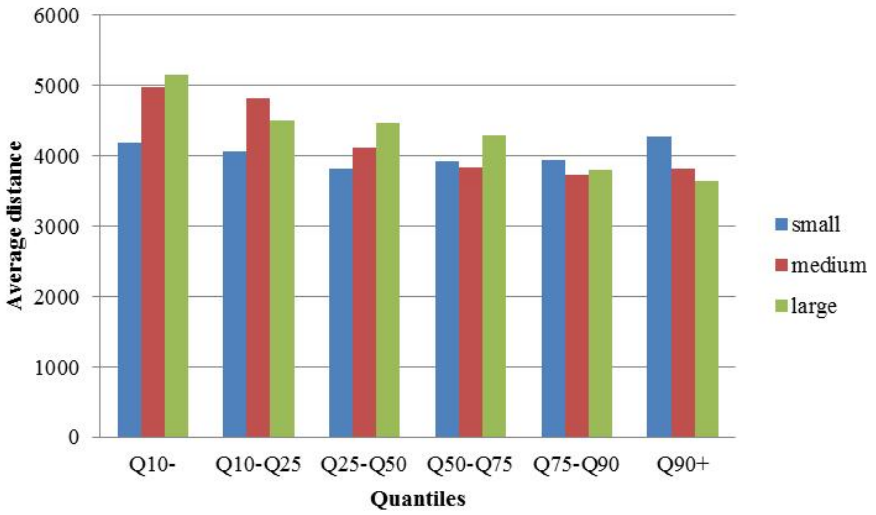
Panel B: Imports



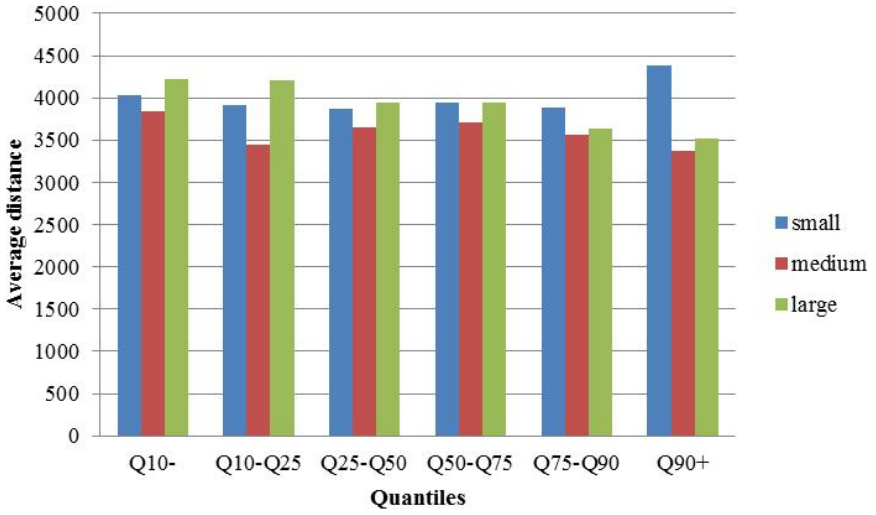
Source: Own calculations based on the data. The size of firms is determined according to the number of employees in each firm. Small: emp<50; Medium: 50≤emp<250; Large: emp≥250.

Figure 2.7: Average Distance in Each Quantile

Panel A: Exports



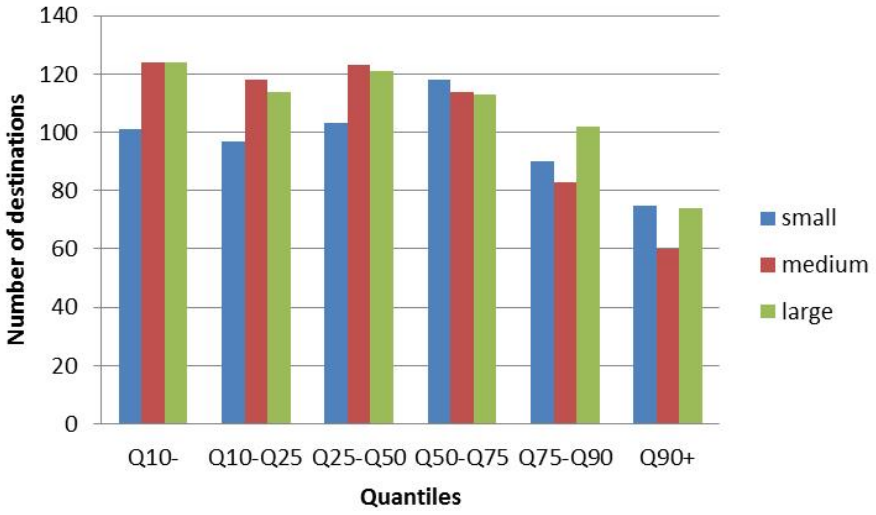
Panel B: Imports



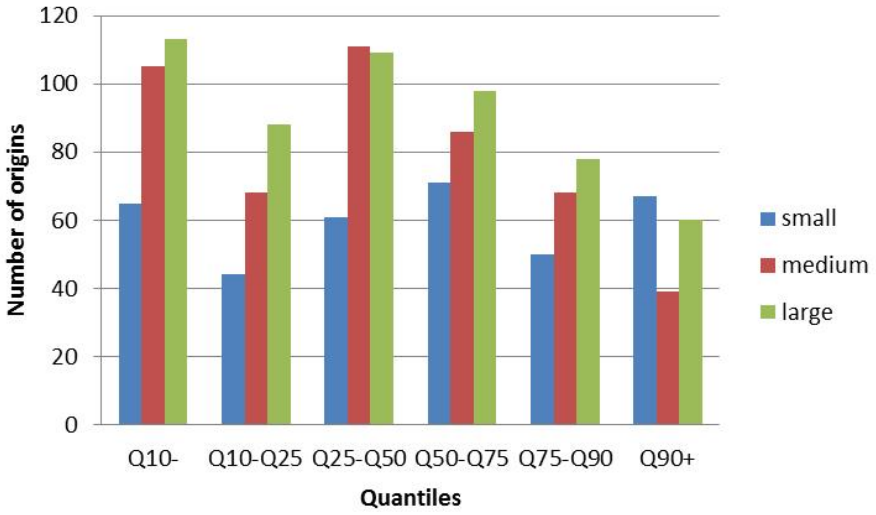
Source: Own calculations based on the data. The size of firms is determined according to the number of employees in each firm. Small: emp<50; Medium: 50≤emp<250; Large: emp≥250.

Figure 2.8: Number of Destinations in Each Quantile

Panel A: Exports



Panel B: Imports



Source: Own calculations based on the data. The size of firms is determined according to the number of employees in each firm. Small: emp<50; Medium: 50≤emp<250; Large: emp≥250.

Appendix 2.A Additional Tables

Table 2A.1: Size and Productivity in Different Quantiles of *trade_value* Variable

	Acc. to export quantiles				**Acc. to import quantiles**			
		obs	mean	std.dev.		obs	mean	std.dev.
employment	<q10	2034	1040.77	11981.08	<q10	2343	783.68	5717.69
	q10-q25	2197	825.84	6426.22	q10-q25	1205	866.53	7731.86
	q25-q50	3958	1222.11	12824.45	q25-q50	3453	744.61	4817.13
	q50-q75	4004	1973.37	18795.38	q50-q75	3506	704.65	4607.13
	q75-q90	2435	1042.04	8153.97	q75-q90	2084	718.52	1829.65
	>q90	1624	4084.87	29316.01	>q90	1397	1376.74	7603.65
LP	<q10	2034	430.82	1910.44	<q10	2343	378.38	7025.59
	q10-q25	2197	813.69	18573.7	q10-q25	1205	277.71	2194.71
	q25-q50	3958	1004.94	15313.68	q25-q50	3453	508.09	9773.61
	q50-q75	4004	2772.91	27171.39	q50-q75	3506	1248.71	17565.59
	q75-q90	2435	5849.59	41192.95	q75-q90	2084	3005.39	29374.37
	>q90	1624	15199.21	67106.25	>q90	1397	15527.81	68302.39
trade value	<q10	2034	1.413	0.492	<q10	2343	1.416	0.493
	q10-q25	2197	4.686	1.425	q10-q25	1205	3.428	0.495
	q25-q50	3958	18.338	7.945	q25-q50	3453	10.238	4.222
	q50-q75	4004	84.129	38.048	q50-q75	3506	47.677	22.932
	q75-q90	2435	361.248	151.179	q75-q90	2084	224.864	101.573
	>q90	1624	4539.695	13865.73	>q90	1397	2799.873	7880.028

Note: Own calculations based on the data. The means and standard deviations of trade value, employment and labour productivity (LP) are calculated for each quantile of service exports and imports.

Table 2A.2: Explanation of the Variables used in the Estimations

	Explanations	Variable	Sources	Expected Sign
Dependent Variables	UK firm level export to the trading partners (£'000)	Export	ITIS	
	UK firm level import from the trading partners (£'000)	Import	ITIS	
	UK firm total export/import to/from the trading partners	Total export/import		
	Number of firms exporting and importing	Number of firms		
	Average export/import value per firm	Average export/import		
Explanatory Variables	GDP of trading partner (current mn US$)	GDP partner	CEPII	+
	GDP per capita of trading partner (current mn US$)	GDPPC partner	CEPII	+
	Population-weighted great circle distance between large cities of the UK and her trading partners	Distance	CEPII	-
	Number of hours difference between the UK and her trading partner	Time difference	CEPII	+/-
	Dummy variable for colonial relationship; 1 if the UK and her trading partner ever in colonial relationship	Colonial relationship	CEPII	+
	Dummy variable for common legislation; 1 if the UK and her trading partner have common legal origin	Common legislation	CEPII	+
	Dummy variable for common language; 1 if a language is spoken by at least 9% of the population in the UK and her trading partner	Common language	CEPII	+
	Dummy variable for regional trade agreement; 1 for regional trade agreement in force between the UK and her trading partner	Regional trade agreement	CEPII	+
	Dummy variable for GATT/WTO membership; 1 if the UK and her trading partner are members of GATT/WTO	GATT membership	CEPII	+
	Dummy variable for EU membership; 1 if the UK and her trading partner are members of EU			
	Total number of employees, point in time	# of employees	ARD	+
	Gross value added per employee	Labor productivity	ARD	+
	Research and development engagement dummy: 1 if the firm is engaged in R&D activities	R&D engagement	ARD	+
	Age of the firm	Age of the firm	BSD	+/-
	Dummy for legal status of the firm; 1 is the firm is an LLC	LLC	BSD	+

Table 2A.3: UK's Exports

Quantiles	>Q10	Q10-Q25	Q25-Q50	Q50-Q75	Q75-Q90	<Q90
number of observations	2034	2197	3958	4004	2435	1624
number of firms	534	686	1019	1089	848	609
number of countries	149	143	142	144	125	95
mean(GDP)	284453	296177	297667	294287	337213	440226
	(1137830)	(1160136)	(1164122)	(1156299)	(1236040)	(1403792)
mean(dist)	3793.1	3733.9	3946.2	3646.2	3823.1	4283.9
	(4103.2)	(3945.0)	(3719.1)	(3906.7)	(3906.3)	(3617.8)
% of obs exporting to dist<2000km	42.97%	46.29%	51.14%	53.87%	56.84%	55.36%
% of obs exporting to dist>10000km	11.13%	8.83%	8.77%	7.52%	6.00%	4.62%

Note: The number of observations is sorted according to export quantiles. For each quantile, then, the number of firms, the number of countries, average GDP of partner countries and average distance between the UK and the partner countries are presented. Finally, the last two rows in the tables provide the share of observations exporting to distance less than 2,000 km and distance more than 10,000 km. Standard deviations of mean(GDP) and mean(dist) are given in the brackets. GDP of the UK in 2005 was 2,201,591 US dollars.

Table 2A.4: UK's Imports

Quantiles	>Q10	Q10-Q25	Q25-Q50	Q50-Q75	Q75-Q90	<Q90
number of observations	2343	1205	3453	3506	2084	1397
number of firms	713	563	1010	1175	953	646
number of countries	131	100	140	120	99	81
mean(GDP)	322549	417052	302422	350448	419713	507121
	(1209053)	(1371604)	(1171792)	(1259973)	(1378296)	(1511212)
mean(dist)	4055.9	3882.7	3818.1	3857.6	3632.7	3580.0
	(4216.9)	(4254.8)	(4023.3)	(4033.9)	(3774.2)	(3755.2)
% of obs exporting to dist<2000km	55.31%	57.51%	56.50%	57.13%	58.97%	59.99%
% of obs exporting to dist>10000km	7.81%	7.21%	6.31%	5.76%	4%	3.79%

Note: The number of observations is sorted according to import quantiles. For each quantile, then, the number of firms, the number of countries, average GDP of partner countries and average distance between the UK and the partner countries are presented. Finally, the last two rows in the tables provide the share of observations importing from distance less than 2,000 km and distance more than 10,000 km. Standard deviations of mean(GDP) and mean(dist) are given in the brackets. GDP of the UK in 2005 was 2,201,591 US dollars.

Appendix 2B Derivation of the standard firm-level revenue equation

In this study the gravity equation has been used as an empirical tool to estimate the determinants of service trade in the UK. In export analyses, in order to relate firm heterogeneity with the trade elacticities obtained from the gravity equation, we introduce a simple model which makes it easier to interpret the coefficients obtained with the gravity equation.

Suppose there is an economy with only one factor of production (labour, L) and there are n types of the differentiated product where each firm i produces only one variety due to increasing returns to scale. Therefore, the subscript i refers to both a variety and a firm. The consumers across countries have the same constant elasticity of substitution (CES) utility function over product i. The decision problem of a representative consumer is as follows:

$$\max_{x_i} \sum_{i=1}^{n} x_i^{\frac{\sigma-1}{\sigma}} \text{ subject to } \sum_{i=1}^{n} x_i p_i = w, \sigma > 1$$

where x_i is the individual demand for variety i and σ measures the elasticity of substitution between two varieties. Since consumers are at the same time workers, their spendings on all varieties is equal to their wages. Solving the maximization problem proposed above and considering that total demand is $x_i L = q_i$, the total demand for variety i is:

$$q_i = p_i^{-\sigma} \frac{wL}{\sum_{i=1}^{n} p_i^{1-\sigma}} \tag{2B.1}$$

where wL is total expenditure on good i and ($P = \sum_{i=1}^{n} p_i^{1-\sigma}$) is the CES price index. The market structure is a monopolistic competition in which each firm supplies a distinct differentiated variety. Production of each unit of good involves a fixed production cost, f_i and a constant marginal cost which is inversely proportional to firm productivity, γ. Finally, firms incur an iceberg cost, τ_{id}, to transport the goods to a destination country, d. Optimal price, which is a mark-up over the marginal cost, is determined by the firms profit maximization problem:

$$p_i = \frac{\sigma}{\sigma - 1} \frac{w\tau_{id}}{\gamma_i} \tag{2B.2}$$

The value of exports by firm i to destination d is $X_{id} = p_i q_i$. Substituting equation (2B.1) and equation (2B.2) into this expression yields equation (3):

$$X_{id} = \left(\frac{\sigma}{\sigma - 1}\right)^{1-\sigma} \tau_{id}^{1-\sigma} w_i^{1-\sigma} \gamma_i^{\sigma-1} PE \tag{2B.3}$$

According to equation (2B.3), the value of exports incurred by each firm is explained by the productivity level of each firm, transportation cost, total expenditure on good i ($E = wL$), CES price index ($P = \sum_{i=1}^{n} p_i^{1-\sigma}$) and wages. The transportation cost can be defined as $\tau_{id} = dist_{id}^{\alpha_0} \times e^{\sum_{j=1}^{k} D_{id,j}^{\beta_j}}$ in terms of the well-known gravity framework. $dist_{id}$ denotes the geographical distance between i and destination d and there are k dummy variables D_{id} to indicate that firm i's country has the same language, the same legislation and colonial relationship with d and they are both members of certain regional trade agreements. Plugging the transportation costs into equation (2B.3) yields the following equation:

$$X_{ids} = (\frac{\sigma}{\sigma - 1})^{1-\sigma} (dist_{id}^{\alpha_0} \times e^{\sum_{j=1}^{k} D_{id,j}^{\beta_j}})^{1-\sigma} w_i^{1-\sigma} \gamma_i^{\sigma-1} PE \tag{2B.4}$$

Equation (2B.4) defines the export flows by firm i to the destination country d (X_{id}) as a function of commonly used gravity equation variables and some firm characteristics. The log-linear version of the equation suggests that the coefficient of the distance variable depends on both the distance elasticity of trade costs and the elasticity of substitution. The GDP of the trading partners is used as the proxy of the total expenditures and the CES price index is included in the error term with other unobserved characteristics, ϵ_{id}:

$$\ln T_{ids} = \beta_0 + \beta_1 \ln GDP_d + \beta_2 \ln dist_{id} + \sum_{f=1}^{m} \gamma_f \ln F_i + \sum_{j=1}^{k} D_{id,j}^{\beta_j} + \epsilon_{ids} \tag{2B.5}$$

Chapter 3

Increasing Chinese Import Competition and Local Labour Markets in the UK [1]

3.1 Introduction

In the international trade literature, numerous studies have analysed the effects of globalisation (in the forms of trade, offshoring and foreign direct investment) on labour market outcomes after the opening process that took place during the 1980s. In particular, the disruptive effects of import competition from developing countries on labour markets in developed countries have been investigated to a large extent (Krugman and Lawrence, 1993; Leamer, 1998; Wood, 1995a,b). On one hand, some studies find no significant effects because exports from developing countries to developed countries are negligible (Krugman, 2008; Krugman and Lawrence, 1993; Lawrence and Slaughter, 1993). Krugman (1995) finds that imports from developing countries only have a minor negative impact on labour markets in developed countries because the total amount of imports from these countries is small, although their wage levels are lower. Katz and Autor (1999) finds that trade is not the reason for changes in the US wage structure, but actually the main factor is skill-biased technological change. Feenstra and Hanson (1997b) show that globalisation in the form of trade and offshoring plays a lesser role in accounting for the wage differentials in the US labour markets than the effects of technological change.

On the other hand, some studies have found the opposite. Rodrik (1997) finds that globalisation increases the volatility of employment and decreases workers bargaining power, while Pavcnik (2003)

[1] This work was based on data from the Quarterly Labour Force Survey, Annual Survey of Hours and Earnings, Annual Respondents Database and Business Structure Database, produced by the Office for National Statistics (ONS) and supplied by the Secure Data Service at the UK Data Archive. The data are Crown Copyright and reproduced with the permission of the controller of HMSO and Queen's Printer for Scotland. The use of the data in this work does not imply the endorsement of ONS or the Secure Data Service at the UK Data Archive in relation to the interpretation or analysis of the data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

and Feenstra and Hanson (1997a) show that the opening process which occurred from the 1980s onwards increased relative demand for skilled labour which in turn increased wage inequality in Chile and Mexico respectively. Feenstra and Hanson (2001) argue that international trade, especially trade in intermediate inputs, constitutes an important explanation for the increase in the wage gap. Minondo (1999) considers Spain to be a middle-income country and analyses the effect of trade on labour markets. He finds that trade with both developed and developing countries damages labour demand, especially in the case of unskilled workers. Using industry-linked individual-level worker data, Ebenstein et al. (2009) present evidence suggesting that globalisation has exerted downward pressure on wages in the US through the reallocation of workers away from higher paid manufacturing jobs into other sectors and occupations.

