Coefficient Heterogeneity in Gravity Equations: Evidence from Quantile Regressions[1]

Özgül Bilici[2]

Abstract

The main purpose of this study is to analyse service export and import in the UK taking into account both country- and firm-level factors throughout the conditional distribution of trade values in the gravity framework. To detect possible parameter heterogeneity across the distribution of firm-level export and import, quantile regression has been used. The results show that the magnitude and significance level of each coefficient are different in each quantile and they are different from OLS estimations. The positive effect of GDP and the negative effect of distance on firm-level service export and import become stronger in higher quantiles, showing that firms with higher level of export and import are affected more by changes in GDP and distance.

JEL Code: F10, F12, F14, L20

[1] This study is a part of my ongoing PhD studies. I would like to thank my supervisor, Dr. Holger Breinlich, for his patience and valuable advice. This work was based on data from the International Trade in Services Survey and Annual Respondents 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.

[2] obilic@essex.ac.uk, Department of Economics, University of Essex, Wivenhoe Park, Colchester, CO4 3SQ, UK

1. Introduction

In last two decades, the number of firm-level studies has increased in international trade literature starting from pioneer study by Bernard and Jensen (1994). Those studies show that exporting firms are larger and more productive, use more capital intensive production processes and employ more highly skilled workforce (see Bernard et al, 2007 and Wagner, 2007 for firm-level good trade and Breinlich and Criscuolo, 2011 and Federico and Tosti, 2011 for firm-level service trade). 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 with different foreign markets and extensive and intensive margins of bilateral trade flows between countries are affected differently by changing trade costs.

However, if firms have different characteristics from lower to higher tale 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 firms with higher trade values are different from firms with lower trade values, then a certain trade determinant would have different impact on different firms. Point estimates such as OLS estimate assume that the conditional distribution of a dependent variable is homogeneous for a given set of explanatory variables. In this case, it is not possible to observe firm heterogeneity. Therefore, in this paper we employ Quantile Regression approach which enables us to examine the impacts of different country- and firm-level variables at different points of conditional distribution of UK's firm-level service export and import. 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; Serti and Tomasi, 2009; Shevtsova, 2010; Velucchi and Viviani, 2011; Hijzen et al, 2011; Powell and Wagner, 2011; Haller, 2012) However, the number of studies which employ quantile regression to analyze the effects of different firm/country level characteristics on firm or country-level trade values is more limited. Moreover these studies generally focus on goods trade (see Wagner, 2004 and Molder, 2011). Especially in service trade literature, there is no study which investigates the effects of different determinants of service trade at different points of conditional distribution of trade values. It is off great importance to look at the heterogeneous impact of a

given variable throughout the trade distribution in terms of successful policy implications. Policies relying on standard trade models would be misleading if it is true that each coefficient estimate of gravity variable varies throughout the trade distribution.

Moreover, the increasing importance of international services trade should be considered. It has depicted faster growth than goods trade. According to World Trade Organization (WTO) statistics, world export in commercial services (services excluding governmental services) stood at 3.7 billion USD in 2010 with an average annually growth rate over 15% over the past 20 years. Moreover, it 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 3% average annual growth rate from 1990 to 2010, and around 45% of total employment is hired by service sectors (World Development Indicators, 2011). On the other hand, the UK is one of the leader countries in trade in services. According to WTO (2011), the UK is the third largest exporter and fourth largest importer in commercial services. Besides, the UK Office for National Statistics provides a very well established database in firm-level service trade. Therefore, the UK has been chosen for the analyses.

The main purpose of this study is to analyse service exports and imports in the UK taking into account both country and firm-level factors throughout the conditional distribution of trade values in the gravity framework. To this end, the gravity model is used as an empirical tool in this study. To estimate gravity equation, quantile regression and OLS have been employed. 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 benchmark estimation. In order to avoid correlated residuals across countries, country clusters are used to obtain cluster corrected standard errors in all firm-level analyses. Quantile regressions used for firm-level service exports and imports are applied on margins of service export and import as well in order to investigate how the effects of different determinants of exports and imports may alter across distribution of different margins.

