Industrial characteristics, the size of countries, and the extensive margin of trade

by

Ha Manh Nguyen

B.A., University of Economics- Ho Chi Minh City, 1998

M.A., Vietnamese-Netherlands Project, 2001

M.A., University of Colorado at Boulder, 2007

A thesis submitted to the

Faculty of the Graduate School of the

University of Colorado in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

Department of Economics

2011

This thesis entitled:
Industrial characteristics, the size of countries, and the extensive margin of trade
written by Ha Manh Nguyen
has been approved for the Department of Economics

Prof. Robert McNown

Prof. Keith Maskus

Date

The final copy of this thesis has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

Nguyen, Ha Manh (Ph.D., Economics)

Industrial characteristics, the size of countries, and the extensive margin of trade

Thesis directed by Prof. Robert McNown

This dissertation consists of three chapters exploring some issues in International Trade.

Chapter 1 explains how home-market effects change across industries in a model of monopolistic competition with heterogeneous firms. The home-market effect hypothesis (Krugman (1980)) states that a large country has more firms (or products) in an increasing return sector than does a small country. However, the large country's share of firms (or products) across industries in an increasing return to scale may vary with industry characteristics. This chapter builds a model of monopolistic competition with heterogeneous firms to investigate which industry characteristics have effects on that change. The model includes two countries with many industries of differentiated products and one industry of homogeneous goods. The model predicts that industries with low trade costs, high fixed-domestic costs, low fixed-export costs, and high productivity dispersion will tend to concentrate in a large country.

Chapter 2 demonstrates empirical evidence to support the first chapter's predictions. As the characteristics of an industry are assumed to be homogeneous across countries, I use a sample of 28 developed countries. This ensures that industry characteristics are similar across countries. In addition, I use the four-digit ISIC industrial classification to categorize countries' industries and use the method of Hummels and Klenow (2002) to measure the relative number of products (or firms) between two countries. The empirical evidence is found to support the predictions from the theoretical model.

Chapter 3 examines how the extensive and intensive margins of trade in developing countries respond to changes in trade barriers through import and export demand functions. The study finds that trade liberalization has a significant impact on both the extensive and intensive margins of trade in developing countries. However, only the intensive margin of trade responds significantly to the yearly change of import and export duties, while the extensive margin responds insignificantly to this. These results are consistent with the theoretical predictions of Ruhl (2008). The method of Hummels and Klenow (2002) is used to measure the extensive and intensive margins and the dynamic-panel regression method is used to estimate models in this paper.

Acknowledgements

To be able to finish the PhD program today, I received help from many people. I would like to take this chance to express my deep and sincere thanks to all of them.

I am grateful to the Vietnamese government who sponsored me to pursue the PhD program in the USA. I am grateful to my advisor, Professor Robert McNown. He was very patient with me. I changed proposals for my thesis many times. Through it all, he was always willing to review and gave me careful feedback. His patience and encouragement greatly helped me to finish my thesis. I am also grateful to Professor Stephen Yeaple, who gave me useful comments, which significantly improved my papers. I would like to express my thanks to Professors Keith Maskus, Thibault Fally, and Mattias Nilsson, who served on my committee. I would like to thank Ms. Patricia Holcomb, the department's graduate coordinator, who is always dedicated and kind to students, and to my dear friend, Michael Snipes, who was always enthusiastic and spent hours to help correct my English in the thesis. I must also not forget to thank Professor Ardeshir Sepehri at the University of Manitoba in Canada. He read and gave me useful advices on my job market paper.

The support from my parents is priceless for me. I believe that if I did not have support and sacrifices from my parents, I could have not finished the PhD program.

Finally, I want to thank my wife and two little daughters who have been by my side all along. My wife was always the first person to read and give me comments on my writings. She, together with my two little girls, helped me to overcome the difficulties and stresses which I had to face on the way to finishing the PhD program.