However, imports from a low-wage country may have a detrimental effect on labour markets in high-wage countries if the low-wage country is very large. The emergence of China has changed the situation described above and most studies have arrived at a consensus that Chinese import competition has placed an increasing strain on industries which produce similar products to China (Krugman, 2008). As a large country with an export-oriented development strategy based on low-wage manufacturing, researchers attention has been drawn to China. Alvarez and Claro (2006) and Schott (2008) show that the export prices of Chinese products are lower than the export prices of products from countries with similar income levels. Rodrik (2006) and Schott (2008) argue that Chinese exports are more sophisticated than its income level would suggest in terms of the range of products exported. Therefore, the competitive pressure due to China may be stronger than in other countries with similar income levels, such as those in Latin America or other Asian countries. Although importing from China allows access to cheaper products, it has been argued that it may also cause higher unemployment, lower labour force participation and lower wages in some of the importing countries.

As a vast country with a rapidly growing economy, China has had a very powerful effect on the world economy during the last two decades. The implementation of an open door policy in the 1980s and the existence of a relatively cheap labour force have made China one of the biggest exporters in the world, especially after joining the World Trade Organization (WTO) in 2001. Table 3.1 shows China's GDP, GDP growth, and export and import shares in GDP, while columns (4), (6) and (9) in Table 1 give the GDP, export growth and import growth rates respectively. Accordingly, for the period 1995-2013, the average GDP growth rate is nearly 10%, while the average export and import growth rate is around 15%. The changes in exports and imports are always positive, except in the case of export growth in 2009, the year of the global financial crisis. Columns (5) and (8) display exports and imports as a share of GDP. The average export share is 28% while the average import

share is 24%, and both exports and imports as a share of GDP accelerate after China's accession to the WTO. Figure 3.1 provides the average decadal GDP growth profiles for China, as well as high income OECD countries, G7 countries, EU countries, and for the world economy as a whole, over the last four decades. China has achieved a growth rate almost three times higher than that of other country groups and the world as a whole over the period in question. For the last three decades, the Chinese GDP growth rate has been around 10%.

The emergence of China as a large country has undoubtedly produced some significant effects on the UK as well. The UK is among the most open countries in the world, with nearly 65% of its total trade share in GDP. China is among the UK's top ten export destinations, as well as being its third largest import partner after Germany and the US, according to WDI Summary Statistics (2012). Chamberlin and Yueh (2011) show that the share of the deficit in GDP in the UK due to international transactions with China increased from 0.1% to 1.1% during the period from 1992 to 2009. In fact, they go further than this by demonstrating that China is the main reason for the UK's trade deficit in recent years. Table 3.2 depicts the UK's trade with the world as a whole and with China in columns (2)-(4) and (5)-(7) respectively. On average, the UK's exports to China have experienced a growth rate which is three times larger than its world export growth rate, while the UK's imports from China have undergone even greater growth, at a rate of more than four times that of the UK's world import growth. However, both figures include the dramatic decreases that occurred immediately after the economic crisis. The last two columns in the table show China's share of the UK's total exports and imports. Although both have increased over the period, the increase in imports from China as a proportion of the UK's total imports is higher than China's share of the UK's total exports. Moreover, China's share of the UK's total exports and imports continued to grow, even though the UK's trade with China and with the world overall both shrunk after the crisis. Over the period 1995-2013, the UK's total imports from China increased by 1,818% while its exports increased by 1,432%.

Taking into account the increasingly important role played by China in the UK's import trade, the aim of this chapter is to investigate the effects of imports from China on labour market outcomes in the UK. Figures 3.2 and 3.3 illustrate the patterns that have emerged in the UK's trade with China and its relationship with unemployment and employment respectively. The unemployment rate decreases until 2004 and increases after that, while imports from China increase over time. Both imports and the proportion of employment in the total population rise until 2008; however, the rate of employment increases more rapidly than that of imports. Nevertheless, it could be the case that the decrease in the employment rate after 2008 was a result of the global economic and financial crisis rather than being caused by the increase in Chinese imports. In fact, figures from ONS (2009)

show that the unemployment rate increases beginning from the second quarter of 2008 as a response to the decrease in GDP due to the crisis, and that it reaches its maximum level (7.1%) since 1997 in the first quarter of 2009.

Although Figures 3.2 and 3.3 do not provide any clear evidence of a negative or positive impact of trade on unemployment or employment, it is of great importance to investigate these effects at the regional level. In a study on the US, Glaeser et al. (2011) show that different regions experience varying economic performances over the long run. Focusing on geographic regions allows us to see the regional variations in exposure to Chinese imports, as the initial specialisations in each region might differ from each other. These initial patterns of industry specialisation make each region effectively an independent sub-economy in terms of trade shocks. Although the importance of China's rapid economic growth is being increasingly recognised, as yet, its importance at regional level has barely been considered. Autor et al. (2013a) show that the effects of Chinese import competition on US labour markets depends on the initial specialisation of each local labour market. Accordingly, some local labour markets are more vulnerable to the effects of Chinese imports, depending on their industrial composition. These local markets are affected more as a result of regional variations in the importance of different industries. Identifying these vulnerable local labour markets within a country would help policy makers to tailor suitable policies for each industry in order to improve labour market outcomes. The effects of imports from China may also vary across local labour markets in the UK depending on their initial industry specialisation. In fact, according to World Integrated Trade Solutions statistics (WITS, 2012), machinery and electrics (36.58%), textiles and clothing (15.27%), metals (5.97%), footwear (4.69%) and plastics and rubber (4.36%) are the main products that the UK imports from China. Therefore, it is particularly important to focus on those local labour markets which specialise mainly in these industries in order to observe the true effects of increasing Chinese imports competition. This chapter tests the theory proposed by Autor et al. (2013a) to investigate how the impact of increasing Chinese import competition varies across local labour markets in the UK.

UK data sources provide different definitions for the regions within the country, but most sources categorise them in terms of administrative areas. However, these administrative definitions are often not relevant to economic behaviour. In a regional analysis of the importance of intangible capital, Riley and Robinson (2011) use *UK City Regions* based on the commuting patterns of skilled workers. Criscuolo et al. (2012) use *Travel to Work Areas* as being representative of economic regions in the UK to analyse the effect of Regional Selective Assistance on employment and investment within firms. This definition of local labour markets also takes into account the commuting patterns of workers. Since the *Travel to Work Areas* variable is more disaggregated, following Criscuolo et al.

(2012), we also use this variable as a proxy for local labour markets to analyse the effects of imports from China on local labour market outcomes in the UK for the period 1998-2013.

Our results show that exposure to imports from China does not have any significant impact on total employment, manufacturing employment, working population and average wages in the UK's local labour markets. The results are sustained when we control for the exposures to exports to China. Analyses of the different demographic groups, such as age, gender, and education level, show that both total employment and manufacturing employment are unaffected by the increase in Chinese imports, with the exception of graduate employment. Exposure to Chinese imports is associated with a decline in graduate employment. The analysis regarding the firm characteristics within the UK's local labour markets suggests that exposure to Chinese imports in the local labour markets decreases the average firm size, whereas the average labour productivity is unaffected.

The rest of the chapter is organised as follows. Previous studies regarding the effects of trade on (local) labour market outcomes are discussed in Section 2. Section 3 and Section 4 provide information on the data and methodology used respectively. Section 5 gives the results of the analysis obtained using empirical models. Finally, Section 6 concludes.

3.2 Literature Review

The international trade literature contains numerous studies which investigate the effects of trade on labour market outcomes. The majority of these studies confirm the disruptive effects of trade using country-, industry- and firm/plant-level data [2] [3]. The existing literature on the effects of Chinese imports is also voluminous, especially after China's accession to the WTO. These studies can be classified into two groups. The first group is comprised of studies that investigate the impact of Chinese imports on developed countries, while the second group focuses on the effects of Chinese imports on developing countries[4].

However, international trade economists have only recently started to investigate the labour market effects of trade at the regional level. Taking into consideration the varying economic behaviours of different regions depending on their initial industrial specialisation, regions are exposed to trade

[2] On US labour markets, see Bernard et al. (2006); Ebenstein et al. (2009); Feenstra and Hanson (1997b); Harrison and McMillan (2011); Katz and Autor (1999); on Latin American countries, see Eslava et al. (2009); Goldberg and Pavcnik (2005); Hanson (2007); Romalis (2007); Trefler (2004).

[3] There are also some studies which investigate the effects of globalisation on labour demand elasticity (see Fajnzylber and Maloney (2005); Hasan et al. (2007); Krishna et al. (2001); Lichter et al. (2013); Mitra and Shin (2012); Slaughter (2001)). However, these studies lie beyond the scope of this study.

[4] See Alvarez and Claro (2006); Blazquez-Lidoy et al. (2006); Bloom et al. (2011); Branstetter and Lardy (2006); Castro et al. (2007); Eichengreen et al. (2004); Iranzo and Ma (2007); Jenkins et al. (2008); Katz and Autor (1999); Krugman (2008); Lederman et al. (2007); Rodriguez-Clare et al. (2006); Shigeoka and Wai-Poi (2006).

shocks in different ways and to different extents. Topalova (2007) can be considered as the pioneering study that investigates the impact of trade reforms on poverty and inequality in Indian districts for the period 1983-2000. She constructed an *employment-weighted average tariff* for each district to identify the differing effects of local labour-market shocks on various locations. Her results show that trade liberalisation led to an increase in the poverty rate and the poverty gap in rural districts which are highly dependent on industries that are more exposed to liberalisation, although the results obtained from aggregated data do not suggest a clear-cut relationship between liberalisation and the poverty rate and/or poverty gap. In another study, she extends this analysis by exploring the mechanisms by which trade reform may affect income distribution, including factor mobility and adjustment in price levels (Topalova, 2010). She demonstrates that factor mobility and the institutions that may influence income distribution play a vital part in mitigating the unequal effects of trade liberalisation. Kovak (2010) uses a similar technique to measure the effects of trade liberalisation on wages in local labour markets and internal migration patterns in Brazil for the period 1987-1995. He finds that regions whose output experienced a larger liberalisation-induced price decline also experienced a steeper wage decline. Chiquiar (2008) exploits regional variations in the exposure to international markets to identify the effects of globalisation on wage levels and skill premiums for Mexico in 1990 and 2000. His results suggest that regions with a greater exposure to international trade exhibit a relative increase in wage levels and a decrease in skill premium in comparison to more inward-oriented regions. Using data for Austrian municipalities, Brulhart et al. (2012) examine the reaction of regional employment and nominal wages to the opening of the Central and Eastern European markets after the fall of the Iron Curtain in 1990. They find that trade liberalisation has statistically significant differential effects on both nominal wages and employment in a narrow band of border regions. Following the approach proposed by Topalova (2007), McLaren and Hakobyan (2010) investigate the effects of reductions in US tariffs on Mexican products under NAFTA on the wages of US workers. Moreover, they also try to identify whether these effects follow a geographic pattern. The results suggest that both local employment-weighted average tariffs and industry tariffs have statistically and economically significant effects on wages. Specifically, reductions in local average tariff rates cause dramatic decreases in blue-collar wages within the locality.

Recently, the importance of the regional initial industrial specialisation has been highlighted by Autor et al. (2013a). Instead of using a system of mapping from trade prices to wages and employment, as in the aforementioned studies, they develope an alternative approach in which the mapping is quantity-based. Accordingly, a region is more exposed to import competition if its sales come mainly from industries in which country's imports increase at a faster rate. They analyse the impact of Chinese import competition on local labour market (commuting zones) outcomes in the US between

1990 and 2007. The novel feature of this study lies in the calculation of the local labour market import exposure index which captures the change in import exposure within a region, based on its initial industrial employment structure. They find that increased exposure to Chinese imports causes higher unemployment, lower labour force participation and lower wages in US local labour markets. As an extension of this study, Autor et al. (2013b) investigate how the magnitude of employment changes respond to trade and technology shocks in US local labour markets between 1980 and 2007. The results are similar to those in the preceding study. They show that a decline in manufacturing employment is more severe for workers without a college education, and that job losses result, not only in terms of production jobs, but also managerial, professional and technical jobs.

Following the approach proposed by Autor et al. (2013a), Dauth et al. (2012), Mendez (2013) and Donoso et al. (2014) exploit cross-regional variations in exposure to Chinese imports due to initial differences in industry specialisations in Germany, Mexico and Spain respectively. Dauth et al. (2012) find that a rise in Chinese imports causes job losses in German regions which specialise in competing import industries, in both manufacturing and other sectors. Donoso et al. (2014) compare the import competition effects for manufacturing and non-manufacturing employment. They show that Spanish provinces with a higher exposure to Chinese imports experience steeper drops in manufacturing employment; however, this reduction is compensated for by increases in non-manufacturing employment. Finally, the results of Mendez (2013)'s study suggest that an increase in competition decreases the employment share in manufacturing for the average Mexican local labour market, while the mobility of workers increases because of the trade shocks. However, wages in Mexican municipalities remain unaffected.

The current chapter is most closely related to the aforementioned literature which identifies the impact of trade shocks at the regional level. In this study, we estimate the economic impact of Chinese import competition on local labour markets in the UK by exploiting the variation in industry specialisation. We calculate the Chinese import exposure index for each travel to work area in the UK, following the methodology developed by Autor et al. (2013a). We investigate its effect on different labour market outcomes, such as change in employment and manufacturing employment, working population growth, and average wages in each local labour market. We repeat the analyses for different demographic groups. Moreover, we also examine the effects of Chinese imports on firms in different regions. In this analysis, we aim to observe how Chinese imports affect average firm size and labour productivity in each region.

The main contribution of this chapter is that, to the best of our knowledge, this is the first regional-level study which investigates the effects of Chinese imports in the UK. The amount of

trade between these two countries makes it worth paying attention to the import exposure of local labour markets in the UK. Being geographically separated from mainland Europe and having a different currency make the UK a special case among the European countries. Moreover, the current literature which investigates the effects of import competition on local labour market outcomes only focuses on the effects of this phenomenon on the workers. However, local labour markets with greater exposure are also more likely to experience changes in firm characteristics due to the increasing import competition. Therefore, we also examine the impact of increasing Chinese import exposure on the change in average firm size and average labour productivity in local labour markets in the UK. Using recent, comprehensive data, we explore local labour markets in the UK in order to identify the effects of increasing Chinese imports on both workers and firms during the period from 1998 to 2013.

3.3 Data Sources and Variable Constructions

In this part of the study, we provide information about the data sources that are used. This is followed by a description of the data management process regarding the construction of variables.

The data sources that have been used to calculate the import exposure index and to analyse its impact on local labour market outcomes are the Quarterly Labour Force Survey (QLFS), the Annual Survey on Hours Earnings (ASHE), and the EUROSTAT database. The QLFS, which is conducted by the Office for National Statistics, is the most important source of labour market data in the UK. It provides information on economic activity and inactivity, earnings and socio-economic characteristics such as age, gender, and country of origin. It also collects information on the education and training of each individual including years of schooling, qualification(s) held, and managerial status. It is a random survey of almost 50,000 households sampling more than 100,000 individuals for each quarter over the period 1992-2013. Within any quarter, the survey captures almost 0.2% of the UK population (ONS, 2011).

The QLFS has a single-stage sample design with a random sampling of addresses so that the sample is effectively stratified geographically. After this stage, in order to do interviews, the country is partitioned into fixed number of interwiev areas. In order to avoid bias within quarters due to fieldwork practice, the sample is designed as a series of weekly two-stage samples spread over the 13 weeks during which the whole country is covered and therefore this quarter as a whole constitutes a single-stage sample. While the interviews for these addresses are accrued, they are not necessarily conducted with the same households because of the rotation system used. Once initially selected, a respondent is interviewed over five successive quarters. After the fifth interview, he/she is dismissed

and replaced by a new respondent. The total sample in each quarter is divided into five groups and, after every quarter, almost one-fifth of the sample is replaced by new respondents. The rotating sample design is aimed at improving the predictions from the sample due to the overlaps and also makes it possible to produce longitudinal datasets (ONS, 2011). The data is collected by face-to-face and telephone interviews and, to a lesser extent, postal surveys. Although it decreases over time, the average response rate for each wave is over 65%. However, this rate is subject to annual change due to the burden of questionnaire completion. Chatzitheochari and Arber (2009) show that the non-response rate for the survey is unlikely to cause significant bias, since it is not strongly related to commonly used socio-demographic variables because non-responders in surveys cannot be identified by any socio-demographic factors. In terms of economic activity/inactivity, we weight the sample data to obtain the actual employment level in each local labour market using the WEIGHT variable provided in the data. Since the target of the QLFS is to represent the entire eligible population of the UK with a probability sample of households and individuals, the WEIGHT variable is formed using a multi-stage population weighting procedure which assigns a calibration weight to each respondent according to region, age and gender. The sum of the calibration weights from an entire dataset gives the eligible population of the UK (ONS, 2011).

Since the QLFS has the largest sample size of any household survey, it is possible to generate statistics for small geographical areas. Moreover, the sampling errors are also small because of the single-stage random sampling of addresses. This unclustered sample design of addresses was introduced in 1992 to improve the precision of estimates, particularly for regional analyses (ONS, 2011). In this study, to estimate the effect of import exposure on each local labour market in the UK, we use the *Travel to Work Areas (TTWAs)* variable as a proxy for the local labour markets, following the method adopted by Criscuolo et al. (2012). A local labour market is an area in which all commuting occurs within the boundary of the area. TTWAs, which have been created as an approximation of these self-contained labour markets for statistical purposes, are the areas where the bulk of the resident population also work within the same area. To be defined as a TTWA, it is also necessary for the total working population in the area to be at least 3,500 (ONS, 2007). The QLFS introduced this variable in 1999, based on 1991 Census data which created 314 TTWAs (including Northern Ireland). However, in 2007, a new definition of the TTWA variable was provided based on 2001 Census data which generated 243 TTWAs (including Northern Ireland) [5]. A reduction in the number of TTWAs has been observed due to the increasing trend towards longer distance commuting. Some TTWAs identified under the 1999 definition have been partitioned and assigned to different TTWAs according to the 2007 definition. Therefore there is no direct mapping from one definition to the other. However,

[5]The Northern Ireland Labour Force Survey is the responsibility of the Department of Enterprise, Trade and Investment (DETINI) and fieldwork is carried out by the Central Survey Unit of the Department of Finance and Personnel. Therefore, the QLFS does not report data for Northern Ireland.

using the ONS Postcode Directory data, which provides a wide range of geographical areas for the UK, we calculate the centroid of each TTWA, and map a TTWA from 1999 to the closest available TTWA from 2007. Moreover, because we want to analyse three five-year periods in our analysis, we include 1998 as well. However, the TTWA variable is not reported for this year. We therefore use the mapping from wards (the primary unit of English electoral geography) to TTWAs, which is provided by the UK Data Service Census Support service in order to produce the TTWA variable for 1998. Finally, the TTWA variable is provided only for the second quarters until 2007, and thus we consider only the second quarters of the QLFS for the period 1998-2013.

The QLFS asks questions about employment status which are used to calculate employment levels in each TTWA. The WRKING variable asks whether an individual is working in the reference week. If the answer is YES, we consider this individual to be "employed". If the answer is NO, then in the JBAWAY variable, they are asked whether they have a job or business that they are away from in the reference week. If the response is YES, these individuals are considered as employed too. According to the data, for the analysis period of 1998-2013, the average employment in the working population is 73%, whereas the labour force participation rate is 64%. These figures are close to the figures reported by the WDI. Employment status can also be obtained from the ILODEFR (ILO definition of economic activity) variable, which splits employment status into the following categories: employed; unemployed; and inactive. However, both approaches are compatible with each other. Since the WRKING and JBAWAY variables exist in all quarters, we have selected the first approach in order to determine employment status. Using the employment status enables us to calculate the employment level or rate in each TTWA for different age groups and genders. Throughout the analyses, we only focus on those individuals aged between 16 and 65.