According to the 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 results show that and 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

higher level of export and import are affected more by changes in GDP and distance. In contrast to firm-level results, the effect of GDP and distance weaken from lower to higher quantile in the analyses for both exports and imports and their margins.

The rest of the paper is organized as follows. The methodology used in the analyses and the information on databases are presented in Section 2 and Section 3. Section 4 gives the analysis results from empirical models. Finally, Section 5 concludes.

2. Empirical Framework

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

$$\ln T_{ids} = \beta_0 + \beta_1 \ln GDP_d + \beta_3 \ln dist_{id} + \sum_{f=1}^{m} \gamma_f \ln F_i + \sum_{j=1}^{k} D_{id,j}^{\beta_j} + \varepsilon_{ids} \qquad (1)$$

The equation (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. The details of the variables that are used to estimate the determinants of the firm-level trade flows are given in Section 4.

If the impacts of certain variables are heterogeneous throughout the distribution of the trade value, then it might lead to misleading predictions. The traditional point estimates assume that the conditional distribution of a dependent variable is homogeneous for a given set of explanatory variables. In this case, it is not possible to observe firm heterogeneity. Therefore, in this paper we employ Quantile Regression approach which enables us 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.

Quantile regression has been used in order to detect possible parameter heterogeneity across the distribution of firm-level export. Quantile estimations have been repeated for 5 quantiles

(10th, 25th, 50th, 75th, and 90th quantiles) and OLS is used as benchmark estimation. In order to avoid correlated residuals across countries, country clusters are used to obtain cluster corrected standard errors in all firm-level analyses. In the second part of the analyses, we repeat the above analyses for the firm-level imports in the UK.

3. Data[3]

This study considers both country- and firm-level factors in order to detect the heterogeneous impacts of different variables on firm-level service 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 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.

The main data source that is used in this study is the UK's International Trade in Services Inquiry (ITIS). ITIS data are collected from a number of different surveys and administrative sources. It provides import and export of 46 different types of services by country of origin and destination for roughly 20,000 firms (from 2001, previously approximately 10,000) 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 the firms covered in 2005, this study focuses on the data from 2005.

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 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

[3] 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).

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 250 employees depending on the year). 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 of 1997-2010. The purpose of the BSD is to create a version of the IDBR for research use, reflecting a wide variet 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; identify accurately birth and death and improve demography statistics and allow historical analysis. As other firm characteristics, firm age variable has been generated from birth and death variables and being a Limited Liability Company (LLC) dummy is generated from legal status variable provided by the BSD.

The last data source that is used in this study is 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 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.

The ITIS reports observation with positive transaction values. It covers 83014 observations reported for 5428 firms trading with 214 countries in 46 service types for 2005. For the same year, the ARD reports variables for firm characteristics for 1860045 observations. However, if we consider only the contributors who were selected and returned data, there are only 52171 observations in question. These firms are operating under 8 different sectors classified according to the UK Standard Industrial Classification of Economic Activities 1992 (SIC(92)): catering, construction, motor trades, production, property, retail, other services and

wholesale. After merging these two database as well as 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.

In order to estimate firm-level service 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 export and import. With such data, the true inference is 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 export and import 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.

4. Analyses

In order to examine the effects of different determinants of services trade at different points of conditional distribution of trade values, we employ 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 regression. Quantile regression has been used in order to detect possible parameter heterogeneity across the distribution of firm-level export. Quantile estimations have been repeated for five quantiles (10th, 25th, 50th, 75th, and 90th quantiles) and OLS is used as benchmark estimation[4]. In order to avoid correlated residuals across countries, country clusters are used to obtain cluster corrected standard errors in all firm-level analyses. In the second part of the analyses, we repeat the above mentioned analyses for the firm-level imports in the UK.

[4] We are aware of that the OLS results and quantile results are not comparable because OLS estimation of log-linearized form of gravity equation suffers from Jensen's inequality (Santos Silva and Tenrero, 2006). However, because of the computational problems due to the high number of observation, we use OLS as benchmark model.