Contents

Chapter

1 The distribution of firms and the size of countries with heterogeneous firms 1

1.1 Introduction 1

1.2 Literature review 4

1.3 The Model 6

1.3.1 Set up 6

1.3.2 Firms 7

1.3.3 Entry firms and market size 9

1.3.4 The model of homogenous firms for many differentiated product industries . 14

1.4 Conclusion 14

2 The home market effect and the industrial characteristics across developed countries 16

2.1 Introduction 16

2.2 Empirical model 17

2.2.1 Empirical method 17

2.2.2 The extensive margins of export 19

2.3 Data and empirical results 20

2.3.1 Data for variables of regression models 20

2.3.2 Data analysis 23

2.3.3 Results of the main regression model 24

2.3.4 Robustness check . . . 30

2.3.5 Discussion . . . 33

2.4 Conclusion . . . 38

3 The effects of trade barriers on the extensive and intensive margins of trade in developing countries 41

3.1 Introduction . . . 41

3.2 Literature review . . . 43

3.2.1 Import and export demand functions . . . 43

3.2.2 Exports, imports, and trade barriers . . . 45

3.2.3 The extensive and intensive margins and trade barriers . . . 45

3.3 Methodology . . . 49

3.3.1 Models . . . 49

3.3.2 Methodology to estimate the models . . . 51

3.3.3 The extensive and intensive margins of trade . . . 57

3.4 Data and Results . . . 59

3.4.1 Data . . . 59

3.4.2 Data analysis . . . 61

3.4.3 Results of regression models . . . 65

3.5 Conclusion . . . 73

Bibliography 78

Appendix

A Chapter 1 87

B Chapter 2 90

B.1 Fixed domestic costs 90

C Chapter 3 92

Tables

Table

2.1 The relationship of industrial characteristics 26

2.2 The impact of industry characteristics on the distribution of firms across industries . 31

2.3 The impact of industry characteristics on the distribution of firms across industries . 32

2.4 The impact of industry characteristics with data of the dependent variable from UNIDO 34

2.5 The impact of industry characteristics with data of the dependent variable from UNIDO 35

2.6 The impact of industry characteristics-Robustness check 36

2.7 Groups of industries with high and low home market effects 39

3.1 Developing countries 62

3.2 Percentage change of import duties and the margin of imports 63

3.3 Extensive and intensive margins of imports and trade barriers of developing countries 68

3.4 Extensive and intensive margins of imports and trade barriers for groups of countries 69

3.5 Extensive and intensive margins of exports and trade barriers of developing countries 71

3.6 Extensive and intensive margins of exports and trade barriers of developing countries 72

3.7 Developing countries- Robustness case 74

3.8 Extensive and intensive margins of imports and trade barriers of developing countries 75

3.9 Extensive and intensive margins of exports and trade barriers of developing countries 76

B.1 Groups of industries with high and low home market effects 91

C.1 Change of import duties, extensive and intensive margins of imports 93

C.2 Change of export duties, extensive and intensive margins of exports 94

Figures

Figure

1.1 Profit from domestic sales and exports 10

2.1 The relationship of industrial characteristics 25

2.2 The relationship of industrial characteristics 25

3.1 The relationship between the percentage change in duties and in imports and export across countries 64

Chapter 1

The distribution of firms and the size of countries with heterogeneous firms

1.1 Introduction

The hypothesis of the "home market effect", which was first introduced by Krugman (1980), suggests two predictions: a large country has more products (or firms) in its increasing-returns to scale sector than does a small country and the large country's share of products (firms) in the increasing-returns sector exceeds its share of size. The second prediction implies that the large country is a net exporter in its increasing returns sector.

Although a large country can produce more products than does a small country, the large country's share of products may not be uniform across industries. Or we can say that the distribution of firms across industries between the large country and the small country is not similar. This difference can depend on industry characteristics. This study will investigate which industry characteristics affect that difference. This paper does not examine Krugman's second prediction (net exporter) of the hypothesis of the home market effect, so we prefer using the term "the distribution of firms across industries" or "difference in the number of products across industries" to using "home market effect" in this study.

Hanson and Xiang (2004)[1] was the first to examine how the strength of home-market effects varies with industry characteristics. They find that industries with high trade costs and low substitution elasticity concentrate more in large countries. However, we think that some other industry

[1] Some studies (i.e. Helpman and Krugman (1987), Amiti (1998), Hanson and Xiang (2004), Holmes and Stevens (2005)) have examined which country characteristics or industry characteristics influence the home market effect.

characteristics such as fixed costs or productivity dispersion may also affect the distribution of firms between large and small countries across industries.