In order to investigate the effect of Chinese imports on wages in each local labour market, we use ASHE, which is one of the largest surveys on individual earnings in the UK. It provides data on the wages, paid hours of work, and pension arrangements of nearly one per cent of the working population for the period 1997-2013. For the purposes of analysis, the average gross weekly wages in each TTWA is calculated by taking into account the calibration weights provided in the data. The calibration is carried out for 108 domains of the population based on the respondent's age, gender, occupation and region of workplace (ONS, 2004).

The latter data source is used to calculate the import exposure index. Figures for the UK's industry level imports from China are obtained from the EUROSTAT Database which provides product level trade values for the European Union (EU) countries using a 6-digit Harmonised System (HS) commodity description. Import values are given in Euros. The type of economic activity in which

individuals are engaged are given according to SIC classification in the QLFS and ASHE. In order to link these datasets to the EUROSTAT data, we use SIC92 and SIC07 as linking variables. To this end, product concordances from the United Nations Statistics Division and the World Integrated Trade Solution (WITS) are used to convert HS into SIC92 and SIC07.

3.4 Methodology

In order to investigate the effects of rising Chinese import competition on different labour market outcomes such as change in employment, change in manufacturing employment, working population growth, and change in average weekly wages in each local labour market we follow the methodology developed by Autor et al. (2013a). In this part of the study, we describe this approach in detail as well as the empirical model used.

3.4.1 Theoretical background

In order to investigate how exogenous growth in Chinese exports to the UK affects local labour market outcomes in the UK, we follow the theoretical motivation proposed by Autor et al. (2013a). According to this, a local labour market is exposed to greater import competition when it accounts for a larger share of the country's sales in those industries in which the country's import growth from China is substantial. They developed a trade model based on monopolistic competition in which each local labour market is treated as a small economy. They use the gravity structure, which enables mapping from trade quantity to wages and employment in the absence of import price data. According to this model, productivity growth or falling trade costs in China can affect a region in the UK through two exogenous channels:

(i) Import demand channel: increased demand for goods in China (captured by the change in expenditure in China on each industry j, $\hat{E}_{Cj}$)

(ii) Export supply channel: increased competition in the markets in which a region sells its output (captured by the change in China's export-supply capability in each industry, $\hat{A}_{Cj}$)

$$\hat{L}_{Ti} = \rho_i \sum_j c_{ij} \frac{L_{ij}}{L_{Ti}} \left[\frac{X_{ijC}}{X_{ij}} \hat{E}_{Cj} - \sum_k \frac{X_{ijk}}{X_{ij}} \frac{M_{Cjk}}{E_{kj}} \hat{A}_{Cj} \right] \tag{3.1}$$

$$\hat{W}_i = \sum_j c_{ij} \frac{L_{ij}}{L_{Ti}} \left[\frac{X_{ijC}}{X_{ij}} \hat{E}_{Cj} - \sum_k \frac{X_{ijk}}{X_{ij}} \frac{M_{Cjk}}{E_{kj}} \hat{A}_{Cj} \right] \tag{3.2}$$

Equations (3.1) and (3.2) show the impacts of export-supply and import-demand shocks in China on region i's employment and wages. They show that a change in employment and wages in region i is the sum of the increase in demand for region i's exports to China and the decrease in demand for region i's shipments to all markets in which it competes with China. The former one is calculated by $\hat{E}_{Cj}$ times region i's initial share of output that is shipped to China (X_{ijC}/X_{ij}), while the latter one is calculated by $\hat{A}_{Cj}$ times region i's initial share of output that is shipped to each market k (X_{ijk}/X_{ij}) and market k's initial share of imports from China in terms of total purchases (M_{Cjk}/E_{kj}). These two terms are totalled across industries and weighted by the initial ratio of employment in industry j to total employment in traded industries (L_{ij}/L_{Ti}). The equation is scaled by the share of the current account deficit in total expenditure in region i (ρ_i), and the general equilibrium scaling factor (c_{ij}) [6].

These two channels have opposite effects on wages and employment; positive shocks to China's export-supply ($\hat{A}_{Cj}$) decrease wages and employment, while positive shocks to China's import-demand ($\hat{E}_{Cj}$) result in increasing wages and employment in traded goods within a region. A trade imbalance ($\rho_i \neq 0$) is required for the model to work because, if the trade between China and the UK is balanced, then these two effects offset each other. In the empirical implementation of the model, Autor et al. (2013a) introduce two restrictions. First, the effects on the local labour markets that stem from third markets have been ignored. The analysis focuses only on Chinese imports to the US and excludes Chinese imports to other countries. Due to the lack of data, we also only focus on Chinese imports to the UK, not to the other markets to which the UK also exports. However, using an instrument which is calculated based on EU14's imports from China instead of the UK's imports from China, we indirectly control for the third market effect. Second, US exports to China have been ignored. When we consider the magnitude of exports from the UK to China compared to the magnitude of imports from China to the UK, we can also maintain the second restriction for this study. Therefore, imports from China affect regions in the UK only through the second channel. However, in the empirical analysis, we control for the effects of exports to China in some of the econometric specifications. Ignoring the first channel (import demand channel) in the equations and rearranging them yields the following equation [7]:

$$\hat{L}_{Ti} = \alpha \sum_j \frac{L_{ij}}{X_{ij}} \cdot \frac{X_{ijUK}}{E_{UKj}} \cdot \frac{M_{CjUK}\hat{A}_{Cj}}{L_{Ti}} \tag{3.3}$$

[6] c_{ij} is a positive constant that is a function of the model parameters, initial sectoral employment, and shares of expenditure (Autor et al. (2013a), Online Theory Appendix).

[7] The wage equation is analogous to this equation.

In equation (3.3), the change in employment in region i ($\hat{L}_{Ti}$) is explained by region i's share of the total purchases in industry j (X_{ijUK}/E_{UKj}), exogenous growth of UK imports from China ($M_{CjUK}\hat{A}_{Cj}$) which is scaled by region i's total employment in traded industries (L_{Ti}), and the employment level in each region i scaled by the total sales generated from this region in industry j (L_{ij}/X_{ij}). Finally it is scaled by the share of trade imbalance in total expenditure and the general equilibrium scaling factor, which are assumed to be the same across all UK regions ($\propto= \rho_i c_{ij}$).

In order to derive the local labour market import exposure variable depending on equation (3.3), two further restrictions are incorporated into the model following Autor et al. (2013a). First, L_{ij}/X_{ij} is considered to be constant. In fact, in a monopolistic competition model with a single production factor, L_{ij}/X_{ij} should not vary by region and/or industry in order to keep the variable unbiased. Second, due to the lack of data on regional production and sales, X_{ijUK}/E_{UKj} is approximated by region i's share of UK employment in industry j (L_{ij}/L_{UKj}). Combining these two restrictions allows us to obtain the following equation for the change in employment in region i ($\hat{L}_{Ti}$):

$$\hat{L}_{Ti} = \alpha \sum_{j} \frac{L_{ij}}{L_{UKj}} \cdot \frac{M_{CjUK}\hat{A}_{Cj}}{L_{Ti}} \tag{3.4}$$

According to equation (3.4), the change in employment in region i depends on growth in imports from China to the UK (M_{CjUK}) mandated by growth in China's export-supply capability ($\hat{A}_{Cj}$), which is scaled by the total employment in region i (L_{Ti}) and weighted by region i's share of UK employment in industry j (L_{ij}/L_{UKj}).

3.4.2 Empirical Approach

In this study, *import competition exposure index in each local labour market* is used as the main explanatory variable in order to investigate the effects of UK imports from China on local labour market outcomes such as employment, working population and average wages in the UK. To this end the empirical proxy of equation (3.4) is used as follows:

$$\Delta MEX_{UKit} = \sum_{j} \frac{L_{ijt}}{L_{UKjt}} \cdot \frac{\Delta M_{jt}^{C-UK}}{L_{it}} \tag{3.5}$$

where ΔM_{jt}^{C-UK} is the observed change in UK imports from China in industry j between the start and end of period t. L_{it} is the total employment in the local labour market i at the start of the period t. $\frac{L_{ijt}}{L_{UKjt}}$ is region i's share in industry j as a proportion of the total employment of industry

j at the start of the period t. The index (ΔMEX_{UKit}) refers to the average change in Chinese imports per worker in local labour market i and is obtained by weighting each industry by its initial share in the country's total employment. The difference between equation (3.4) and equation (3.5) is that, in equation (3.5), import quantity is divided by total employment in the local labour market (L_{it}) instead of trading or non-trading sector employment (L_{Ti}), since the data used in the analyses do not distinguish between trading and non-trading sectors.

Two main concerns arise when estimating the effects of import exposure on local labour market outcomes. First, UK imports from China might be affected not only by exogenous factors, such as growing productivity or falling trade costs in China, but also by unobserved demand shocks in the UK. In the case of negative demand shocks, the OLS estimates will be downward biased since both employment level and imports from China in the UK will be lower. To avoid the endogeneity bias, following Autor et al. (2013a), *import competition exposure index is instrumented* by ΔMEX_{EU14it} which is calculated using *observed change in Chinese exports to other European Union countries* [8].

$$\Delta MEX_{EU14it} = \sum_{j} \frac{L_{ijt}}{L_{UKjt}} \cdot \frac{\Delta M_{jt}^{C-EU14}}{L_{it}} \tag{3.6}$$

where ΔM_{jt}^{C-EU14} is the observed change in EU-14 imports from China in industry j between the start and end of period t. Using the amount of Chinese exports to EU14 countries will identify the exogenous component of China's imports, since all of its trading partners are vulnerable to rising import exposure. This will mop up the effects of possible shocks that simultaneously affect the UK imports and local labour market outcomes. The instrument chosen must have explanatory power and should not be strongly correlated with the demand shocks in the UK. EU14 countries, which have similar income levels to the UK, are also affected by increasing Chinese imports. However, because the UK is geographically separated from mainland Europe and has a different currency, this makes it less likely that changes in import flows between EU14 countries and China will have direct effects on local labour markets in the UK.

Second, the contemporaneous local labour market outcomes might be affected by anticipated Chinese imports, which would cause simultaneity bias. To moderate this bias, we use one-period lagged levels of employment. This yields the following *non-UK import competition exposure index*:

[8]This non-UK import exposure index takes into account the imports of EU14 countries from China instead of the UK's imports from China. EU14: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden.

$$\Delta MEX_{EU14it} = \sum_{j} \frac{L_{ijt-1}}{L_{UKjt-1}} \cdot \frac{\Delta M_{jt}^{C-EU14}}{L_{it-1}} \tag{3.7}$$

The import competition index given in equation (3.5) is the main explanatory variable employed in the following regression model which is used throughout the analyses:

$$\Delta y_{it} = \beta_0 + \beta_1 \Delta MEX_{UKit} + K'_{it}\beta_2 + e_{it} \tag{3.8}$$

In this equation, Δy_{it} refers to different dependent variables such as employment growth, manufacturing employment growth, working population growth and wages in each local labour market (TTWAs). In order to estimate these regressions, a set of control variables (K_{it}) is used along with the import exposure index. K_{it} contains the share of manufacturing in each TTWA at the start of the period, the share of graduates in each TTWA at the start of the period, the proportion of the population that is foreign born in each TTWA at the start of the period, the share of women that are employed in each TTWA at the start of the period, and finally the share of young people (aged 16-34) in employment in each TTWA at the start of the period. In the 2SLS estimations, ΔMEX_{UKit} is instrumented by ΔMEX_{EU14it} and one-period lagged explanatory variables are used.

Autor et al. (2013a) calculate the import exposure variable and the dependent variables using decadal observed changes in imports from China to the US and in the manufacturing employment share of the working-age population in region i respectively. Our data covers the period from 1998 to 2013. We divide this longer period into three five-year periods: $t1$: 1998-2003; $t2$: 2003-2008; and $t3$: 2008-2013. Therefore, Δy_{it} is the five-year change in each dependent variable. Each regression includes a constant term, dummies for each time period, and dummies for 11 Nomenclature of Territorial Units for Statistics (NUTS1) regions in the UK to control for geographical heterogeneity [9]. Following the analysis regarding the main local labour market outcomes, we analyse how the impact of Chinese imports varies among different demographic groups such as age, gender, and education level. Next, we calculate the export exposure index and include it in the main regressions to examine the effects of UK's exports to China. Finally, in the last part of the analyses, we investigate the effects of Chinese imports on firms in local labour markets. To this end, we analyse the effects of import exposure on average firm size and productivity in each local labour market.

[9] NUTS1 regions in the UK: North East, North West, Yorkshire and the Humber, East Midlands, West Midlands, East of England, London, South East, South West, Wales and Scotland.

3.5 Analysis

To estimate the effects of rising Chinese import competition on different labour market outcomes such as employment, manufacturing employment, working population and average weekly wages in each local labour market, we use OLS and 2SLS. The main explanatory variable, the import exposure index, is calculated according to the methodology suggested by Autor et al. (2013a). Figure 3.4 demonstrates the regression plot between import exposure and change in employment in the UK during the period 1998-2013. The time dummies and regional dummies are included in the model in order to control for time and regional variations. Furthermore, the model weights the TTWAs according to their share in the in total population at the start of the period. The figure reveals a slightly negative relationship and it also shows that outliers are unlikely to have a sizeable effect. Following the descriptive statistics, we first present the results from the main local labour market outcomes, and then we repeat the same analysis for different demographic groups. The models that control for the UK's exports to China are presented next. In the last part of the analysis, we examine the effects of Chinese imports on firms in local labour markets. To this end, we analyse the effects of import exposure on average firm size and labour productivity in each local labour market. In the 2SLS estimations, the import exposure variable is instrumented by a new exposure index which is calculated using Chinese imports to other EU countries instead of Chinese imports to the UK. In each table, model 1 and model 4 include only the import exposure variable, whereas in models 2 and 5 we control for the manufacturing employment share in each TTWA at the start of the period. Finally, in models 3 and 6, we add all the other control variables. The coefficients of the instrumental variable, the F-statistics and the weak instrument test (KP test proposed by Kleibergen and Paap (2006)) from the first stages of the 2SLS estimations are also provided. The highly significant coefficients and the values of the KP test suggest that the instrumental variable is relevant in each regression. Each regression includes a constant term, dummies for each time period, and dummies for 11 NUTS1 regions in the UK to control for time and geographical heterogeneity.

3.5.1 Descriptive Statistics

Table 3.3 reports some summary statistics for the main variables regarding the key characteristics of the UK's local labour markets. The share of total employment in the working population increases during the first period and remains nearly the same in the second period. However, in the last period, the share of employment in working-age population decreases on average. In terms of the share of manufacturing employment in working population, we observe decreases in the first two

periods, while in the last period it undergoes a 0.13 percentage point increase. The average Chinese import exposure is different in each period. It is approximately 3,000 Euros per worker in the first period and it increases to 4,650 Euros per worker in the second period. Finally, in the last period, it decreases to the level of 2,500 Euros per worker. Although in the first two periods, the amount that the UK's imports from China increases considerably, in the last period the observed change in the UK's imports from China reveals a 1% decrease. Therefore, the decrease in average Chinese import exposure during the last period can be explained by the trade collapse brought about by the recession in the last period.

In Figure 3.5, the start of the period manufacturing employment in each period is compared to the start of the period manufacturing employment in the following period. The figure reveals large differences in manufacturing employment across TTWAs. In 1998, the range is between 2% (179, Pitlochry) and 27% (036, Burnley, Nelson & Colne). However, in 2003 the range is between 1% (047, Carmarthen & Llandovery) and 24% (190, Rugby) and, finally, in 2008 the figures range from between 4% (188, Richmond & Catterick) and 22% (091, Grantham). Panel A compares manufacturing employment in 1998 with the corresponding figure in 2003. From 1998 to 2003, the share of manufacturing employment in working population increases in 60 TTWAs but decreases in 158 TTWAs. The highest increase is seen in Whitby (230), with a rise of 15 percentage points while the highest decrease is witnessed in Ludlow (138) with a decrease of 12 percentage points. Panel B compares the share of manufacturing employment in the working population in 2003 and 2008. From 2003 to 2008, the share of manufacturing employment in working population increases in 72 TTWAs but decreases in 150 TTWAs. The highest increase is achieved by Invergordon (110) with an increase of 12% percentage points, while the highest decrease is recorded by Bude & Holsworthy (035) with a fall of 13 percentage points [10]

Figure 3.6 visually compares the evolution of the import exposure index and change in employment for all the periods. The TTWAs are classified into four quartiles according to the relevant variable and the variation differs considerably in each quartile. The map on the left in each panel shows the change in exposure to Chinese import competition whereas the map on the right shows the change in total employment in each TTWA during a particular period. In all the periods, the maps depict considerable variations across TTWAs in terms of both variables. The TTWAs with the least exposure across all periods are in the north of the UK. Panel A provides a visual impression of both variables for the period 1998-2003. Generally, the most exposed TTWAs are located in Wales and Eastern England. However, there is no visual evidence for a low level of employment among highly exposed TTWAs. In the second period (2003-2008), the TTWAs which are most exposed to Chinese

[10]The code of each TTWA is given in brackets along with the name of the TTWAs. See Table 3A.5.

import competition are located in the middle of the country, from south to north, while increases in employment are observed in the north and the southeast. Finally, in the last period, the TTWAs with the highest import exposure indices are located in the south of England and the TTWAs with the greatest change in employment are located in the south and the north [11]. Manufacture of plastic products, manufacture of brooms and brushes, manufacture of footwear, manufacture of knitted and crocheted fabrics, manufacture of sports goods, aluminium production, manufacture of electronic valves and tubes and other electronic components, manufacture of aircraft and spacecraft, manufacture of apparatus of television and radio, and manufacture of special purpose machinery are examples of the types of industries by highly exposed TTWAs. These are in line with the observed data which shows that machinery and electrics (36.58%), textiles and clothing (15.27%), metals (5.97%), footwear (4.69%), and plastics and rubber (4.36%) are the main products that the UK imports from China (WITS, 2012) [12].

3.5.2 Import Exposure and Local Labour Market in the UK

This subsection presents the results from the analyses relating to the different outcomes from the local labour markets in the UK.

3.5.2.1 Import Exposure and Employment

Table 3.4 presents the results for both the OLS and 2SLS estimations for a five-year change in employment as a share of the working population. The coefficient of the import exposure variable is negative in all the models. According to the OLS results, the point estimate indicates that an increase of 1,000 Euros per worker in a TTWA's exposure to Chinese imports during the five-year period is associated with a decline in employment of 0.1 percentage points of the working age population. The magnitude of the coefficient increases to 0.2 in the 2SLS analysis where endogeneity

[11] A list of the ten TTWAs which are most and least exposed to Chinese import competition in all the periods is given in Table 3A.3. Column 2-4 provide the ranking of the least exposed ten TTWAs for all three periods, while column 5-7 provide the ranking of the most exposed ten TTWAs for all three periods. Column 4 and 7 report the import exposure index calculated for the corresponding TTWA. The figures are provided for the first three industries (where possible). For example, in the 1st period, Mull & Islay was the least exposed TTWA, while Telford & Bridgnorth was the most exposed TTWA. The industry content of these TTWAs, according to SIC92 industrial classification, is provided in Table 3A.4. The table is constructed according to the ranking of TTWAs based on their import exposure indices. The first column provides the starting year of each period since the import shares are calculated for this years. Column 3 reports the import share of each TTWA in UK's total imports, while column 6 reports the import share of the industry (given in column 5) in the TTWA's (given in column 2) imports. For example, in the first period, the import share of Mull & Islay in UK's total imports is 0.05%. The main importing activity in the TTWA is "operation of fish hatcheries and fish farms". 100% of imports from China to Mull & Islay is accrued in this industry. The industrial content of highly exposed TTWAs consists of manufacturing industries, whereas the industrial content of less exposed TTWAs comprises agriculture and mining. Although some TTWAs with a low import exposure index specialise mainly in manufacturing (especially in 2008), the share of these TTWAs in the UK's total imports is negligible.