4.1. Export Analysis

To interpret the coefficients obtained from export analyses, it would be helpful to use a standard firm-level revenue equation:

$$X_{ids} = \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} (dist_{id}^{\alpha_0} \times e^{\sum_{j=1}^{k} D_{id,j}^{\alpha_j}})^{1-\sigma} w_i{}^{1-\sigma} \gamma_i^{\sigma-1} PE \qquad (5)$$

The equation (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 for of the equation (given in equation (4) for trade flows), the GDP of the trading partners is used as the proxy of the total expenditures (E) and the CES price index (P) and the equation suggests that the impact of the distance depends on two parameters: the elasticity of substitution and the distance elasticity of trade costs[5].

Quantile regressions for firm-level exports are given in Table 1 where Figure 1 and Figure 2 display the changes in coefficients of significant variables throughout the distribution of exports. In the table, column 1 and column 2 provide OLS estimations without and with firm-level variables. According to the Table 1, the positive effect of GDP and the negative effect of distance on firm-level service export vary over the quantiles (see Figure 1). Effect of GDP becomes stronger in higher quantiles while effect of distance exhibits an increase on average even though its effect is higher in the median. This suggests that firms with higher level of export are affected more by changes in GDP and distance. Increasing effect of GDP towards the higher quantiles would be explained by the heterogeneous nature of service trade. Feenstra et al (2001) suggests that the effect of GDP is significantly higher for differentiated goods than homogeneous goods. Grunfeld and Moxnes (2003) provide evidence from service trades in OECD countries that the coefficient of GDP is higher for service trade because of the higher heterogeneity. Therefore, firms with higher export values are more affected by a change in GDP as the service types in these quantiles become more heterogeneous. On the other hand, firms with high level of export are harmed from increasing distance between countries. The increasing impact of distance is clearer in the quantile regressions with firm

[5] The dataset provides 'gross wages and salaries' variable. It has been used as a proxy of the 'wages' in equation (5). However the coefficients are insignificant and negligible in all quantiles. Excluding this variable did not affect the impact of other variables.

characteristics. This suggests that the distribution of export value gets narrower as the distance increases. Not all firms are exporting to all destinations. Especially in the lower quantiles, only the better exporting firms survive as distance increases, this explains smaller impact of distance in the lower quantiles. The higher quantiles contain firms which always export. These firms with higher export values can be considered as best firms which are able to export to different destinations in different varieties. The impact of the distance becomes stronger depending on two parameters: higher elasticity of substitution and higher distance elasticity of trade costs. Since service trade types are considered more differentiated, the increasing coefficient for distance can be explained by increasing effect of distance elasticity of trade cost. Firms in higher quantiles are similar to each other while in lower quantiles, firms which are more heterogeneous, export to only close destination.

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 25^{th} quantile regression with additional firm-level variables although common language variable has an unexpected sign. The effect of GDP per capita depicts slight increase from lower to higher quantiles and it has an insignificant effect in the 10^{th} quantile showing that firms with low export level are not affected by development level of the trading partners. Linder hypothesis suggests that the GDP per capita is an important determinant of tastes. As GDP per capita increases in a country, consumers tend to increase the demand for different varieties (Ramezzana, 2000). Firms with higher export values are able to export different varieties, therefore, the effect of GDP per capita is stronger for the firms in higher quantiles while its effect is insignificant in the lowest quantile. Regional trade agreements, EU and WTO membership dummies have significantly negative effects on firm-level export for all quantiles except 10^{th} quantile. Negative effects of these variables are increasing for higher quantiles. Models extended with additional firm-level variables have similar pattern as in models without firm-level variables. The effects of all firm-level variables except R&D engagement and LLC dummy are higher for higher quantiles. The effects of firm size and labour productivity become stronger in higher quantiles, showing that the distribution of export value turns out to be wider as those variables increase. Larger and more productive firms exhibit very different levels of export. Firms with high export level 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.