We build a model based on the mechanism of heterogeneous firms (Melitz (2003)) to examine whether other industry characteristics affect the distribution of firms between large and small countries across industries (or the home market effect). Our model includes two countries; each country has many differentiated product industries in the increasing returns sector and one homogeneous product industry in the constant return sector. Labor is the only production factor in the model. As a result, our model shows that industries with low trade costs, high fixed domestic costs, low fixed export costs, high productivity dispersion, and high elasticity of substitution will concentrate more in the large country, or the difference in the number of products between the large country and the small country is larger in these industries. Among these industry characteristics, the model shows that the impact of trade costs, fixed costs, and productivity dispersion on the distribution of firms (products) across industries between the large country and the small country is uniform. The impact of substitution elasticity depends on the relationship between fixed domestic costs and fixed export costs of the industry. In this study, we assume that fixed domestic costs are smaller than fixed export costs, so industries with high substitution elasticity will concentrate more in the large country.

Economies of scale can be a key factor to explain why industries with low trade costs, low fixed export costs, and high fixed domestic costs locate more in large countries. Because of economies of scale, the production costs of firms in the increasing returns to scale sector of the large country are lower than those in the small country. As a result, firms in the large country will produce products with lower prices. When trade costs and fixed export costs of industries are low, products with low prices from the large country will easily penetrate the small country and defeat the high price products of the small country. So, industries with low trade costs or low fixed export costs will tend to concentrate in the large country. Industries with high fixed domestic costs have high economics of scale, so the large country will attract more firms in these industries.

This study also shows that industries with high productivity dispersion and high elasticity of substitution concentrate more in the large country. Firms with low productivity can not operate in the small country due to high competitive pressures, but these firms still can still operate in the large country because of the diversity of consumer demand in the large country. So, industries with high productivity dispersion prefer concentrating in the large country to concentrating in the small country. Industries with high substitution elasticity have less differentiated goods or few substitutes, and when trade liberalization occurs, consumers choose and buy cheaper goods from the large country. Firms of the small country which cannot compete with firms of the large country may exit the market. This explains why industries with high elasticity of substitution tend to concentrate in the large country.

As a result, our model finds that, in addition to the industry characteristics found in Hanson and Xiang (2004), other characteristics also affect the distribution of industries, such as fixed costs and productivity dispersion. In addition, the impact of the similar characteristics in our model also has some differences from Hanson and Xiang (2004). Our model finds that industries with low trade costs tend to concentrate in the large country, while Hanson and Xiang (2004) predict the opposite. However, the effect of this variable in their theoretical model is not monotonic: this proposition fails for industries with very high trade costs. If we assume that fixed domestic costs are smaller than fixed export costs, our model suggests that industries with a high elasticity of substitution will locate more in the large country likewise contrasting with Hanson and Xiang (2004). These differences originate from the differences in the models: Our model is based on the mechanism of heterogeneous firms and has the appearance of a homogeneous product sector. While Hanson and Xiang (2004) use the mechanism of homogeneous firms and don't use the homogeneous product sector in their model.

To sum up, our paper contributes to the existing literature in ways: First, this paper formulates a model of monopolistic competition with heterogenous firms to study the distribution of firms across industries between large and small countries. Second, in comparison with previous studies, our model incorporates three additional industry characteristics: fixed export costs, fixed domestic costs, and productivity dispersion, which are found to influence the distribution of firms across industries (or home market effect of industries).

The results would be of interest to policy makers in both developed and developing countries, in terms of potential identifying industries these countries should invest and develop to compete in globalized trade.

The rest of the paper is organized as follows: section 2 introduces a model with heterogeneous firms and discusses its predictions. Section 3 describes the empirical methods used to examine the predictions from the theoretical model. Section 4 presents some data analysis and discusses the results of the empirical model. Section 5 concludes with discussion of some implications.

1.2 Literature review

The role of country size on arrangement of industries between large and small countries can be seen through the property of the home market effects which is introduced the first time by Krugman (1980). From a simple model with Cobb Doulags preferences, two countries, and two sectors: a increasing return sector of differentiated goods and a constant return sector of homogeneous goods, he built the following relationship:

$$\frac{n}{n^*} = \frac{\frac{L}{L^*} - \rho}{1 - \rho\frac{L}{L^*}}$$

Here n and $n*$ be the number of varieties (firms) of home country and foreign country respectively in increasing return sector (the sector of differentiated goods). L and L^* are sizes of home and foreign countries. $\rho = \tau^{1-\sigma} < 1$: τ is trade costs between countries and σ is the elasticity of substitution of products in increasing return sector.