[12] The numbers in brackets represent the proportion of imports for each type of product as a percentage of the UK's total imports from China.

and simultaneity bias have been controlled for with the instrument. However, all the coefficients are statistically insignificant, showing that the TTWAs in the UK have not been affected by the increase in Chinese imports during the period 1998-2013. In Table 3.5, the analysis described above is repeated for manufacturing employment. In the model without any additional explanatory variable, the coefficient of the import exposure index is negative and statistically significant. The estimate shows that an increase of 1,000 Euros per worker in a TTWA's exposure to Chinese imports during the five-year period is associated with a decline in manufacturing employment of 0.4 percentage points of the working age population. In the second column we control for the share of manufacturing employment at the beginning of the period in each of the TTWAs. This variable allows us to control for the overall declining trend in UK manufacturing instead of the component that captures the differences across manufacturing industries due to their exposure to increasing Chinese competition. The coefficient of this variable is negative and significant at the 1% level. It indicates that a rise of one percentage point in the manufacturing share causes manufacturing employment to decrease by 0.32 percentage points over a five-year period. However, the coefficient of the import exposure index becomes insignificant in this model. The third column augments the model with demographic variables. Among all the controls, only the share of the foreign-born population as a percentage of total employment has a significant and negative effect on manufacturing employment. The effect of the significant explanatory variables decreases in the 2SLS estimations. The import exposure index is significant only in the model without any additional control variables (column 4) and it shows that OLS overestimates the effect of Chinese imports on manufacturing employment. As in the OLS analysis, the 2SLS does not reveal any significant effects of import exposure on manufacturing employment in the TTWAs. Among the additional variables, the proportion of female workers and foreign-born population do not have any significant effect, while the effect of other variables is significantly negative. Nonetheless, these results are not in line with the existing literature (Autor et al. (2013a), Dauth et al. (2012), Mendez (2013) and Donoso et al. (2014)). Among these studies, the highest coefficients for the import exposure variable within the manufacturing employment analyses are found by Mendez (2013). One possible explanation for this result is that US manufacturing imports from China substantially outweigh US manufacturing imports from Mexico, which causes higher manufacturing job losses in Mexico [13].

[13]The regressions in Table 3.4 and Table 3.5 are re-estimated for the alternative definitions of the corresponding dependent variables. Instead of the share of employment and manufacturing employment in working population, the five-year change in log employment and the five-year change in log manufacturing employment are used. The results are presented in Table 3A.1 and Table 3A.2 respectively. The interpretations are consistent with the former analysis.

3.5.2.2 Effects on Working Population and Wages

Table 3.6 shows the results from the regressions in which the dependent variable denotes growth in the working population. According to the table, Chinese imports have negative but insignificant effects on the working population in each TTWA. The negative impact of import exposure decreases in the 2SLS estimations, showing that the OLS overestimates the coefficient when potential endogeneity and simultaneity are present. Accordingly, import shocks to local labour markets do not change the working age populations in the TTWAs. Donoso et al. (2014) and Mendez (2013) also detect no statistically significant effects on growth in working population in Spanish provinces and Mexican municipalities, while Dauth et al. (2012) finds negative import exposure effects for German local labour markets.

Tables 3.7 and 3.8 provide estimations of average gross weekly wages in each TTWA. Table 3.7 considers all workers, while Table 3.8 compares wages for males and females. According to both tables, the insignificant negative effects are valid for both males and females, as well as for all workers, implying that increases in Chinese imports do not have significant effects on the average gross weekly wages in any of the TTWAs in the UK. The coefficients for the exposure index become positive in the 2SLS models in which we control for potential endogeneity and simultaneity. However, the effects are statistically insignificant. Among the additional control variables, only the share of graduate employment and the share of foreign-born population as a proportion of total employment have significantly positive effects on average log weekly wages.

3.5.2.3 Chinese Imports and Different Demographic Groups in TTWAs

Table 3.9 through to Table 3.11 repeats the 2SLS estimations for specific demographic groups of interest. Each table consists of two panels. Panel A provides the results for the effects of Chinese imports on employment growth, while in panel B, the dependent variable is the growth in manufacturing employment. Table 3.9 compares female employment with male employment. Accordingly, although the magnitude of the coefficients is higher for manufacturing employment and the negative impacts are slightly stronger for females in both cases, increasing Chinese import competition has no impact on either female or male workers. The results regarding the different gender groups working in US commuting zones suggest that imports from China negatively affect both groups and that the effects are stronger on males than on females (Autor et al., 2013a). In Table 3.10, the effects of Chinese imports on graduates are compared to the effects on non-graduates

[14]. Panel A shows that only graduate employment is negatively affected by imports from China. According to the results, an increase of 1,000 Euros per worker in a TTWA's exposure to Chinese imports is associated with a decline in graduate employment of approximately 0.03 log points. Within manufacturing employment, the effect of increasing Chinese imports is insignificant on both graduates and non-graduates, except in the first model which focuses only on the effect of import exposure on graduate manufacturing employment. The coefficient is twice as large as the coefficient obtained for the corresponding model in the total employment analysis. Finally, the analyses regarding the different age groups are presented in Table 3.11. Employed people are divided into three age groups: young workers (aged 16-34); middle-aged workers (aged 35-49); and old workers (aged 50-64). The results suggest that none of the age groups are significantly affected by the increases in Chinese import exposures. According to the table, only young workers employed in manufacturing are negatively affected by the increasing Chinese import competition. Different age groups employed within manufacturing industry are also compared by Autor et al. (2013a), who likewise find that the most affected age group is that of the young workers.

3.5.2.4 Export Exposure and Local Labour Markets

To consider the regional export exposure we use the analogous equation:

$$\Delta XEX_{UKit} = \sum_{j} \frac{L_{ijt}}{L_{UKjt}} \cdot \frac{\Delta X_{jt}^{C-UK}}{L_{it}} \tag{3.9}$$

ΔX_{jt}^{C-UK} is the observed change in UK exports to China in industry j between the start and end of period t. The export exposure index has been included in equation (3.8) as an additional control variable in order to examine the regional effects of the UK's exports to China. Tables 3.12-3.15 present the repeated analyses for total employment, manufacturing employment, working population and average weekly wages respectively. According to Table 3.12 and Table 3.14, the inclusion of the export exposure variable does not change the coefficient of the import exposure variable or the other control variables in the total employment analysis and the working population growth analysis. Although the coefficient of the export exposure variable is positive, it is statistically insignificant. In the manufacturing employment analysis, exports to China have negative impacts on manufacturing employment. The impact is stronger in the 2SLS analysis. According to the 2SLS regressions shown in Table 3.13, the coefficient of the variable is negative and significant at the 10% significance level. An increase of 1,000 Euros per worker in a TTWA's exports to China

[14] *Graduates* are defined as those who had completed a degree or higher education qualification by the start of the survey period in question.

is associated with a decline in manufacturing employment of approximately 0.25 percentage points. The decrease in manufacturing employment due to the increase in the UK's exports to China can possibly be explained by the industrial components of the UK's exports and by the standard Melitz type trade model. The UK's exports to China mostly consist of manufacture of motor vehicles and medical and surgical equipment, machinery, and processing nuclear fuel which require highly-skilled workers. It could be the case that instead of hiring a large quantity of low-skilled workers, firms are employing a smaller amount of highly-skilled workers, and this leads to an overall decrease in manufacturing employment. Moreover, the Melitz type trade model suggests that, as there are more exporting opportunities in the market, more successful firms are able to expand and crowd out the less productive ones, which also leads to a decrease in employment (Melitz, 2003). Compared to Table 3.6, the effect of the share of manufacturing employment at the start of the period remains the same while the coefficients for the import exposure index decrease in the 2SLS analysis. In Table 3.15, the regressions for the log weekly wages are repeated with the export exposure index. The changes in the coefficients for the other variables are negligible; the effect of the export exposure index is positive and insignificant except in the case of model 5. According to the 2SLS estimate which is only controlled for the share of manufacturing employment at the start of the period, the export exposure index has a positively significant effect on the change in average log weekly wages in each TTWA.

3.5.2.5 Import Exposure and Firm Characteristics

In the final analysis, we examine the effects of Chinese import exposure on the change in firm characteristics in each TTWA. To extend the analysis using the effects on firms, we employ the Annual Respondent Database (ARD) and the Business Structure Database (BSD). The dependent variables are the change in average firm size and the change in average firm productivity in each TTWA. The number of employees in each firm and the gross value added per employee in each firm are the proxies for firm size and labour productivity respectively, and these are both obtained from the ARD, which provides structural variables for UK firms. The ARD contains a wide range of variables including employment, turnover/output, capital expenditure, intermediate consumption, and gross value added for the selected firms, while the BSD records a wide variety of firm demographics including the life span and postcodes for virtually all firms in the UK. In the ARD, the annual selection is a combination of stratified random sample (based on employment) and simple random sampling. Sample fractions differ for firms of different sizes. A weight variable is also provided by the ARD, which is calculated by employment size bands stratified by industry and region. When we calculate the average firm size and the average firm productivity in each TTWA, we take into account

the sampling probabilities provided for each firm in order to obtain estimates which represent all the firms in the TTWAs. This dataset is then merged with the BSD by using the link variable the Inter-Departmental Business Register (IDBR) reference numbers, which are anonymous but unique reference numbers assigned to the business organisations. The BSD dataset is used to obtain the TTWA variable and to calculate the share of foreign-owned firms in each TTWA. Nevertheless, the TTWA variable is not reported in the BSD before 2008. However, the dataset reports anonymous postcodes for each firm, and the correspondence of these postcodes to TTWAs is provided in the ONS Postcode Directory. Therefore, the TTWA variable is obtained from the Postcode Directory for the years 1998 and 2003.

Tables 3.16 and 3.17 provide the OLS and 2SLS results for average firm size and average labour productivity respectively. The set of control variables is slightly different from the analysis above. The log of the average firm size at the start of the period in each TTWA is included as well as the manufacturing employment share at the start of the period. In addition to the share of females and graduates as a proportion of total employment, the share of foreign-owned firms at the start of the period is included in the other control variables [15]. According to Table 3.16, the effect of import exposure on average firm size is insignificant, but in the 2SLS estimations, the impact of Chinese imports per worker becomes negative and significant. According to model 4, which contains no control variables, the average firm size in the TTWAs decreases by 0.02 percentage points if the TTWAs' imports from China increase by a 1,000 Euros per worker. The effect becomes stronger with the additional variables. In model 5, where only initial manufacturing share and initial firm size are controlled for, the coefficient of the import exposure is -0.04 and the initial share of manufacturing employment has a positive effect, whereas initial firm size has a negative effect on average firm size at the 5% significance level. However, Chinese imports do not have any significant effect on average labour productivity in any of the TTWAs according to Table 3.17.

3.5.3 Summary of the results

In order to examine the effects of the UK's imports from China on the local labour market outcomes, we calculate the import exposure index and look at its impact on several dependent variables. We estimate the models using OLS and 2SLS for three different specifications. In Table 3.18, we present the coefficients of import exposure from the 2SLS estimations for the model which includes the full set of control variables, time and region dummies. As shown in the table, the coefficient is statistically significant and negative only for the change in graduate employment and change in average firm

[15] In the additional regressions, the average labour productivity at the beginning of the period is also included. The coefficients remain the same after controlling for this variable.

size, showing that an increase of 1,000 Euros per worker in a TTWA's exposure to Chinese imports is associated with a decline in graduate employment and average firm size of approximately 0.03 log points and 0.03 percentage points, respectively. According to the results, in contrast to the existing literature, imports from China do not have any significant impact on total employment, manufacturing employment, average wages and average labour productivity [16]. These different results can be driven by various reasons. One possible explanation for these results could be the low import share of each TTWA as a proportion of UK's total imports. As shown in Table 3A.4, even in those TTWAs with a high level of exposure in all three periods, either the share of imports by each TTWA is lower, or the share of imports in a specific industry is lower in that TTWA. For example, one of the highly exposed TTWAs in the third period is Wisbech which is specialised in manufacturing. Almost 58% of imports from China to Wisbech comprised of "manufacturing of TV and radio receivers, sound or video recording or reproducing apparatus and associated goods". Although the import share of manufacturing in Wisbech is high, since the import share of Wisbech in UK's total imports is only 5.8%, it is less likely to observe significant impact of increasing Chinese import competition on labour market outcomes in this TTWA. However, this could also be explained by the fact that the UK experienced a big wave of deindustrialisation in the 1980s which resulted in traditional manufacturing industries being replaced by high-technology industries. Therefore, although import competition due to increasing Chinese imports is expected to affect employment, because UK's industry content is high-skilled intensive, the UK's local labour markets remain unaffected. High-skilled workers are not exposed to increasing Chinese import competition due to the deindustrialisation process, while low-skilled workers are not exposed to increasing Chinese import competition because they are mostly employed in non-tradable industries.

Another possible explanation can be constituted on the differences between the UK and the other countries that have been analysed in the previous studies. First, the UK can be considered as a country which has comparative advantages in the services. The value added in the UK economy is mostly driven by the services, followed by manufacturing and agricultural industries. According to WDI statistics, the share of value added by services in GDP in the UK was 78% in 2013. This figure is similar in the other countries that have been analysed in the previous studies. However, the UK is the only country which has the highest services trade share in GDP. In 2013, the share of services trade in GDP was 19.6% in the UK, followed by Spain (14.1%), the US (6.9%) and Mexico (4.15%). The Mexico and Spain cases are different from the UK case in terms of their trade deficit figures as well. In recent years, the trade deficit in these countries is mostly because of the increasing Chinese imports. Although in all four countries, both Chinese imports and exports have increased

[16]The regressions are repeated for a subsample which includes only highly exposed TTWAs. However, the coefficients remain insignificant in these analyses as well.

considerably in the last two decades, the imports from China have always exceeded the exports from China. Mexico experiences the highest trade deficit due to the Chinese trade, while the UK experiences the lowest trade deficit due to the Chinese trade according to Comtrade statistics. The US case is the most similar case to the UK case in terms of the economic structure. Since the UK is smaller country compared to the US (in terms of GDP per capita) and the trade-to-GDP ratio is higher in the UK, the competitive exposure in the UK is expected to be larger. Nevertheless, one third of the total trade in the UK is constituted by the services trade, while this figure is around one fifth in the US case [17]. However, when we consider only the goods trade, the share of total Chinese trade in both total trade and GDP is higher in the US. The comparison between the UK and the US is given in figures 3.7 and 3.8. According to the figures, the share of total Chinese trade in total trade and in GDP is higher in the US during the last 20 years. Another difference between the UK and the other countries stems from the definition of the local labour markets. The geographic units that are considered as the local labour markets in the UK are much smaller compared to the US, Mexico and Spain cases. It can be the case that the regression results are affected by the physical size of the geographic units [18]. These differences between the UK and the other countries might explain why the UK local labour markets have not been affected by the increasing Chinese trade.

3.6 Conclusion

China's emergence in the world economy has had important demand and supply side-effects on most countries. The last two decades have witnessed dramatic growth rates along with increasing exports in China. Understanding the consequences of those developments for the labour markets in the UK is of great importance, from both an economic and a political perspective, since the UK is also exposed to increasing competition from Chinese imports. This study analyses whether differences in levels of exposure to imports from China explain differences in labour market outcomes across UK local labour markets during the period 1998-2013.

The main contribution of this study is that, to the best of our knowledge, this is the first study which investigates the effects of Chinese imports in the UK UK local labour markets. The amount of trade between these two countries makes it worth paying attention to import exposures to the UK's local labour markets since some local labour markets will be more severely affected as a result of

[17] According to the WDI statistics, GDP per capita in the US is higher than in the UK, while the average growth in GDP per capita during the analysis period is higher in the UK. In 2013, the trade-to-GDP ratio in the UK was 62% and the trade-to-GDP ratio in the US was 30%, while the share of services trade in GDP was 19.6% in the UK and 6.8% in the US.

[18] Riley and Robinson (2011) use *UK City Regions* which also considers the commuting patterns of workers. However, this definition of the local labour markets only focuses on skilled workers and only covers England and some parts of Wales.

regional variations in the importance of different industries. Detecting these vulnerable local labour markets within a country can help policy makers to tailor suitable policies to each industry in order to improve labour market outcomes.

However, our results show that exposure to imports from China does not have any significant impact on total employment, manufacturing employment, working population and average wages in the UK's local labour markets. These results are sustained when we control for the exposures to exports to China. From the analyses for the different demographic groups such as age, gender, and education level, it can be seen that both total and manufacturing employment are unaffected by the increase in Chinese imports, although graduate employment is an exception to this rule. Exposure to Chinese imports is associated with a decline in graduate employment. The analysis regarding the firm characteristics in the UK's local labour markets suggests that exposure to Chinese imports in the local labour markets decreases the average firm size, whereas the average labour productivity remains unaffected. The statistically significant and negative coefficients for graduate employment and average firm size indicate that an increase of 1,000 Euros per worker in a TTWA's exposure to Chinese imports is associated with a decline in graduate employment and average firm size of approximately 0.03 log points and 0.03 percentage points, respectively. One possible explanation for these results might be the low import share of each TTWA as a proportion of total imports. As shown in Table 3A.4, even in TTWAs with a high level of exposure in all three periods, either the imports by a TTWA has a lower share in total imports or the imports in a specific industry has a lower share in a TTWA's imports. Another possible explanation is the big wave of deindustrialisation that took place in the UK during the 1980s. Due to the deindustrialisation process, high-technology industries have replaced traditional manufacturing industries, and these industries do not compete with Chinese manufacturing industries. On one hand, due to deindustrialisation, high-skilled workers in the UK's local labour market remain unaffected, while low-skilled workers are not exposed to increasing Chinese import competition because they are mostly employed in non-tradeable industries. The insignificant results could also be explained by differences between the UK and the countries that have been analysed in the previous studies. The UK is the most open country among all others, however, almost one third of the total trade consists of services trade and in terms of goods trade, the trade deficit due to the Chinese trade is the lowest in the UK. Moreover, China's share in total imports is also lower in the UK.