4.2. Import Analysis[6]

Quantile estimations for firm-level imports are presented in Table 2 and Figure 3 and Figure 4. First two columns give OLS estimations without and with firm-level variables. As shown in figures, all coefficients are different in each quantile as well as in OLS estimations. According to the Table 2, among country-level variables only GDP and distance variables have significant effects on firm-level import. 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 with higher import level are affected more by increasing trade cost than firms with lower import level. As found in export analysis, the distribution of the import value becomes narrower as distance increases and becomes wider as GDP increases. Firms in higher quantiles are able to import more as GDP of the partner country increases. This can be explained by Armington assumption which explains the degree of elasticity of substitution between domestic and imported products. Firms with higher imports are affected by the economic size which is the proxy of the supply capability of the partner country. Countries with higher GDP supply 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 can be considered worst firms, as the distance increases, only some of these firms can bear the increasing cost of importing. Therefore, distance have lower coefficient in the lower quantiles. The development level of exporting countries does not have impact on lower quantiles as found in OLS estimation. However its effect turns into significant for the 75th and 90th quantiles, only firms with high level import are influenced by the development level of the trading partners. Models extended with additional firm-level variables have similar pattern 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 import values of firms increase. Especially the effects of firm size and

[6] Most of the literature on import demand models explain imports as a function of GDPs of countries, domestic price index and import price index (Murray and Ginman (1976), Deyak et al (1993), Shiferaw and Kilmer (2007) and Narayan & Kumar (2010)). Due the lack of information on prices, we employ equation (1) to estimate import flows in gravity framework.

productivity come into prominence for the firms with high import values. Firm age variable is insignificant in both OLS and quantile estimations. As found in OLS estimation, R&D engagement has negative impact on firm-level imports, however it has significant effects for only 25^{th} and 50^{th} quantiles.

In Figure 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 are increasing throughout the distributions. In both models without and with firm-level variables, 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 panel, we compare the coefficients of firm size and productivity from exports with the ones obtained from import analysis. Coefficients from both variables are increasing from lower to upper quantiles of both imports and exports, and the impacts are higher for export firms. These different results from imports and exports analyse suggest that exporting firms are different from importing firms and importing firms are more sensitive to changes in GDP, firm size and productivity where importing firms are more sensitive to changes in distance.

5. Conclusion

During the last two decades, the trade in services becomes prominent in the wolrd economy as well as in the UK economy. The UK is one of the leader countries in trade in services. Therefore it is of great importance to analyse the determinants of service trade flows in this country. On the other hand, an analysis on aggregate trade values might be misleading from the policy perspective since firms engaged in international trade are different from not only non-trading firms bot also the other trading firms. Hence, in this study we analyse the determinants of *firm-level* service trade in the UK. However, if the firms are heterogeneous leading them to have different trade values, the effects of different variables explaining the trade values by firms vary through the distribution of trade. To observe this possible heterogeneity across the distribution of firm-level trade, in this paper, we employ Quantile Regression approach which enables us to examine the impacts of different country- and firm-

level variables at different points of conditional distribution of UK's firm-level service export and import.

The results 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 higher level of export and import are affected more by changes in GDP and distance. These differences in the coefficients can be explained by the heterogeneous nature of the service trade and self-selection of the firms into export and import markets. For example, firms with higher export values are more affected by a change in GDP as the service types in these quantiles become more heterogeneous and the impact of distance is increasing for these firms because only some firms are able to export to all destinations. There are some extra costs of exporting including transportation costs, marketing costs (need of personnel with 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. 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 is not varying over different quantiles, however it has an insignificant effect in the 10th quantile showing that firms with low export level are not affected by development level of the trading partners. Regional trade agreements, EU and WTO membership dummies have significantly negative effects on firm-level export for all quantiles except 10th quantile. Negative effects of these variables are increasing for higher quantiles.

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Tables and Figures

Table 1. Firm-level Export - 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	16252	15726	16252	15726	16252	15726	16252	15726	16252	15726	16252	15726
r2	0.0722	0.173	0.0692	0.165	0.0714	0.169	0.0717	0.172	0.0715	0.171	0.0695	0.168

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; t-statistics are calculated based on cluster-robust standard errors.