This equation implies that if $\frac{L}{L^*} > 1$, $\frac{n/n^*}{L/L^*} > 1$. This result is called the hypothesis of home market effect. This hypothesis implies two predictions: the large country have more firms (products) in increasing returns to scale than does the small country and the large country's share of firms (products) in this sector is larger than its share of size. In this model, Helpman and Krugman (1987) show that when trade costs are low ($\tau \cong 1$), small difference in country size will lead the differentiated product industry to concentrate in the larger country. They assume the elasticity of substitution between varieties in the increasing return to scale is similar across countries, so this coefficient doesn't affect the home market effect in their model.

Hanson and Xiang (2004) extend the monopolistic competition model for two countries with a continuum of differentiated-product industries (no homogeneous good sector) to study how the home market effect changes across industries. They assume that labor endowment and wage of the small country are 1 and labor endowment of the large country is L (> 1). The result of this model implies that the wage of the large country (w) is bigger than 1: the production cost of the large country is higher than the production cost of the small country. They withdraw a relationship between the relative number of firms and countries'size of two countries. From that relationship, they show that industries with high trade costs and low elasticity of substitution have higher home market effects. However, the effect of trade costs on the home market effect in their model is not monotonic. It is failed if trade costs of industry are very high. It means that the home market effect doesn't happen for industries with very high trade costs.

They developed a framework to test the predictions of their model based on a difference-in-difference gravity specification for OECD countries. They use data of SITC industries of the US to represent industry characteristics: Trade costs are from freights of import goods of the US and the elasticity of substitution are estimated through the method of Hummels (1999). Their empirical results support for the predictions from their theory model: industries with high trade costs and lower elasticity of substitution will locate more in the larger country or the home market effects of these industries are bigger than other industries.

The impact of trade costs on the home market effects is different between Krugman (1980) and Hanson and Xiang (2004). Krugman (1980) shows that when trade costs between countries decrease, home market effects will happen higher. Although trade costs in Krugman (1980) are understood between countries, we see that this result is still right across industries when we extend the model of Krugman (1980) for many differentiated product industries in increasing return sector: industries with low trade costs have higher home market effects. This result contrasts with Hanson and Xiang (2004) which find that industries with high trade costs have higher home market effects. The most fundamental difference between two models is the existence of homogeneous good sector in the model of Krugman (1980) (or Helpman and Krugman (1987)) while Hanson and Xiang (2004) don't use this sector in their model. They say that industries with high trade costs should locate in the large country to save trade costs. However, this proposition in their model is failed for industries with very high trade costs as mentioned above.

1.3 The Model

1.3.1 Set up

Based on Helpman et al. (2004), we will build a model to study the above issues. Assume that there are two countries (i,j), and each country has H+1 industries. One industry produces a homogeneous product z with constant return to scale, while the remaining H industries produce a continuum of differentiated products with increasing returns to scale. Each firm is a monopolist for the variety which it produces. Let β_h denote the share of income spent on differentiated goods for sector h. The share of income spent on the homogeneous sector is then $1 - \sum_{h=1}^{H} \beta_h$. The homogeneous good z is considered as the numeraire and it can be freely traded. The price of good z is set to 1, so that if every country producing this good will have identical wage rate (=1). On the demand side, assume that all individuals in country i have the same utility function:

$$\max U = (1 - \sum_{h=1}^{H} \beta_h) \ln z + \sum_{h=1}^{H} \frac{\beta_h}{\alpha_h} ln(\int_0^{n_h^i} x_h^i(v)^{\alpha_h} dv)$$

where $x_h^i(v)$ is the consumption of country i on a variety v produced by industry h. Let n_h^i denote the number of varieties produced by industry h. The parameter $\sigma_h = \frac{1}{1-\alpha_h} > 1$ is the constant elasticity of substitution across varieties in industry h with $\alpha_h > 0$. The budget constraint of country i is then

$$z + \sum_{h=1}^{H} \int_0^{n_h^i} p_h(v) x_h^i(v) dv = Y_i$$

where Y_i denotes total expenditure on all goods in country i. Combining the utility function with the budget constraint yields the following demand for each variety produced by an industry h in country i:

$$x_h^i(v) = \frac{\beta_h Y_i p_h(v)^{-\sigma_h}}{P_h^{i\,1-\sigma_h}}$$

Where $P_h^i = \left(\int_0^{n_h^i} p_h(v)^{1-\sigma_h} dv\right)^{\frac{1}{1-\sigma_h}}$ is country i's ideal price index for industry h and $p_h(v)$ is the price of variety v in country i.