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Tables

Table 3.1: China in World Economy

Year	GDP (constant 2005 US$)	GDP growth (annual %)	Exports of goods and services (constant 2005 US$)	Exports of goods and services (% of GDP)	Exports of goods and services (annual % growth)	Imports of goods and services (constant 2005 US$)	Imports of goods and services (% of GDP)	Imports of goods and services (annual % growth)
1995	915513.5	13.08	150654.1	20.23	11.3	157450.6	18.58	11.42
1996	1015533.1	10.92	176798.6	20.05	17.35	180238.4	18	14.47
1997	1117173	10.01	233579.3	21.75	32.12	200805.4	17.26	11.41
1998	1221037	9.3	266408.8	20.35	14.06	222359.9	16.05	10.73
1999	1316685	7.83	295924.3	20.4	11.08	252861	17.57	13.72
2000	1417014.3	7.62	359332	23.33	21.43	308652.2	20.92	22.06
2001	1534631	8.3	399774.8	22.6	11.25	352104.3	20.48	14.08
2002	1674007.2	9.08	483123.8	**25.13**	20.85	431588.3	**22.56**	22.57
2003	1841832.8	10.03	571922	**29.56**	18.38	525277.5	**27.37**	21.71
2004	2027582.3	10.09	679208.8	**34.08**	18.76	628179.4	**31.43**	19.59
2005	2256902.6	11.31	836622.3	**37.07**	23.18	712035	**31.55**	13.35
2006	2542999.6	12.68	1036641.9	**39.13**	23.91	825996.2	**31.43**	16
2007	2903149.3	14.16	1242176.9	**38.4**	19.83	940322.4	**29.59**	13.84
2008	3182858.1	9.63	1347103.6	**34.98**	8.45	976148.7	**27.27**	3.81
2009	3476132.9	9.21	1207813.1	**26.72**	**-10.34**	1016951.7	**22.31**	4.18
2010	3839284.2	10.45	1543247	**29.4**	27.77	1221328.5	**25.64**	20.1
2011	4196333.2	9.3	1681167	**28.53**	8.94	1344560.5	**26.05**	10.09
2012	4517459.8	7.65	1769293.7	**27.32**	5.24	1428434.2	**24.5**	6.24
2013	4864002.8	7.67	1921753.8	**26.4**	8.62	1579962.5	**23.84**	10.61
average		9.91		27.65	15.38		23.81	13.68

Source: World Development Indicators

Table 3.2: Evolution of Exports and Imports in the UK: Trade with China and the World

	World				China					
Year	Exports (million dollars)	Imports (million dollars)	Growth in Exports (%)	Growth in Imports (%)	Exports (million dollars)	Imports (million dollars)	Growth in Exports (%)	Growth in Imports (%)	China in Total Exports (%)	China in Total Imports (%)
1995	234372.2	261456.48			1183.09	3001.92				
1996	253622.09	282720.14	8.21	8.13	1036.1	3392.36	-12.42	13.01	0.41	1.2
1997	278906.97	305135.41	9.97	7.93	1507.43	4087.27	45.49	20.48	0.54	1.34
1998	270295.29	311879.51	-3.09	2.21	1439.83	4905.63	-4.48	20.02	0.53	1.57
1999	265442.49	315333.08	-1.8	1.11	1876.8	5665.58	30.35	15.49	0.71	1.8
2000	294899.05	374702.69	11.1	18.83	2223.83	15830.69	18.49	**179.42**	0.75	4.22
2001	279425.46	358702.94	-5.25	-4.27	2480.85	16790.05	11.56	6.06	0.89	4.68
2002	285996.25	372059.5	2.35	3.72	2277.91	19346	-8.18	15.22	0.8	5.2
2003	312059.9	425369.49	9.11	14.33	3181.39	23495.43	39.66	21.45	1.02	5.52
2004	355027.95	502886.19	13.77	18.22	4360.57	30097.2	37.07	28.1	1.23	5.98
2005	392744.02	528460.95	10.62	5.09	5139.82	36153.93	17.87	20.12	1.31	6.84
2006	458598.56	614811.65	16.77	16.34	6034.54	41828.38	17.41	15.7	1.32	6.8
2007	454005.49	679917.92	-1	10.59	7580.76	53227.61	25.62	27.25	1.67	7.83
2008	482020.96	705344.16	6.17	3.74	9065.64	58220.7	19.59	9.38	1.88	8.25
2009	**359615.54**	**552042.03**	**-25.39**	**-21.73**	**8053.61**	**52101.3**	**-11.16**	**-10.51**	**2.24**	**9.44**
2010	422014.12	627617.52	17.35	13.69	11293.78	61733.67	40.23	18.49	2.68	9.84
2011	517288.69	717606.23	22.58	14.34	14088.51	66039.71	24.75	6.98	2.72	9.2
2012	481225.75	689137.01	-6.97	-3.97	15688.19	56267.4	11.35	-14.8	3.26	8.16
2013	548967.45	655698.17	14.08	-4.85	18119.2	57587.92	15.5	2.35	3.3	8.78
average			5.48	5.75			17.71	21.9	1.51	5.93

Source: UN Comtrade, own calculations.

Table 3.3: Means and Standard Deviations of TTWA Level Variables

		1998-2003		2003-2008		2008-2013	
% Δ in imports from China	observed percentage change (0-100)	378.95		147.80		-1.09	
% Δ in exports to China	observed percentage change (0-100)	120.96		184.96		99.87	
	Unit	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Main Dependent Variables							
Δ in employment/working pop	100*(employment/working pop)	1.96	4.256	0.01	3.862	-1.63	4.079
Δ in manufacturing emp/working pop	100*(manufacturing emp/working pop)	-2.36	2.747	-1.839	2.654	0.13	2.672
% Δ in working population	Percentage change (0-100)	6.59	24.073	4.86	8.302	-19.29	18.188
Δ in log employment	Log change	0.07	0.238	0.05	0.092	-0.26	0.235
Δ in log manufacturing employment	Log change	-0.16	0.355	-0.013	0.296	-0.27	0.385
Δ in log average wages	Log change	0.22	0.091	0.32	0.202	0.07	0.05
Main Explanatory Variables							
Δ in Chinese M exposure	1,000 Euros per worker	2.99	1.605	4.65	2.587	2.5	1482
Δ in Chinese X exposure	1,000 Euros per worker	0.42	0.373	0.81	0.738	2.15	2.297
Initial share of manufacturing emp	% share in total employment (0-100)	18.73	6.715	14.86	5.375	12.27	4.054
Control Variables							
Initial share of women	% share in total employment (0-100)	45.56	2.262	45.79	2.339	46.1	2.409
Initial share of graduates	% share in total employment (0-100)	23.48	6.573	18.61	5.021	21.18	5.639
Initial share of foreigners	% share in total employment (0-100)	8.18	7.882	6.73	6.024	9.22	7.1
Initial share of young	% share in total employment (0-100)	41.24	4.13	37.55	4.394	36.39	4.889
Number of observations		212		209		212	

Import exposure & export exposure in 1,000 Euros per worker. Weighted averages. Δ: 5-year change.

Table 3.4: Import Exposure and Employment
Dependent variable: Five-year change in employment in working population level in each TTWA (%)

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.111	-0.104	-0.104	-0.159	-0.192	-0.202
	(0.077)	(0.097)	(0.100)	(0.172)	(0.231)	(0.235)
Manu-employment share		-0.005	-0.017		0.019	0.008
		(0.041)	(0.049)		(0.054)	(0.060)
Female share			-0.059			-0.055
			(0.073)			(0.088)
Graduate share			-0.024			-0.052
			(0.034)			(0.043)
Foreign share			0.011			0.040
			(0.034)			(0.042)
Young share			-0.024			0.007
			(0.042)			(0.050)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU				0.099***	0.080***	0.084***
				(0.016)	(0.017)	(0.018)
KP test				38.61	22.33	20.72
N	633	633	633	409	409	409
R-squared	0.149	0.149	0.150	0.069	0.069	0.073
F	11.830	10.920	9.416	3.939	3.530	3.388

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.5: Import Exposure and Manufacturing Employment
Dependent variable: Five-year change in manufacturing employment in working population level in each TTWA (%)

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.423***	-0.026	-0.003	-0.271**	-0.155	-0.101
	(0.068)	(0.066)	(0.062)	(0.136)	(0.167)	(0.151)
Manu-employment share		-0.321***	-0.376***		-0.066*	-0.080**
		(0.030)	(0.029)		(0.034)	(0.038)
Female share			-0.041			0.098
			(0.045)			(0.071)
Graduate share			-0.032			-0.046*
			(0.024)			(0.027)
Foreign share			-0.073***			0.025
			(0.019)			(0.026)
Young share			-0.009			-0.065*
			(0.022)			(0.037)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU				0.098***	0.080***	0.083***
				(0.016)	(0.017)	(0.019)
KP test				37.62	21.79	20.37
N	594	594	594	383	383	383
R-squared	0.224	0.387	0.413	0.189	0.185	0.193
F	13.778	28.655	32.575	4.224	4.539	6.296

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.6: Import Exposure and Working Population Growth
Dependent variable: Five-year change in working population in each TTWA

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.257	-0.090	-0.148	-0.206	-0.029	0.001
	(0.350)	(0.420)	(0.416)	(0.554)	(0.728)	(0.732)
Manu-employment share		-0.133	-0.021		-0.099	-0.042
		(0.194)	(0.205)		(0.233)	(0.226)
Female share			0.007			-0.275
			(0.329)			(0.351)
Graduate share			0.116			0.505***
			(0.169)			(0.154)
Foreign share			0.058			-0.210
			(0.171)			(0.168)
Young share			0.232			-0.358
			(0.159)			(0.224)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU				0.099***	0.080***	0.084***
				(0.016)	(0.017)	(0.018)
KP test				38.61	22.33	20.72
N	633	633	633	409	409	409
R-squared	0.309	0.310	0.314	0.430	0.431	0.450
F	50.607	49.219	40.226	28.860	26.635	26.313

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.7: Import Exposure and Gross Weekly Wages
Dependent variable: Five-year change in average log weekly wages in each TTWA

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.006	-0.005	-0.005	0.006	0.024	0.010
	(0.005)	(0.006)	(0.006)	(0.013)	(0.020)	(0.017)
Manu-employment share		-0.001	-0.000		-0.010***	-0.004
		(0.001)	(0.001)		(0.003)	(0.003)
Female share			0.000			0.001
			(0.002)			(0.003)
Graduate share			0.000			0.004**
			(0.001)			(0.002)
Foreign share			0.000			0.006***
			(0.001)			(0.002)
Young share			0.004***			0.001
			(0.001)			(0.002)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU				0.100***	0.082***	0.085***
				(0.016)	(0.017)	(0.018)
KP test				39.26	23.36	21.21
N	633	633	633	410	410	410
R-squared	0.442	0.442	0.454	0.487	0.452	0.553
F	28.111	27.038	42.106	8.200	7.608	46.722

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.8: Import Exposure and Gross Weekly Wages, by Gender

	Female			Male		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.003	0.014	-0.002	0.005	0.022	0.009
	(0.012)	(0.019)	(0.016)	(0.012)	(0.018)	(0.016)
L.Manu-employment share		-0.010***	-0.003		-0.010***	-0.004
		(0.004)	(0.003)		(0.003)	(0.003)
L.Female share			0.001			0.003
			(0.004)			(0.004)
L.Graduate share			0.003			0.004**
			(0.002)			(0.002)
L.Foreign share			0.008***			0.006***
			(0.002)			(0.002)
L.Young share			0.001			-0.000
			(0.002)			(0.002)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU	0.100***	0.082***	0.085***	0.100***	0.082***	0.085***
	(0.016)	(0.017)	(0.018)	(0.016)	(0.017)	(0.018)
KP test	39.26	23.36	21.21	39.26	23.36	21.21
N	410	410	410	410	410	410
R-squared	0.518	0.512	0.580	0.413	0.375	0.480
F	7.331	5.922	45.782	6.403	7.198	46.793

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.9: Import Exposure by Gender: Female vs. Male

		Female			Male		
		(1)	(2)	(3)	(1)	(2)	(3)
A-Employment Growth	Import Exposure	-0.002	0.002	0.002	-0.003	0.001	-0.001
		(0.007)	(0.010)	(0.010)	(0.007)	(0.010)	(0.010)
	Manu-employment share		-0.002	-0.002		-0.002	-0.001
			(0.003)	(0.003)		(0.003)	(0.003)
	Control Variables	yes	yes	yes	yes	yes	yes
	Time dummies	yes	yes	yes	yes	yes	yes
	Nuts dummy	yes	yes	yes	yes	yes	yes
	N	410	410	410	409	409	409
	First-stage F	38.53	22.24	20.54	38.48	22.23	20.54
B- Manufacturing Employment Growth	Import Exposure	-0.021	0.003	0.004	-0.015	-0.007	0.003
		(0.030)	(0.039)	(0.039)	(0.016)	(0.021)	(0.020)
	Manu-employment share		-0.014	-0.013		-0.005	-0.008
			(0.009)	(0.010)		(0.005)	(0.005)
	Control Variables	yes	yes	yes	yes	yes	yes
	Time dummies	yes	yes	yes	yes	yes	yes
	Nuts dummy	yes	yes	yes	yes	yes	yes
	N	320	320	320	377	377	377
	First-stage F	35.22	20.33	18.96	37.13	21.71	20.15

2SLS estimation with one period lagged variables. All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. First-stage F-test of excluded instruments is reported. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.10: Import Exposure by Education: Graduates vs. Non-Graduates

		Graduate			Non-Graduate		
		(1)	(2)	(3)	(1)	(2)	(3)
A-Employment Growth	Import Exposure	**-0.029*** **	**-0.037** **	**-0.035** **	0.002	0.006	0.007
		(0.011)	**(0.016)**	**(0.016)**	(0.008)	(0.012)	(0.012)
	Manu-employment share		0.004	0.004		-0.002	-0.003
			(0.004)	(0.004)		(0.003)	(0.003)
	Control Variables	yes	yes	yes	yes	yes	yes
	Time dummies	yes	yes	yes	yes	yes	yes
	Nuts dummy	yes	yes	yes	yes	yes	yes
	N	408	408	408	409	409	409
	First-stage F	38.43	22.21	20.51	38.48	22.23	20.54
B- Manufacturing Employment Growth	Import Exposure	**-0.061** **	-0.058	-0.042	-0.008	0.003	0.007
		(0.031)	(0.041)	(0.039)	(0.017)	(0.024)	(0.024)
	Manu-employment share		-0.002	-0.006		-0.006	-0.009
			(0.009)	(0.011)		(0.006)	(0.007)
	Control Variables	yes	yes	yes	yes	yes	yes
	Time dummies	yes	yes	yes	yes	yes	yes
	Nuts dummy	yes	yes	yes	yes	yes	yes
	N	300	300	300	372	372	372
	First-stage F	59.52	30.65	28.42	36.91	21.51	19.99

2SLS estimation with one period lagged variables. All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. First-stage F-test of excluded instruments is reported. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.11: Import Exposure by Age: Young vs. Middle vs. Old

		Young			Middle			Old		
		(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
A-Employment Growth	Import Exposure	0.004	0.003	-0.003	-0.003	0.001	-0.000	0.007	0.017	0.022
		(0.012)	(0.016)	(0.016)	(0.006)	(0.009)	(0.009)	(0.011)	(0.015)	(0.015)
	Manu-employment share		0.001	0.003		-0.002	-0.001		-0.005	-0.007*
			(0.004)	(0.004)		(0.003)	(0.003)		(0.004)	(0.004)
	Control Variables	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Nuts dummy	yes	yes	yes	yes	yes	yes	yes	yes	yes
	N	403	403	403	410	410	410	407	407	407
	First-stage F	38.37	22.15	20.45	38.53	22.24	20.54	38.48	22.20	20.50
B- Manufacturing Employment Growth	Import Exposure	**-0.056***	-0.060	-0.056	-0.023	-0.012	-0.006	-0.003	-0.001	0.013
		(0.029)	(0.039)	(0.036)	(0.015)	(0.019)	(0.018)	(0.029)	(0.037)	(0.036)
	Manu-employment share		0.002	0.003		-0.006	-0.008		-0.001	-0.007
			(0.008)	(0.008)		(0.005)	(0.005)		(0.007)	(0.008)
	Control Variables	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Nuts dummy	yes	yes	yes	yes	yes	yes	yes	yes	yes
	N	329	329	329	384	384	384	334	334	334
	First-stage F	35.17	19.98	18.78	37.57	21.75	20.21	34.69	20.41	19.04

2SLS estimation with one period lagged variables. All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. First-stage F-test of excluded instruments is reported. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.12: Import & Export Exposure and Employment
Dependent variable: Five-year change in employment in working population level in each TTWA (%)

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.115	-0.108	-0.108	-0.196	-0.220	-0.221
	(0.079)	(0.098)	(0.100)	(0.178)	(0.233)	(0.235)
Export exposure	0.041	0.043	0.043	0.180	0.172	0.178
	(0.087)	(0.088)	(0.088)	(0.179)	(0.177)	(0.181)
Manu-employment share		-0.006	-0.018		0.014	0.000
		(0.042)	(0.049)		(0.054)	(0.062)
Female share			-0.062			-0.053
			(0.073)			(0.091)
Graduate share			-0.023			-0.056
			(0.034)			(0.044)
Foreign share			0.010			0.038
			(0.034)			(0.042)
Young share			-0.023			0.005
			(0.042)			(0.052)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU				0.100***	0.083***	0.086***
				(0.018)	(0.018)	(0.019)
Export Exposure EU				0.198***	0.197***	0.198***
				(0.037)	(0.038)	(0.038)
KP test				18.03	11.36	10.58
First-stage F (MEXP)				19.81	11.45	10.52
First-stage F (XEXP)				16.41	14.40	13.89
N	629	629	629	405	405	405
R-squared	0.149	0.149	0.151	0.065	0.065	0.069
F	11.178	10.333	9.065	3.411	3.135	2.890

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. First-stage F-test of excluded instruments is reported for both endogenous variables: MEXP is the import exposure index and XEXP is the non-UK export exposure index. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.13: Import & Export Exposure and Manufacturing Employment
Dependent variable: Five-year change in manufacturing employment in working population level in each TTWA (%)

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.405***	-0.026	-0.003	-0.192	-0.096	-0.057
	(0.068)	(0.066)	(0.063)	(0.145)	(0.175)	(0.162)
Export exposure	-0.176*	-0.070	-0.061	-0.259*	-0.224*	-0.178
	(0.091)	(0.074)	(0.074)	(0.133)	(0.128)	(0.125)
Manu-employment share		-0.314***	-0.369***		-0.059*	-0.070*
		(0.029)	(0.029)		(0.035)	(0.040)
Female share			-0.043			0.092
			(0.045)			(0.071)
Graduate share			-0.033			-0.041
			(0.024)			(0.027)
Foreign share			-0.072***			0.030
			(0.019)			(0.026)
Young share			-0.009			-0.074**
			(0.022)			(0.038)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU				0.099***	0.083***	0.086***
				(0.018)	(0.018)	(0.019)
Export Exposure EU				0.209***	0.209***	0.210***
				(0.039)	(0.039)	(0.040)
KP test				17.62	11.12	10.40
First-stage F (MEXP)				19.31	11.18	10.34
First-stage F (XEXP)				16.31	14.71	14.28
N	590	590	590	379	379	379
R-squared	0.234	0.388	0.413	0.193	0.186	0.197
F	13.774	25.738	29.534	4.311	4.332	5.447

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. First-stage F-test of excluded instruments is reported for both endogenous variables: MEXP is the import exposure index and XEXP is the non-UK export exposure index. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.14: Import & Export Exposure and Working Population
Dependent variable: Five-year change in working population in each TTWA

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.275	-0.101	-0.158	-0.427	-0.253	-0.188
	(0.358)	(0.424)	(0.419)	(0.544)	(0.757)	(0.765)
Export exposure	0.180	0.228	0.210	0.958	1.016	1.025
	(0.594)	(0.621)	(0.610)	(1.183)	(1.154)	(1.149)
Manu-employment share		-0.142	-0.029		-0.105	-0.061
		(0.203)	(0.211)		(0.234)	(0.235)
Female share			0.007			-0.287
			(0.329)			(0.367)
Graduate share			0.121			0.485***
			(0.170)			(0.165)
Foreign share			0.056			-0.203
			(0.170)			(0.172)
Young share			0.230			-0.380
			(0.160)			(0.237)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU				0.100***	0.083***	0.086***
				(0.018)	(0.018)	(0.019)
Export Exposure EU				0.198***	0.197***	0.198***
				(0.037)	(0.038)	(0.038)
KP test				18.03	11.36	10.58
First-stage F (MEXP)				19.81	11.45	10.52
First-stage F (XEXP)				16.41	14.40	13.89
N	629	629	629	405	405	405
R-squared	0.306	0.307	0.311	0.424	0.425	0.443
F	46.510	45.620	37.393	26.530	24.369	23.866