Table 2. Firm Level Import – 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	13988	13012	13988	13012	13988	13012	13988	13012	13988	13012	13988	13012
r2	0.0389	0.0781	0.0325	0.0657	0.0376	0.0713	0.0385	0.0768	0.0384	0.0765	0.0370	0.0738

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; t-statistics are calculated based on cluster-robust standard errors.

Figure 1. The Coefficients of Significant Variables in Export Analysis

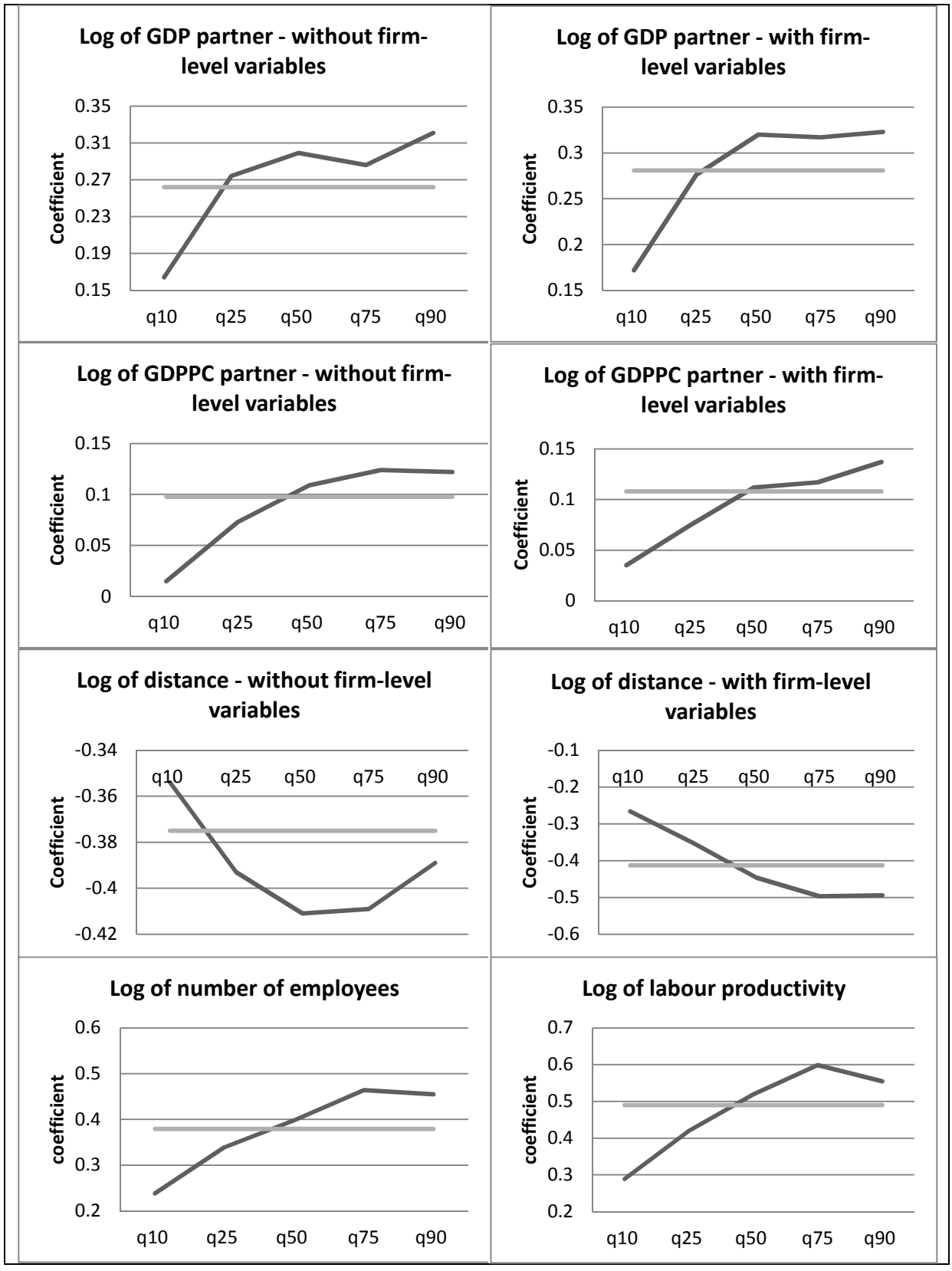

Figure 2. The Coefficients of Significant Variables in Export Analysis – Comparison of two models