1.3.2 Firms

Labor is the only input and the number of units of labors (a) needed to produce one unit of product varies across firms. In addition, a firm must pay a overhead production cost of f_d^h units of labor to produce a positive amount in each period. The overhead production costs refer to an ongoing expense of operating a firm such as accounting fees, advertising, rent, and utilities costs. This overhead fixed cost is assumed to be identical across firms operating in each industry. So the production cost of a firm is $ax_{ii}^h(v) + f_d^h$. If the firm sells its products to the foreign market, it must pay a fixed cost of f_x^h units of labor per foreign market in each period. The fixed export costs include costs of establishing the distribution network, advertising, or administrative costs in the foreign market.

In addition, an exporting firm in industry h must face an iceberg transportation cost of $\tau_{ij}^h \geq 1$. The production cost of an exporting firm is then given by $\tau_{ij}^h a x_{ij}^h(v) + f_x^h$. Assume that the fixed cost and the distribution function of a in each industry are identical in two countries. In addition, transport costs are assumed to be identical between two countries, that is, $\tau_{ji}^h = \tau_{ij}^h = \tau^h$.

Each firm chooses the price of its variety to maximize its profit, taking as given the price charged by other firms. Since a is the number of units of labor required to produce one unit of the product in industry h in country i, $\frac{1}{a}$ is considered the productivity of a firm in industry h. Firms having a productivity larger than $\frac{1}{a_D^{ih}}$ produce and sell their products in the domestic market and firms with the productivity $\frac{1}{a_D^{ih}}$ earn zero profits. The set of firms with $\frac{1}{a} > \frac{1}{a_X^{ih}}$ produce products for the domestic market and for the exporting market. The set of firms with $\frac{1}{a_D^{ih}} \leq \frac{1}{a} \leq \frac{1}{a_X^{ih}}$ produce for the domestic market only. The set of firms with $\frac{1}{a} \leq \frac{1}{a_D^{ih}}$ earn a negative profit and do not produce.

The profit of a firm in industry h in country i selling its product in the domestic market is

$$\pi_d^{ih} = p_{ii}^h(v)x_{ii}^h(v) - (ax_{ii}^h(v) + f_d^h)$$

The profit of an exporting firm is

$$\pi_x^{ih} = p_{ij}^h(v)x_{ij}^h(v) - (a\tau x_{ij}^h(v) + f_x^h)$$

The price which a firm will set for the domestic market is $p_{ii}^h(v) = (\frac{\sigma_h}{\sigma_h - 1})a = \frac{a}{\alpha_h}$ and for the foreign market $p_{ij}^h(v) = \frac{\tau^h a}{\alpha_h}$. Substituting domestic value, exporting value, and the prices into the profit equations, the profits of firms in industry h in the domestic market (i) and the exporting market(j) are:

$$\pi_d^{ih} = a^{1-\sigma_h} B_h^i - f_d^h$$

$$\pi_x^{ih} = a^{1-\sigma_h} \tau^{1-\sigma_h} B_h^j - f_x^h$$

with $B_h^i = A_h^i \alpha_h^{\sigma_h - 1}(1 - \alpha_h)$ and $A_h^i = \frac{\beta_h Y_i}{\int_0^{n_h} p(v)^{(1-\sigma_h)} dv}$.

Since firms with the productivity level $\frac{1}{a_D^{ih}}$ earn zero profit in the domestic market, and the firms with productivity $\frac{1}{a_X^{ih}}$ earn the zero profit in the exporting market (the profit of these firms in the domestic market is positive), we can determine the cutoff levels of productivity through the equations of profit equal to zero:

$$\begin{aligned} (a_D^{ih})^{1-\sigma_h} B_h^i &= f_d^h \Rightarrow a_D^{ih} = \left(\frac{f_d^h}{B_h^i}\right)^{\frac{1}{1-\sigma_h}} \\ ((\tau^h a_x^{ih})^{1-\sigma_h}) B_h^j &= f_x^h \Rightarrow \tau^h a_X^{ih} = \left(\frac{f_x^h}{B_h^j}\right)^{\frac{1}{1-\sigma_h}} \end{aligned}$$

Since fixed costs are assumed to be the same in both countries, the distribution function G(.) is also the same in both countries. In addition, since the trade costs are also the same between two countries. The cutoff levels of productivity are also equal in both countries. This means that $a_D^{ih} = a_D^{jh} = a_D$ and $a_X^{ih} = a_X^{jh} = a_X^h$. These results imply $B_h^i = B_h^j = B_h$ (see Appendix C). These results hold for each of H industries in country i and country j. In the following sections we focus on industry h in country i and j and drop the h subscript.