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. First-stage F-test of excluded instruments is reported for both endogenous variables: MEXP is the import exposure index and XEXP is the non-UK export exposure index. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.15: Import & Export Exposure and Wage
Dependent variable: Five-year change in average log weekly wages in each TTWA

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.008	-0.007	-0.008	0.003	0.023	0.009
	(0.005)	(0.006)	(0.006)	(0.013)	(0.020)	(0.017)
Export exposure	0.003	0.003	0.003	0.007	0.014**	0.009
	(0.002)	(0.002)	(0.002)	(0.005)	(0.006)	(0.005)
Manu-employment share		-0.000	0.001		-0.012***	-0.006*
		(0.002)	(0.002)		(0.003)	(0.003)
Female share			0.002			-0.000
			(0.003)			(0.004)
Graduate share			0.001			0.006**
			(0.002)			(0.003)
Foreign share			0.000			0.005*
			(0.002)			(0.002)
Young share			0.005***			0.002
			(0.001)			(0.002)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU				0.101***	0.084***	0.087***
				(0.018)	(0.018)	(0.019)
Export Exposure EU				0.198***	0.197***	0.198***
				(0.037)	(0.038)	(0.039)
KP test				18.13	11.62	10.62
First-stage F (MEXP)				20.04	11.79	10.57
First-stage F (XEXP)				16.32	14.34	13.70
N	621	621	621	401	401	401
R-squared	0.409	0.409	0.425	0.454	0.425	0.520
F	26.936	25.345	43.852	7.945	6.125	36.098

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. First-stage F-test of excluded instruments is reported for both endogenous variables: MEXP is the import exposure index and XEXP is the non-UK export exposure index. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.16: Import Exposure and Average Firm Size
Dependent variable: Five-year change in average firm size in each TTWA (%)

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	0.004	0.002	0.000	-0.019*	-0.037**	-0.034*
	(0.007)	(0.006)	(0.006)	(0.012)	(0.018)	(0.019)
Manu-employment share		-0.005**	-0.003		0.011**	0.009
		(0.002)	(0.002)		(0.005)	(0.006)
Log avg. firm size		-0.539***	-0.576***		-0.132**	-0.080
		(0.035)	(0.035)		(0.054)	(0.060)
Female share			0.002			-0.000
			(0.003)			(0.006)
Graduate share			0.005**			-0.005
			(0.002)			(0.003)
Foreign owned share			0.014*			-0.014
			(0.008)			(0.011)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU				0.097***	0.080***	0.080***
				(0.016)	(0.017)	(0.017)
KP test				37.37	22.06	21.73
N	637	637	637	411	411	411
R-squared	0.325	0.498	0.509	0.343	0.330	0.347
F	8.114	69.775	53.391	7.210	9.600	11.050

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3.17: Import Exposure and Average Labour Productivity
Dependent variable: Five-year change in average labour productivity in each TTWA (%)

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	0.086	0.032	0.043	0.491	0.425	0.429
	(0.089)	(0.109)	(0.113)	(0.386)	(0.521)	(0.525)
Manu-employment share		0.054	0.058		0.024	0.029
		(0.037)	(0.040)		(0.097)	(0.097)
Log avg. firm size		0.821	0.992		0.966	0.802
		(0.988)	(1.078)		(0.691)	(0.849)
Female share			0.078			0.041
			(0.066)			(0.118)
Graduate share			-0.007			0.003
			(0.030)			(0.052)
Foreign owned share			-0.056			0.128
			(0.208)			(0.173)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU				0.097***	0.080***	0.080***
				(0.016)	(0.017)	(0.017)
KP test				37.37	22.06	21.73
N	637	637	637	411	411	411
R-squared	0.126	0.130	0.132	0.086	0.097	0.098
F	5.383	3.984	3.816	3.075	2.814	2.368

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

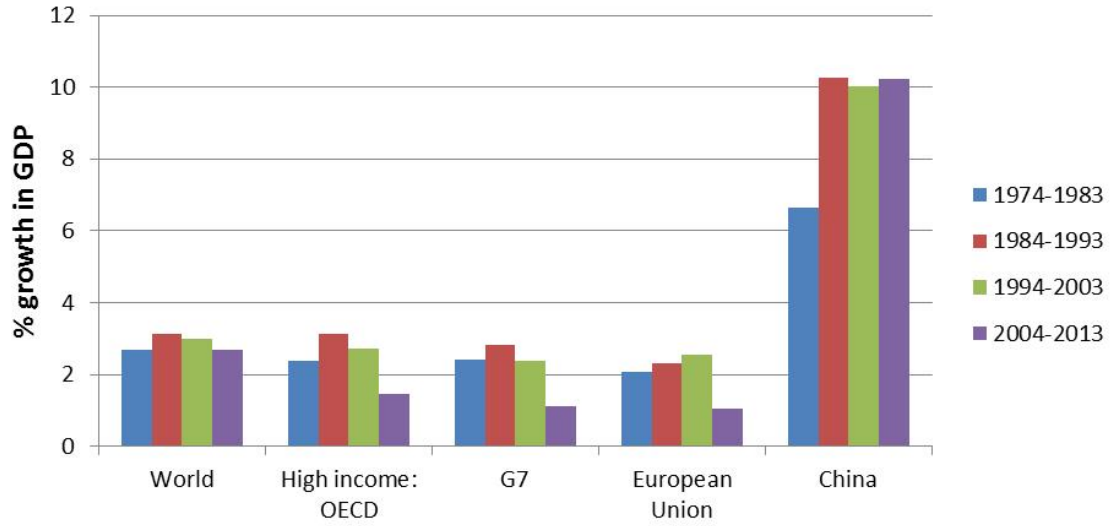
Table 3.18: Summary of the Results

Measure	Dependent Variable		Coefficient of the Import Exposure Variable
Change in the share of total employment in working pop.	Change in employment		-0.202
		Total	-0.001
		Female	0.002
		Male	-0.001
Change in log employment	Change in employment	Graduates	**-0.035****
		Non-Graduates	0.007
		Young	-0.003
		Middle-age	-0.000
		Old	0.022
Change in the share of manufacturing employment in working pop.	Change in Manufacturing employment		-0.101
		Total	-0.008
		Female	0.004
		Male	0.003
Change in log manufacturing employment	Change in Manufacturing employment	Graduates	-0.042
		Non-Graduates	0.003
		Young	-0.056
		Middle-age	-0.006
		Old	0.013
% change in working age population	Change in Working Population		0.001
		Total	0.01
Change in average log weekly wages	Wages	Female	-0.002
		Male	0.009
% change in average firm employment	Change in firm size		**-0.034***
% change in average firm labour productivity	Change in productivity		0.429

2SLS regressions with all controls, time and region dummies. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

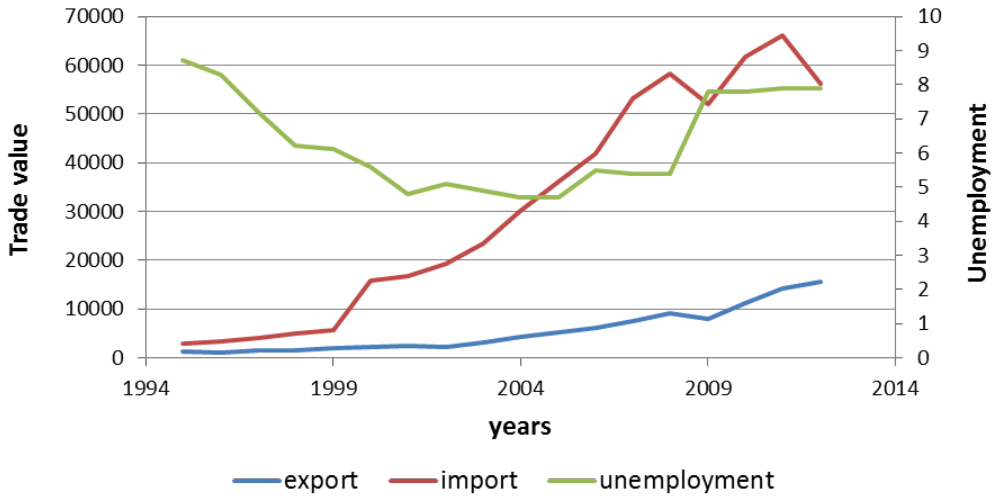
Figures

Figure 3.1: Trends in GDP Growth, 1974-2013



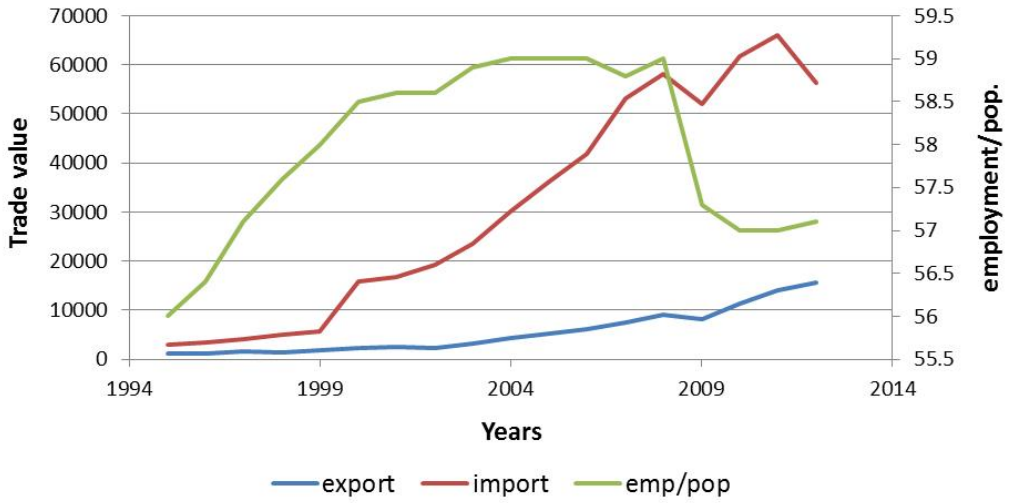
Source: Own calculations based on WDI. Annual average % growth in GDP.

Figure 3.2: Trade with China vs. Unemployment



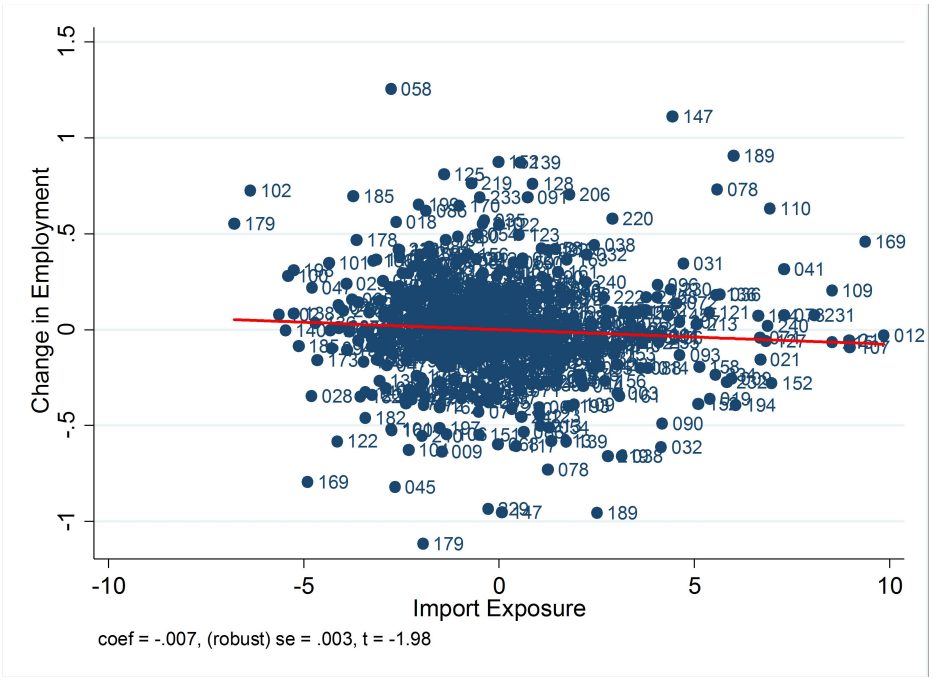
Source: Own calculations. Export import in million dollars, from COMTRADE; Unemployment (% of total labour force) (modeled ILO estimate), from WDI.

Figure 3.3: Trade with China vs. Employment in total population



Source: Own calculations. Export import in million dollars, from COMTRADE; Employment to population ratio, 15+, total (%) (national estimate), from WDI.

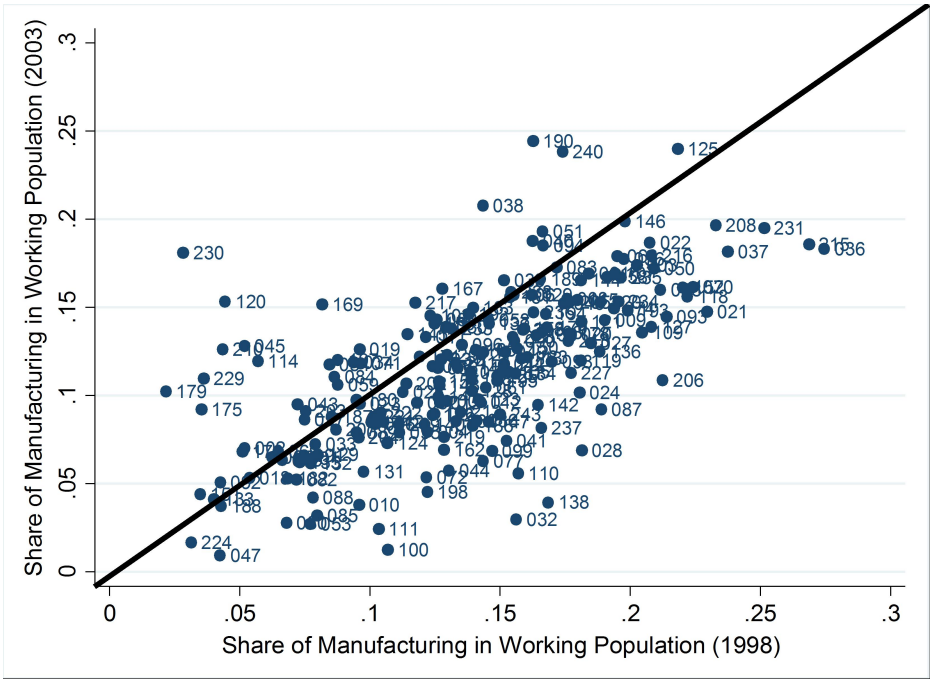
Figure 3.4: Regression Plot between Import Exposure and Change in Employment in the UK (1998-2013)



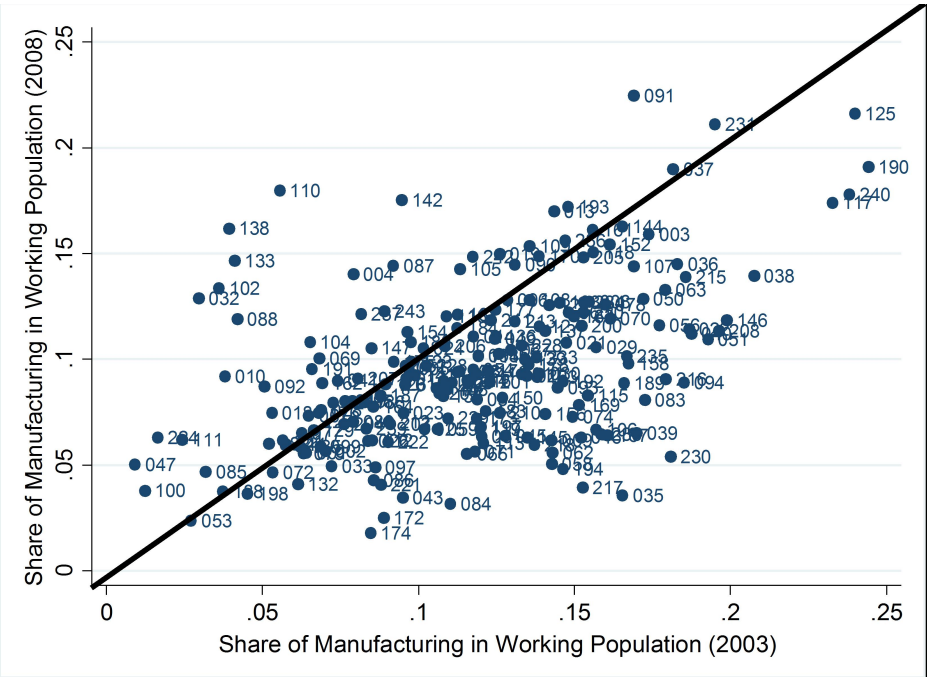
Note: The numbers represent the TTWA codes. See Table 3A.5.

Figure 3.5: Initial Period Manufacturing Employment in TTWAs (% of working population)

Panel A: 1998 vs. 2003



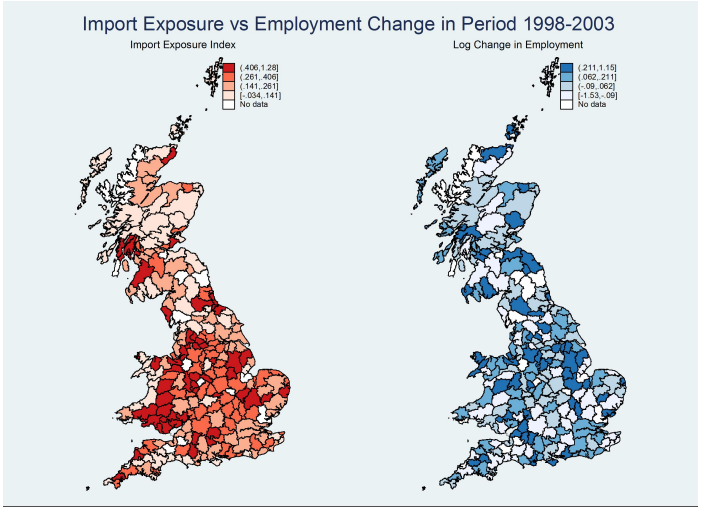
Panel B: 2003 vs. 2008



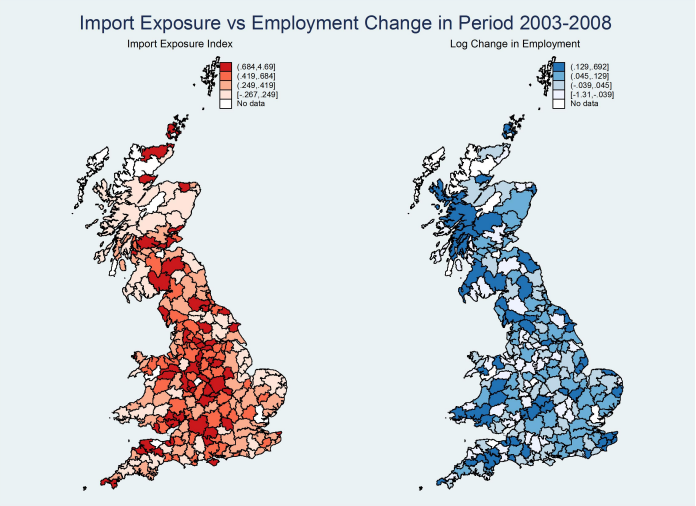
Note: The numbers represent the TTWA codes. See Table 3A.5.