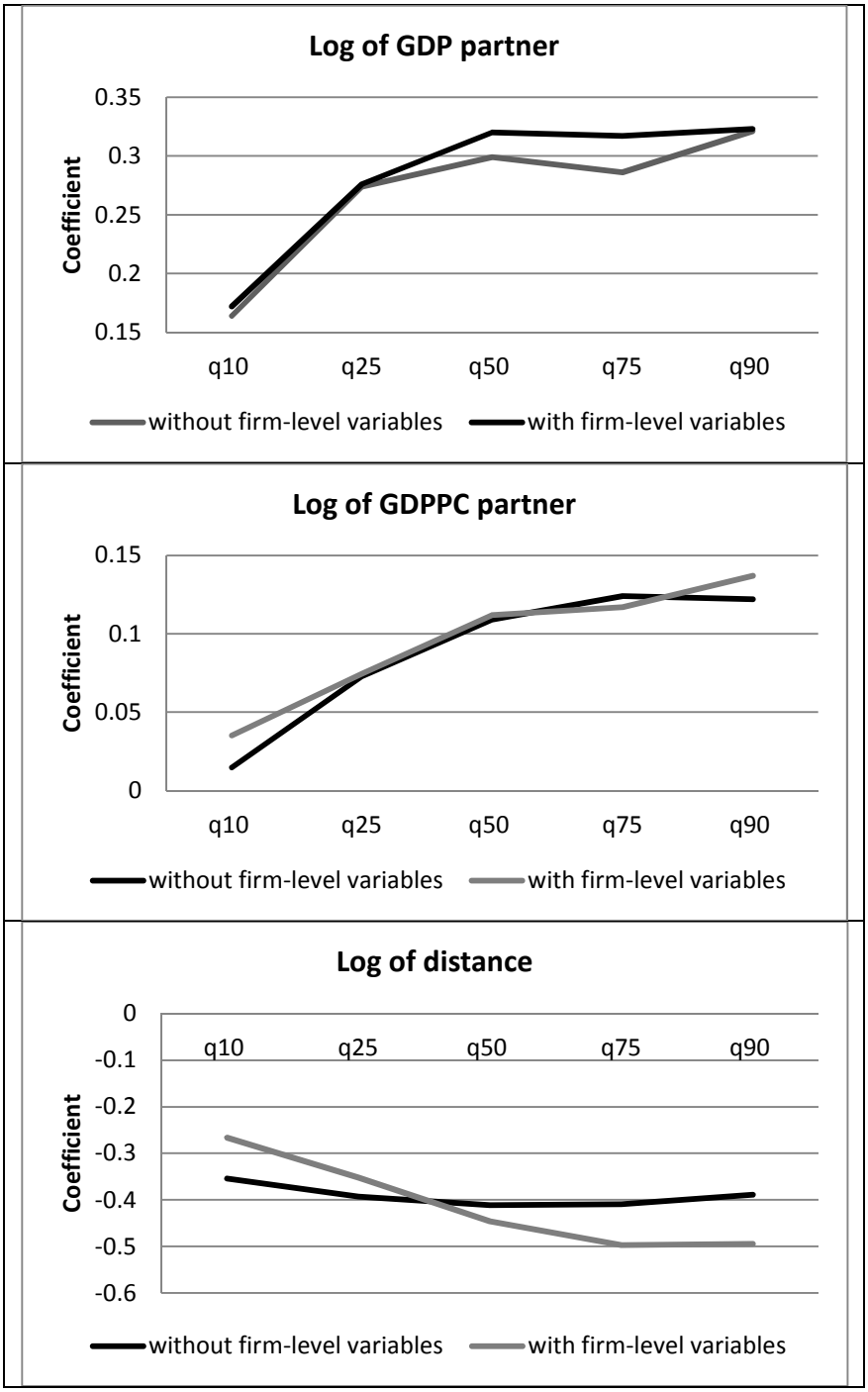

Figure 3. The Coefficients of Significant Variables in Import Analysis

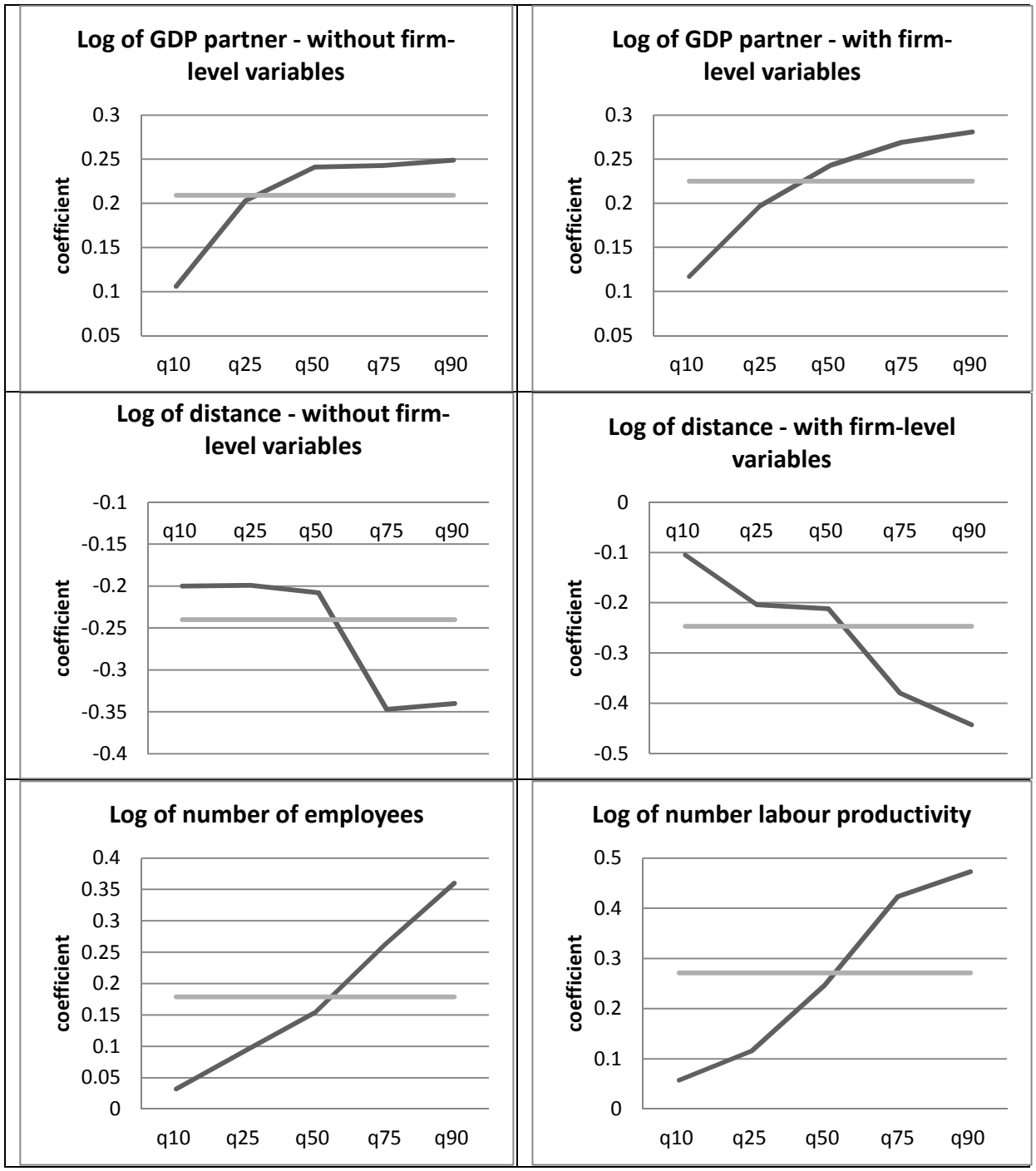

Figure 4. The Coefficients of Significant Variables in Import Analysis – Comparison of two models