Figure 3.6: Evolution of Import Exposure (10,000 Euros per worker) and Employment in TTWAs

Panel A: Period 1



Panel B: Period 2



Panel C: Period 3

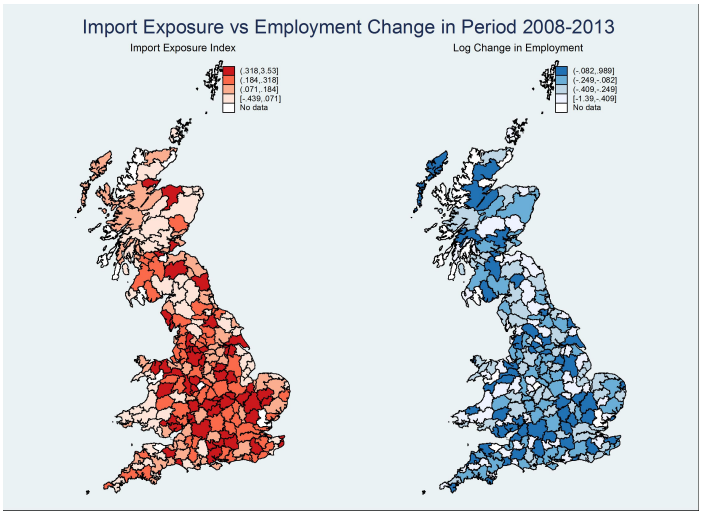
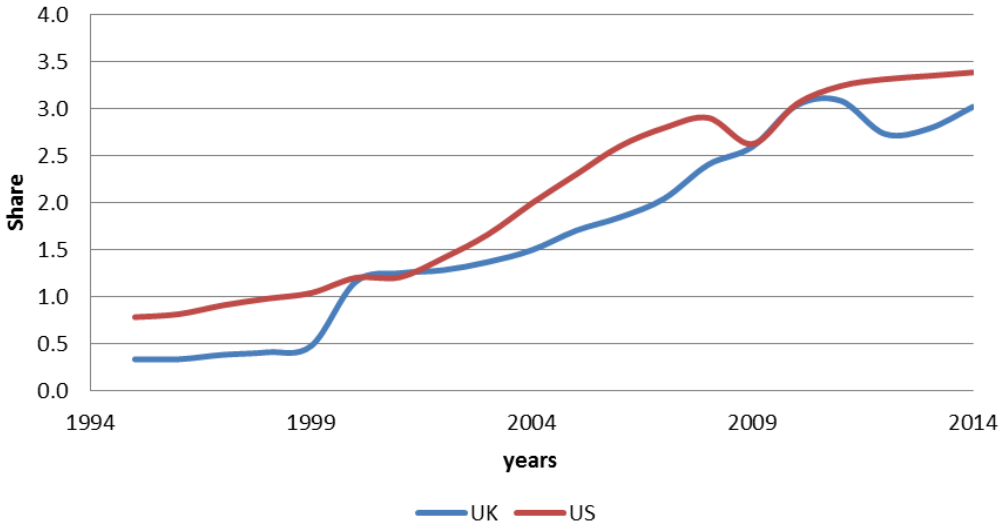
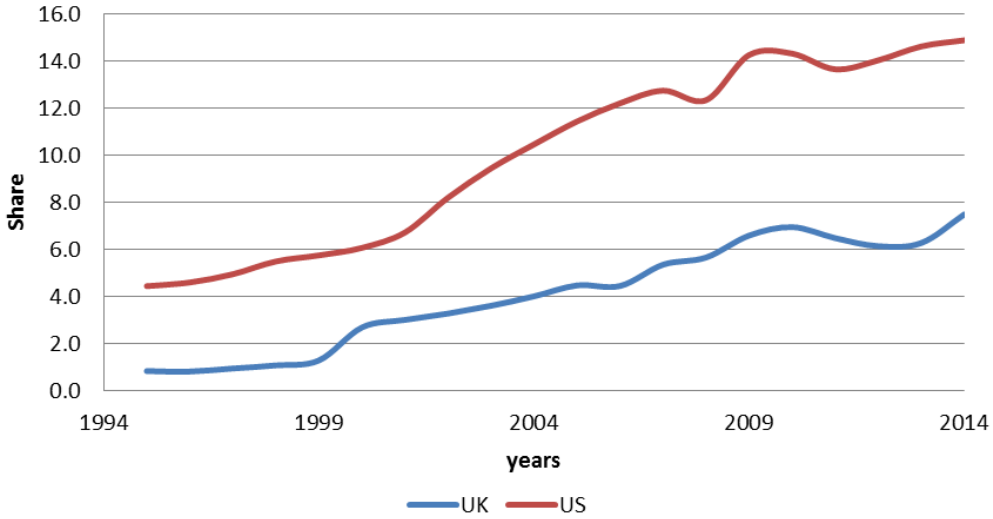


Figure 3.7: Total Chinese Trade in GDP, %



Note: Share of the Chinese trade in GDP, comparison of the US and the UK.
Own calculations based on the COMTRADE tade statistics and WDI.

Figure 3.8: Total Chinese Trade in Total Trade, %



Note: Share of the Chinese trade in total trade, comparison of the US and the UK.
Own calculations based on the COMTRADE tade statistics.

Appendix 3.A Additional Tables

Table 3A.1: Import Exposure and Employment
Dependent variable: Five-year change in log employment level in each TTWA

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.007**	-0.005	-0.005	-0.004	0.000	-0.001
	(0.003)	(0.003)	(0.003)	(0.006)	(0.008)	(0.008)
Manu-employment share		-0.002	-0.001		-0.002	-0.001
		(0.002)	(0.002)		(0.003)	(0.003)
Female share			0.001			-0.003
			(0.004)			(0.004)
Graduate share			0.001			0.005***
			(0.002)			(0.002)
Foreign share			0.000			-0.002
			(0.002)			(0.002)
Young share			0.004**			-0.003
			(0.002)			(0.003)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU				0.099***	0.080***	0.084***
				(0.016)	(0.017)	(0.018)
KP test				38.61	22.33	20.72
N	640	640	640	416	416	416
R-squared	0.372	0.373	0.379	0.437	0.437	0.447
F	35.818	32.689	25.989	27.772	25.895	23.982

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3A.2: Import Exposure and Manufacturing Employment
Dependent variable: Five-year change in log manufacturing employment level in each TTWA

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.037***	-0.013*	-0.011	-0.023	-0.013	-0.008
	(0.006)	(0.007)	(0.007)	(0.014)	(0.018)	(0.017)
Manu-employment share		-0.024***	-0.028***		-0.005	-0.007
		(0.003)	(0.004)		(0.005)	(0.005)
Female share			0.000			0.001
			(0.007)			(0.010)
Graduate share			-0.003			0.000
			(0.003)			(0.004)
Foreign share			-0.006**			-0.002
			(0.003)			(0.004)
Young share			0.002			-0.006
			(0.003)			(0.005)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nuts dummies	Yes	Yes	Yes	Yes	Yes	Yes
Import Exposure EU				0.098***	0.080***	0.083***
				(0.016)	(0.017)	(0.019)
KP test				37.62	21.79	20.37
N	601	601	601	390	390	390
R-squared	0.092	0.156	0.166	0.102	0.096	0.093
F	7.929	14.424	10.015	3.489	3.689	3.600

All regressions include a constant. Robust standard errors in parentheses are clustered on TTWAs. All control variables are the shares in total employment. Graduates are the ones who completed a degree or higher education qualification and foreign employment is calculated based on the people who were born outside the UK. One period lagged values of explanatory variables in 2SLS estimations. * Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

Table 3A.3: The Least and Most Exposed TTWAs

	Lowest 10			Highest 10		
period	rank	TTWA	M exp.	rank	TTWA	M exp.
1st period	1	Mull & Islay	-0.034	1	Bridgend	0.752
	2	Dolgellau & Barmouth	-0.005	2	Merthyr Tydfil & Aberdare	0.815
	3	Pwllheli	-0.003	3	Wick	0.826
	4	Hexham & Haltwhistle	0.000	4	Shaftesbury & Blandford Forum	0.863
	5	Okehampton	0.001	5	Burnley, Nelson & Colne	0.904
	6	Pitlochry	0.004	6	Ebbw Vale & Abergavenny	0.930
	7	Kirkcudbright	0.005	7	Monmouth & Cinderford	0.955
	8	Lochaber	0.008	8	Louth & Horncastle	0.957
	9	Penzance & Isles of Scilly	0.011	9	Bishop Auckland & Barnard Castle	0.970
	10	Richmond & Catterick	0.016	10	Telford & Bridgnorth	1.278
2nd period	1	Pitlochry	-0.267	1	Barnstaple	1.412
	2	Hawick	-0.152	2	Chesterfield	1.509
	3	Mull & Islay	-0.007	3	Bridgend	1.527
	4	Machynlleth & Tywyn	-0.007	4	Blackburn	1.560
	5	Kirkcudbright	-0.003	5	Andover	1.666
	6	Haverfordwest & Fishguard	-0.001	6	Falmouth & Helston	1.756
	7	Wick	0.000	7	Harrogate & Ripon	2.183
	8	Dunoon & Bute	0.005	8	Holyhead	2.675
	9	Stranraer	0.013	9	Bridgwater	2.688
	10	Pwllheli	0.027	10	Tiverton	4.695
3rd period	1	Hawick	-0.439	1	Northallerton & Thirsk	0.652
	2	Orkney Islands	-0.292	2	Telford & Bridgnorth	0.756
	3	Fraserburgh	-0.214	3	Rochdale & Oldham	0.893
	4	Bridgend	-0.066	4	Invergordon	0.898
	5	Whitby	-0.049	5	Cambridge	0.907
	6	Skegness	-0.034	6	Wisbech	0.911
	7	Porthmadog & Ffestiniog	-0.029	7	Huntingdon	1.030
	8	Haverfordwest & Fishguard	-0.020	8	Morpeth, Ashington & Alnwick	1.754
	9	Perth & Blairgowrie	-0.008	9	Galashiels & Peebles	2.670
	10	Grimsby	-0.004	10	Grantham	3.533

The least and most exposed 10 TTWAs to the Chinese import penetration in three periods, based on import exposure index calculations. 10,000 Euros per worker. Number of observations: 1st period=212; 2nd period=209; 3rd period= 212.

Table 3A.4: The Share of the Least and Most Exposed TTWAs in UK's Total Imports and Their Industrial Contents

year	TTWA	share of TTWA in UK's total imports	92	UK SIC92 Heading	share of industry in TTWA's imports
1998	Mull & Islay	0.05	5020	Operation of fish hatcheries and fish farms	100.00
1998	Dolgellau & Barmouth	0.02	1220	Farming of sheep, goats, horses, asses, mules and hinnies	100.00
1998	Pwllheli	0.05	1410	Agricultural service activities	49.50
1998	Pwllheli	0.05	1220	Farming of sheep, goats, horses, asses, mules and hinnies	50.50
1998	Hexham & Haltwhistle	0.00	1210	Farming of cattle, dairy farming	17.66
1998	Hexham & Haltwhistle	0.00	93020	Hairdressing and other beauty treatment	82.34
1998	Okehampton	0.06	15820	Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes	27.81
1998	Okehampton	0.06	27510	Casting of iron	72.19
1998	Pitlochry	0.15	15120	Production and preserving of poultry meat	0.43
1998	Pitlochry	0.15	11200	Service activities incidental to oil and gas extraction excluding surveying	4.00
1998	Pitlochry	0.15	29121	Manufacture of pumps	95.57
1998	Kirkcudbright	0.13	15710	Manufacture of prepared feeds for farm animals	2.74
1998	Kirkcudbright	0.13	1410	Agricultural service activities	16.88
1998	Kirkcudbright	0.13	26210	Manufacture of ceramic household and ornamental articles	19.43
1998	Kirkcudbright	0.13	72500	Maintenance and repair of office, accounting and computing machinery	60.94
1998	Lochaber	0.19	5010	Fishing	0.69
1998	Lochaber	0.19	5020	Operation of fish hatcheries and fish farms	23.94
1998	Lochaber	0.19	1110	Growing of cereals and other crops n.e.c.	75.36
1998	Penzance & Isles of Scilly	0.22	15810	Manufacture of bread; manufacture of fresh pastry goods and cakes	23.71
1998	Penzance & Isles of Scilly	0.22	1120	Growing of vegetables, horticultural specialities and nursery products	29.71
1998	Penzance & Isles of Scilly	0.22	22220	Printing not elsewhere classified	35.36
1998	Richmond & Catterick	0.42	28520	General mechanical engineering	26.60
1998	Richmond & Catterick	0.42	1250	Other farming of animals	27.65
1998	Richmond & Catterick	0.42	29140	Manufacture of bearings, gears, gearing and driving elements	40.20
1998	Bridgend	8.21	36501	Manufacture of professional and arcade games and toys	10.00
1998	Bridgend	8.21	32100	Manufacture of electronic valves and tubes and other electronic components	12.65
1998	Bridgend	8.21	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	31.96
1998	Merthyr Tydfil & Aberdare	7.96	31300	Manufacture of insulated wire and cable	10.45
1998	Merthyr Tydfil & Aberdare	7.96	17300	Finishing of textiles	14.15
1998	Merthyr Tydfil & Aberdare	7.96	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	32.97
1998	Wick	1.12	33403	Manufacture of photographic and cinematographic equipment	30.07
1998	Wick	1.12	29710	Manufacture of electric domestic appliances	69.93
1998	Shaftesbury & Blandford Forum	4.78	25240	Manufacture of other plastic products	16.64
1998	Shaftesbury & Blandford Forum	4.78	32100	Manufacture of electronic valves and tubes and other electronic components	21.74
1998	Shaftesbury & Blandford Forum	4.78	31620	Manufacture of other electrical equipment not elsewhere classified	27.40

1998	Burnley, Nelson & Colne	13.84	52740	Repair not elsewhere classified	8.53
1998	Burnley, Nelson & Colne	13.84	31620	Manufacture of other electrical equipment not elsewhere classified	9.46
1998	Burnley, Nelson & Colne	13.84	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	18.96
1998	Ebbw Vale & Abergavenny	6.07	28750	Manufacture of other fabricated metal products not elsewhere classified	9.72
1998	Ebbw Vale & Abergavenny	6.07	30010	Manufacture of office machinery	10.92
1998	Ebbw Vale & Abergavenny	6.07	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	43.19
1998	Monmouth & Cinderford	5.09	30010	Manufacture of office machinery	13.03
1998	Monmouth & Cinderford	5.09	32100	Manufacture of electronic valves and tubes and other electronic components	20.40
1998	Monmouth & Cinderford	5.09	52740	Repair not elsewhere classified	23.19
1998	Louth & Horncastle	6.16	25240	Manufacture of other plastic products	12.91
1998	Louth & Horncastle	6.16	36501	Manufacture of professional and arcade games and toys	13.33
1998	Louth & Horncastle	6.16	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	42.62
1998	Bishop Auckland & Barnard Castle	11.36	25240	Manufacture of other plastic products	7.00
1998	Bishop Auckland & Barnard Castle	11.36	32100	Manufacture of electronic valves and tubes and other electronic components	9.14
1998	Bishop Auckland & Barnard Castle	11.36	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	23.09
1998	Telford & Bridgnorth	12.97	25240	Manufacture of other plastic products	6.13
1998	Telford & Bridgnorth	12.97	36501	Manufacture of professional and arcade games and toys	6.33
1998	Telford & Bridgnorth	12.97	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	20.23
2003	Pitlochry	0.21	1410	Agricultural service activities	9.36
2003	Pitlochry	0.21	36220	Manufacture of jewellery and related articles not elsewhere classified	90.64
2003	Hawick	0.14	92720	Other recreational activities not elsewhere classified	15.12
2003	Hawick	0.14	1250	Other farming of animals	41.43
2003	Hawick	0.14	17220	Woollen type weaving	43.15
2003	Mull & Islay	0.01	15910	Manufacture of distilled potable alcoholic beverages	0.19
2003	Mull & Islay	0.01	5010	Fishing	99.81
2003	Machynlleth & Tywyn	0.01	1220	Farming of sheep, goats, horses, asses, mules and hinnies	100.00
2003	Kirkcudbright	0.01	1210	Farming of cattle, dairy farming	0.86
2003	Kirkcudbright	0.01	5010	Fishing	99.14
2003	Haverfordwest & Fishguard	0.04	23201	Mineral oil refining	10.34
2003	Haverfordwest & Fishguard	0.04	1220	Farming of sheep, goats, horses, asses, mules and hinnies	32.96
2003	Haverfordwest & Fishguard	0.04	1410	Agricultural service activities	56.57
2003	Dunoon & Bute	0.02	14210	Operation of gravel and sand pits	100
2003	Stranraer	0.02	15910	Manufacture of distilled potable alcoholic beverages	0.05
2003	Stranraer	0.02	1210	Farming of cattle, dairy farming	0.22
2003	Stranraer	0.02	17511	Manufacture of woven carpets and rugs	99.73
2003	Pwllheli	0.16	1410	Agricultural service activities	12.26
2003	Pwllheli	0.16	92720	Other recreational activities not elsewhere classified	12.97
2003	Pwllheli	0.16	22220	Printing not elsewhere classified	74.74

2003	Barnstaple	2.04	35300	Manufacture of aircraft and spacecraft	17.40
2003	Barnstaple	2.04	52720	Repair of electrical household goods	25.17
2003	Barnstaple	2.04	19300	Manufacture of footwear	38.40
2003	Chesterfield	8.75	31300	Manufacture of insulated wire and cable	10.91
2003	Chesterfield	8.75	36120	Manufacture of other office and shop furniture	11.87
2003	Chesterfield	8.75	31620	Manufacture of other electrical equipment not elsewhere classified	18.98
2003	Bridgend	9.93	36400	Manufacture of sports goods	9.69
2003	Bridgend	9.93	32100	Manufacture of electronic valves and tubes and other electronic components	12.69
2003	Bridgend	9.93	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	34.73
2003	Blackburn	16.36	36120	Manufacture of other office and shop furniture	6.35
2003	Blackburn	16.36	17300	Finishing of textiles	7.38
2003	Blackburn	16.36	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	21.09
2003	Andover	11.50	32100	Manufacture of electronic valves and tubes and other electronic components	10.96
2003	Andover	11.50	31620	Manufacture of other electrical equipment not elsewhere classified	14.44
2003	Andover	11.50	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	29.99
2003	Falmouth & Helston	6.06	36400	Manufacture of sports goods	15.89
2003	Falmouth & Helston	6.06	32100	Manufacture of electronic valves and tubes and other electronic components	20.79
2003	Falmouth & Helston	6.06	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	56.94
2003	Harrogate & Ripon	6.26	25240	Manufacture of other plastic products	14.33
2003	Harrogate & Ripon	6.26	32100	Manufacture of electronic valves and tubes and other electronic components	20.14
2003	Harrogate & Ripon	6.26	31620	Manufacture of other electrical equipment not elsewhere classified	26.56
2003	Holyhead	1.01	27420	Aluminium production	4.47
2003	Holyhead	1.01	36400	Manufacture of sports goods	95.53
2003	Bridgwater	3.68	36620	Manufacture of brooms and brushes	13.98
2003	Bridgwater	3.68	19300	Manufacture of footwear	21.29
2003	Bridgwater	3.68	25240	Manufacture of other plastic products	24.34
2003	Tiverton	2.53	35300	Manufacture of aircraft and spacecraft	14.07
2003	Tiverton	2.53	17600	Manufacture of knitted and crocheted fabrics	14.67
2003	Tiverton	2.53	31620	Manufacture of other electrical equipment not elsewhere classified	65.79
2008	Hawick	1.85	17401	Manufacture of soft furnishings	9.78
2008	Hawick	1.85	17720	Manufacture of knitted and crocheted pullovers, cardigans and similar articles	29.69
2008	Hawick	1.85	17600	Manufacture of knitted and crocheted fabrics	59.38
2008	Orkney Islands	0.56	23201	Mineral oil refining	0.45
2008	Orkney Islands	0.56	1220	Farming of sheep, goats, horses, asses, mules and hinnies	0.86
2008	Orkney Islands	0.56	17720	Manufacture of knitted and crocheted pullovers, cardigans and similar articles	98.69
2008	Fraserburgh	0.71	63400	Activities of other transport agencies	0.00
2008	Fraserburgh	0.71	15810	Manufacture of bread; manufacture of fresh pastry goods and cakes	9.42
2008	Fraserburgh	0.71	28520	General mechanical engineering	19.10
2008	Fraserburgh	0.71	52720	Repair of electrical household goods	70.73
2008	Bridgend	2.38	34300	Manufacture of parts and accessories for motor vehicles and their engines	12.12