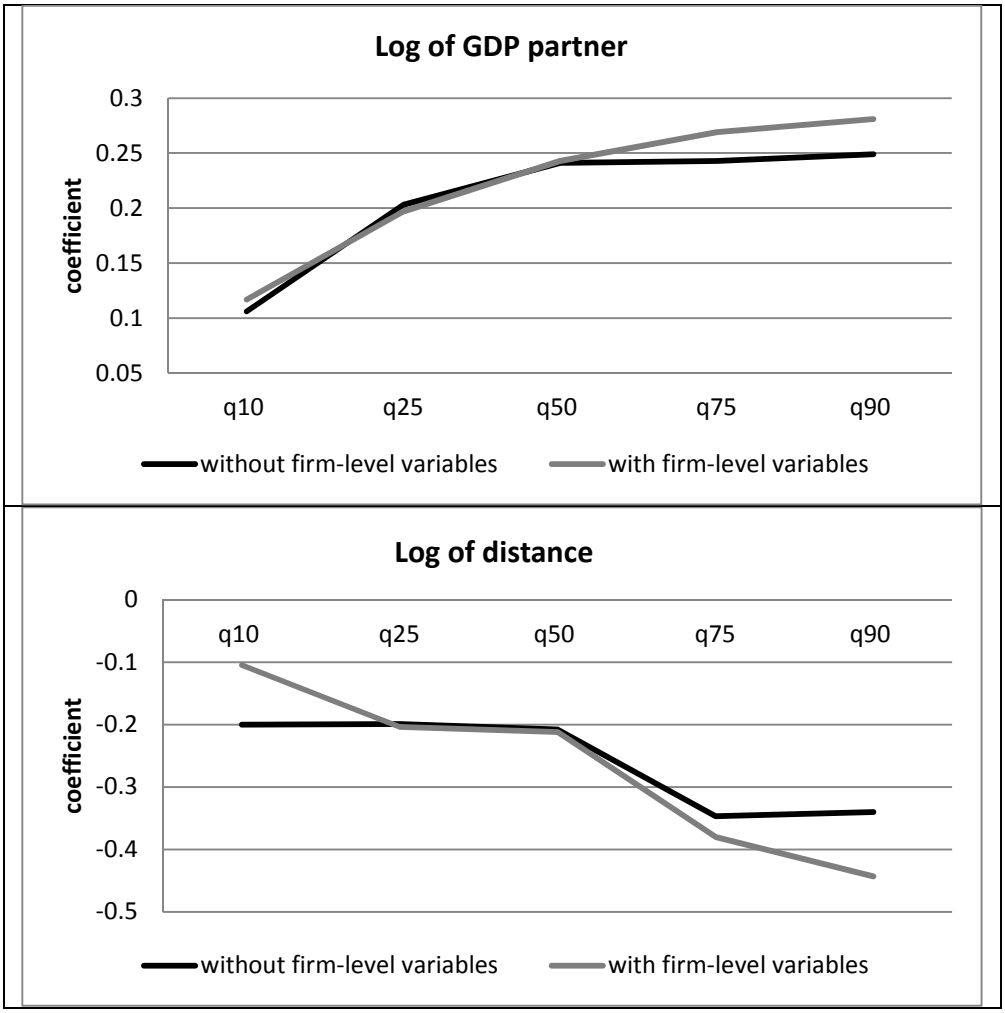

Figure 5. Coefficients of the significant Variables - Export Analysis vs. Import Analysis