2008	Bridgend	2.38	52720	Repair of electrical household goods	21.05
2008	Bridgend	2.38	33100	Manufacture of medical and surgical equipment and orthopaedic appliances	32.14
2008	Whitby	0.29	92720	Other recreational activities not elsewhere classified	18.13
2008	Whitby	0.29	22220	Printing not elsewhere classified	32.96
2008	Whitby	0.29	27520	Casting of steel	46.10
2008	Skegness	0.58	1240	Farming of poultry	1.65
2008	Skegness	0.58	15330	Processing and preserving of fruit and vegetables not elsewhere classified	12.20
2008	Skegness	0.58	52720	Repair of electrical household goods	85.78
2008	Porthmadog & Ffestiniog	0.12	93020	Hairdressing and other beauty treatment	1.74
2008	Porthmadog & Ffestiniog	0.12	2010	Forestry and logging	98.26
2008	Haverfordwest & Fishguard	0.35	92720	Other recreational activities not elsewhere classified	15.16
2008	Haverfordwest & Fishguard	0.35	2010	Forestry and logging	33.28
2008	Haverfordwest & Fishguard	0.35	28520	General mechanical engineering	38.71
2008	Perth & Blairgowrie	1.13	28520	General mechanical engineering	11.96
2008	Perth & Blairgowrie	1.13	35300	Manufacture of aircraft and spacecraft	23.86
2008	Perth & Blairgowrie	1.13	22110	Publishing of books	34.04
2008	Grimsby	1.25	20300	Manufacture of builders' carpentry and joinery	11.73
2008	Grimsby	1.25	28110	Manufacture of metal structures and parts of structures	20.27
2008	Grimsby	1.25	34100	Manufacture of motor vehicles	34.09
2008	Northallerton & Thirsk	3.20	28750	Manufacture of other fabricated metal products not elsewhere classified	20.76
2008	Northallerton & Thirsk	3.20	30010	Manufacture of office machinery	32.30
2008	Northallerton & Thirsk	3.20	32100	Manufacture of electronic valves and tubes and other electronic components	34.71
2008	Telford & Bridgnorth	6.07	93020	Hairdressing and other beauty treatment	0.03
2008	Rochdale & Oldham	6.85	31300	Manufacture of insulated wire and cable	11.64
2008	Rochdale & Oldham	6.85	25130	Manufacture of other rubber products	11.80
2008	Rochdale & Oldham	6.85	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	48.66
2008	Invergordon	2.59	22110	Publishing of books	14.85
2008	Invergordon	2.59	33100	Manufacture of medical and surgical equipment and orthopaedic appliances	29.49
2008	Invergordon	2.59	19200	Manufacture of luggage, handbags and the like, saddlery and harness	34.90
2008	Cambridge	10.36	36400	Manufacture of sports goods	9.31
2008	Cambridge	10.36	31620	Manufacture of other electrical equipment not elsewhere classified	14.56
2008	Cambridge	10.36	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	32.20
2008	Wisbech	5.78	29240	Manufacture of other general purpose machinery not elsewhere classified	9.06
2008	Wisbech	5.78	29710	Manufacture of electric domestic appliances	16.47
2008	Wisbech	5.78	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	57.65
2008	Huntingdon	9.50	25130	Manufacture of other rubber products	8.51
2008	Huntingdon	9.50	30010	Manufacture of office machinery	10.88
2008	Huntingdon	9.50	32300	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	35.10
2008	Morpeth, Ashington & Alnwick	7.35	36400	Manufacture of sports goods	13.13
2008	Morpeth, Ashington & Alnwick	7.35	32100	Manufacture of electronic valves and tubes and other electronic components	15.13

2008	Morpeth, Ashington & Alnwick	7.35	31620	Manufacture of other electrical equipment not elsewhere classified	20.53
2008	Galashiels & Peebles	2.98	29560	Manufacture of other special purpose machinery not elsewhere classified	15.86
2008	Galashiels & Peebles	2.98	33100	Manufacture of medical and surgical equipment and orthopaedic appliances	25.66
2008	Galashiels & Peebles	2.98	32100	Manufacture of electronic valves and tubes and other electronic components	37.30
2008	Grantham	4.80	29560	Manufacture of other special purpose machinery not elsewhere classified	9.85
2008	Grantham	4.80	28750	Manufacture of other fabricated metal products not elsewhere classified	13.85
2008	Grantham	4.80	25240	Manufacture of other plastic products	16.17

Note: The able reports the list of ten most and least exposed TTWAs to Chinese import competition in all periods, and their industrial content according to SIC92 industrial classification.

Table 3A.5: The List of TTWAs

TTWA	Name	TTWA	Name	TTWA	Name
001	Aberdeen	082	Exeter & Newton Abbot	163	Northampton & Wellingborough
002	Aberystwyth & Lampeter	083	Falkirk	164	Norwich
003	Andover	084	Falmouth & Helston	165	Nottingham
004	Ashford	085	Folkestone	166	Oban
005	Ayr & Kilmarnock	086	Forfar & Montrose	167	Okehampton
006	Badenoch	087	Fraserburgh	168	Omagh
007	Ballymena	088	Galashiels & Peebles	169	Orkney Islands
008	Banbury	089	Glasgow	170	Oswestry
009	Banff	090	Gloucester	171	Oxford
010	Bangor, Caernarfon & Llangefni	091	Grantham	172	Paignton & Totnes
011	Barnsley	092	Great Yarmouth	173	Pembroke & Tenby
012	Barnstaple	093	Greenock	174	Penrith & Appleby
013	Barrow-in-Furness	094	Grimsby	175	Penzance & Isles of Scilly
014	Basingstoke	095	Guildford & Aldershot	176	Perth & Blairgowrie
015	Bath	096	Harlow & Bishop's Stortford	177	Peterborough
016	Bedford	097	Harrogate & Ripon	178	Peterhead
017	Belfast	098	Hartlepool	179	Pitlochry
018	Berwick	099	Hastings	180	Plymouth
019	Bideford	100	Haverfordwest & Fishguard	181	Poole
020	Birmingham	101	Hawes & Leyburn	182	Porthmadog & Ffestiniog
021	Bishop Auckland & Barnard Castle	102	Hawick	183	Portsmouth
022	Blackburn	103	Hereford & Leominster	184	Preston
023	Blackpool	104	Hexham & Haltwhistle	185	Pwllheli
024	Bolton	105	Holyhead	186	Reading & Bracknell
025	Boston	106	Honiton & Axminster	187	Rhyl & Denbigh
026	Bournemouth	107	Huddersfield	188	Richmond & Catterick
027	Bradford	108	Hull	189	Rochdale & Oldham
028	Brecon	109	Huntingdon	190	Rugby
029	Bridgend	110	Invergordon	191	Salisbury
030	Bridgwater	111	Inverness & Dingwall	192	Scarborough
031	Bridlington & Driffield	112	Ipswich	193	Scunthorpe
032	Bridport & Lyme Regis	113	Irvine & Arran	194	Shaftesbury & Blandford Forum
033	Brighton	114	Isle of Wight	195	Sheffield & Rotherham
034	Bristol	115	Kelso & Jedburgh	196	Shetland Islands
035	Bude & Holsworthy	116	Kendal	197	Shrewsbury
036	Burnley, Nelson & Colne	117	Kettering & Corby	198	Skegness
037	Burton upon Trent	118	Kidderminster	199	Skye & Lochalsh
038	Bury St Edmunds	119	King's Lynn & Fakenham	200	South Holland
039	Buxton	120	Kingsbridge & Dartmouth	201	Southampton
040	Calderdale	121	Kirkcaldy & Glenrothes	202	Southend & Brentwood
041	Cambridge	122	Kirkcudbright	203	St Andrews & Cupar
042	Campbeltown	123	Lanarkshire	204	St Austell
043	Canterbury	124	Lancaster & Morecambe	205	Stafford
044	Cardiff	125	Launceston	206	Stevenage
045	Cardigan	126	Leeds	207	Stirling & Alloa
046	Carlisle	127	Leicester	208	Stoke-on-Trent
047	Carmarthen & Llandovery	128	Lincoln	209	Strabane
048	Chelmsford & Braintree	129	Liverpool	210	Stranraer
049	Cheltenham & Evesham	130	Livingston & Bathgate	211	Sunderland
050	Chester & Flint	131	Llandrindod Wells & Builth Wells	212	Swansea Bay
051	Chesterfield	132	Llandudno & Colwyn Bay	213	Swindon
052	Chichester & Bognor Regis	133	Lochaber	214	Taunton
053	Clacton	134	Lochgilphead	215	Telford & Bridgnorth
054	Colchester	135	London	216	Thetford & Mildenhall
055	Coleraine	136	Louth & Horncastle	217	Thurso
056	Coventry	137	Lowestoft & Beccles	218	Tiverton
057	Craigavon	138	Ludlow	219	Torquay
058	Craven	139	Luton & Watford	220	Trowbridge & Warminster
059	Crawley	140	Machynlleth & Tywyn	221	Truro, Redruth & Camborne
060	Crewe & Northwich	141	Maidstone & North Kent	222	Tunbridge Wells
061	Cromer & Sheringham	142	Malton & Pickering	223	Ullapool & Gairloch
062	Darlington	143	Manchester	224	Wadebridge
063	Derby	144	Mansfield	225	Wakefield & Castleford
064	Derry	145	Margate, Ramsgate & Sandwich	226	Walsall & Cannock
065	Dolgellau & Barmouth	146	Matlock	227	Warrington & Wigan
066	Doncaster	147	Merthyr Tydfil & Aberdare	228	Warwick & Stratford-upon-Avon
067	Dorchester & Weymouth	148	Middlesbrough & Stockton	229	Wells & Shepton Mallet
068	Dornoch & Lairg	149	Mid-Ulster	230	Whitby
069	Dover	150	Milton Keynes & Aylesbury	231	Whitehaven
070	Dudley & Sandwell	151	Minehead	232	Wick
071	Dumbarton	152	Monmouth & Cinderford	233	Wirral & Ellesmere Port
072	Dumfries & Annan	153	Moray	234	Wisbech
073	Dundee	154	Morpeth, Ashington & Alnwick	235	Wolverhampton
074	Dunfermline	155	Mull & Islay	236	Worcester & Malvern
075	Dungannon	156	Newbury	237	Workington & Keswick
076	Dunoon & Bute	157	Newcastle & Durham	238	Worksop & Retford
077	Eastbourne	158	Newport & Cwmbran	239	Worthing
078	Ebbw Vale & Abergavenny	159	Newry	240	Wrexham & Whitchurch
079	Edinburgh	160	Newton Stewart & Wigtown	241	Wycombe & Slough
080	Eilean Siar	161	Newtown & Welshpool	242	Yeovil & Chard
081	Enniskillen	162	Northallerton & Thirsk	243	York

Conclusion

This thesis aims at providing helpful insights into the trade of goods and services. The first two chapters focus on the micro-level determinants of international trade in services in the UK. The first chapter shows that the gravity model, which is most commonly used to analyse the determinants of goods trade, also provides a good method of examining the determinants of services trade at firm level, while the second chapter focuses on the coefficient heterogeneity in the gravity equation. The third chapter investigates the impact of Chinese import competition on UK workers and firms.

The first chapter applies the gravity equation - a very well-known and widely used framework for analysing the determinants of goods trade - to service trade. Both country and firm characteristics were considered in order to try to explain firm-level services trade in the UK for the year 2005. Four different approaches (OLS, LPM, Tobit and PPML) were used in the estimations and the selection of the suitable approach was discussed. The objectives of this chapter were to understand which forces determine firm-level service exports and imports in the UK, and to compare the results from the firm-level analysis with their country-level counterparts, in order to understand how the effects of different determinants of firm-level services trade (e.g. distance and trade barriers) may differ from those obtained from the aggregate-level data. These firm-level analyses were followed by analyses of margins of services trade in order to investigate how the different margins of services exports and imports contribute to variations across UK's trading partners and demonstrate how the effects of different determinants of services exports and imports may vary across different margins. To this end, total exports and imports to/from a country were decomposed into the extensive margin (the number of firms) and the intensive margin (the average amount of exports/imports per firm). After determining the margin that drives country-level variations in total services exports and imports, the determinants of each margin were estimated by OLS and PPML.

The results show that among the country-level variables, GDP, GDP per capita, distance, common language, common legislation and GATT membership have a significant impact on firm-level service exports, while GDP, GDP per capita, distance, colonial relationship and time-differences have significant impacts on firm-level service imports. Including the firm characteristics in the models

slightly changes the coefficients of significant variables. Firm size, labour productivity and R&D engagement have a positive effect on exports, as expected. However, exports decrease as firms become older, which confirms the hypothesis of a negative relationship between exports and firm age since younger firms are more flexible and quicker to adapt to changing international conditions and new technology. All the firm-level variables except the age of the firms have significantly positive effects on firm-level service imports. To compare these results with the results obtained from the aggregated data, we aggregated the firm-level data up to country- level and estimated similar regressions using OLS and PPML. The coefficients of the determinants of total exports and imports differ considerably from those of the firm-level analysis. For example, the negative impact of distance is stronger for the overall analysis than for the firm-level analysis. This could suggest that the policies based on the results from the country-level analyses might not be appropriate for all of the trading firms. It is important to take the firm characteristics into account since they may affect trading decisions made by the firms. However, this holds only in the OLS analyses. The comparison of the firm-level results with the country-level results shows that the PPML is invariant to the level of aggregation since it is not necessary to take the log of dependent variable. This implies that there is no additional benefit of collapsing data down to firm-level. PPML should be preferred not only because it provides consistent estimates in the presence of zero trade values and heteroskedasticity, but also because it provides similar coefficients in both firm-level and country-level analyses.

Finally, the findings regarding the determinants of the margins of trade show that both GDP and distance are significant in explaining the total exports and imports and their respective margins. The negative impact of distance and the positive impact of GDP are stronger in the case of total imports and its extensive margin, while for the intensive margin, the coefficients are higher in the export analyses. This suggests that any policy implications related to GDP would primarily affect the number of exporters and the number of importers, whereas policies related to distance would be of greater importance for the number of exporting firms and the average import value per importing firm.

The second chapter considers three research questions in order to examine any possible parameter heterogeneity in the gravity equations:

- *How do certain characteristics of a firm such as its size and labour productivity influence the impact of typical gravity variables?*

- *How do the determinants of firm-level services trade in the UK alter along the distribution of trade value?*

- *How do the effects of different determinants of exports and imports vary across the distribution of total service exports and imports and their margins?*

In order to address these questions in relation to the UKs services trade, it is helpful to use interaction and quantile regressions. Incorporating interaction terms into the regressions enables us to observe the effects of firm size and productivity on the impacts of GDP and distance when determining the firm-level exports and imports in a gravity framework. Estimating service trade using quantile regressions enables us to observe the effects of heterogeneity due to the distribution of service exports and imports. Quantile estimations were applied to both firm-level data and aggregated data to address the second and third questions respectively. If the firms possess different characteristics which influence their trade value, then it is important to question the effects of these characteristics on the determinants of exports and imports. In particular, within the service trade literature, there have been no studies to date that have investigated the possible parameter heterogeneity caused by the distribution of the services trade and different firm characteristics.

The findings from the OLS regressions with interaction terms show that the firm size influences the effects of GDP and distance on firm-level exports and imports, while the productivity level of each firm influences the effects of GDP and distance for the imports analysis only. Accordingly, exports and imports of larger firms are affected to a greater extent by the market size of the trading partner country and the distance between the UK and its trading partners. This result may suggest that small firms mostly export (import) particular services to (from) certain countries; therefore, changes in market size and trade costs have less effect on these firms. The quantile regressions provide similar findings in terms of parameter heterogeneity: the significant coefficients from the firm-level exports and imports exhibit changes throughout the distribution of exports and imports. For example, the effect of GDP increases from the lower to the higher quantiles of exports, which suggests that firms in the higher quantiles are more affected by the changes in GDP. One possible reason for the flatter slope of the GDP in the lower quantiles could be the type of services exported by these firms. It may be the case that these services are very specific and only demanded by a certain type of consumers in each country; therefore demand for them does not vary much with the changes in GDP. The distance variable also has a flatter slope in the lower quantiles. When the distance is very small, all the firms engage in exporting and importing. However, as the distance increases, only the firms that are more successful at exporting survive in the lower quantiles, while those with a lower export value leave the market. Therefore, firm composition could be one of the reasons why the slope for the distance variable is flatter. Another possible reason might be the composition of the service types. The higher coefficient in the higher quantiles suggests that the service types in the higher quantiles are more homogeneous; therefore, small price changes cause large decreases in exports and imports.

The results from the margins of trade analysis show that the coefficients of the determinants of service exports and imports not only differ from those of the OLS, but also from the coefficients for each quantile. The effects of GDP and distance weaken from the lower to the higher quantile in the analyses for both exports and imports and their intensive and extensive margins.

The impact of increasing Chinese import competition on workers and firms in the UK's local labour markets is investigated in the third chapter. The analysis covers goods trade for the period 1998 to 2013, which includes China's accession to the WTO. The fact that the UK is among China's top trading partners makes it particularly important to analyse how the effects of Chinese import competition vary across the local labour markets in the UK. The analysis considers the cross-market variation in import exposure stemming from initial differences in industry specialisation because some local labour markets may be more exposed to the effects of Chinese imports, depending on their industrial composition. The existing literature shows that increasing Chinese imports are associated with declines in manufacturing employment, working population and average wages in local labour markets. This is the first regional-level study which assesses these effects in the UK's local labour markets. Moreover, it is also likely that changes will be observed in firms within the local labour markets due to the increasing import competition. Firms can reduce their size and limit their trading activities with non-exposed industries or improve the quality of their products to enable them to cope more effectively with Chinese competition. Therefore, it is also important to examine the effects of increasing Chinese import exposure on changes in firm characteristics such as firm size or labour productivity.

The results show that increasing Chinese import competition does not have any significant impact on total employment, manufacturing employment, working population and average wages in the UK's local labour markets. The results are sustained when we control for the share of female workers, graduate workers, young workers and foreign-born workers as a proportion of the total employment figure at the start of the period. Additionally, we analysed the effects of increasing Chinese exports on the local labour market outcomes since the UK also substantially increased its exports to China during the analysis period. We did not detect any significant impacts of exposure to exports to China on total employment, working population and average wages in the UK's local labour markets. However, the results show that increasing export exposure is associated with a decline in manufacturing employment whereas increasing import exposure has no effect on manufacturing employment. The analysis regarding the different demographic groups such as age, gender, and education level shows that both total and manufacturing employment are unaffected by the increase in Chinese imports, with the exception of graduate employment. Exposure to Chinese imports is associated with a decline in graduate employment in the local labour markets. Finally

the findings from the analysis of the firm characteristics suggest that exposure to Chinese imports in the local labour markets decreases the average firm size whereas the average labour productivity remains unaffected. One possible explanation for these results could be that each of the TTWAs only accounts for a small share of the total imports. Although imports from China have increased substantially, when we consider the share of imports represented by a specific industry in a specific local labour market as a proportion of the UK's total imports, the effects remain limited.