1.3.3 Entry firms and market size

The price index of industry h in country i includes the product prices of domestic firms and the one of exporting firms from country j in industry h.

$$\begin{aligned}\int_0^{n_i^e} p(v)^{1-\sigma} dv &= n_i \int_0^{a_D} (\frac{a}{\alpha})^{1-\sigma} dG(a) + n_j \int_0^{a_X} (\tau\frac{a}{\alpha})^{1-\sigma} dG(a) \\ &= n_i(\frac{1}{\alpha})^{1-\sigma} V(a_D) + n_j\tau^{1-\sigma}(\frac{1}{\alpha})^{1-\sigma} V(a_X)\end{aligned} \tag{1.1}$$

Parameters n_i, n_j are considered the entry firms in country i and j in industry h. Substituting the above results into (1.1) yields:

$$n_i V(a_D) + n_j \tau^{1-\sigma} V(a_X) = \frac{(1-\alpha)\beta Y_i}{B} \tag{1.2}$$

Similarly for country j

$$n_j V(a_D) + n_i \tau^{1-\sigma} V(a_X) = \frac{(1-\alpha)\beta Y_j}{B} \tag{1.3}$$

Using equations (1.2) and (1.3) and solving for $\frac{n_i}{n_j}$:

$$\frac{n_i}{n_j} = \frac{\frac{Y_i}{Y_j} - \frac{\tau^{1-\sigma}V(a_X)}{V(a_D)}}{1 - \frac{\tau^{1-\sigma}V(a_X)}{V(a_D)}\frac{Y_i}{Y_j}} = \frac{\lambda - \rho}{1 - \rho\lambda} \tag{1.4}$$

Where $\lambda = \frac{Y_i}{Y_j}$ and $\rho = \frac{\tau^{1-\sigma}V(a_X)}{V(a_D)}$. If we assume that the productivity of firms in the industry ($x = 1/a$) has a Pareto distribution in $x \geq \theta$ with the cumulative distribution function of x: $F(x) = 1 - (\frac{\theta}{x})^k$. Here, k denotes the dispersion parameter of productivity. Industries with low value of k have high productivity dispersion and industries with high value of k have low productivity dispersion. From that, the cumulative distribution function of a will be: $G(a) =$

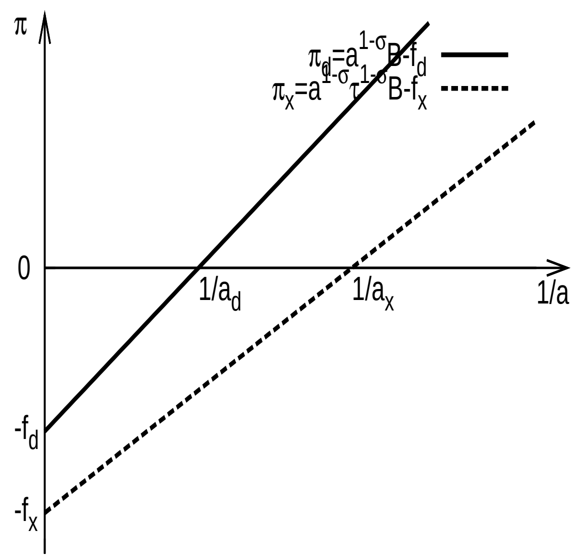

Figure 1.1: Profit from domestic sales and exports

$P(\frac{1}{x} \leq a) = P(x \geq \frac{1}{a}) = 1 - F(\frac{1}{a}) = 1 - (1 - (\theta a)^k) = (\theta a)^k$ for $a \leq \frac{1}{\theta}$. The population density function is

$$dG(a) = k\theta(\theta a)^{k-1}da$$

$V(a_D)$ and $V(a_X)$ are

$$V(a_D) = \int_0^{a_D} a^{1-\sigma} dG(a) = ca_D^{k-(\sigma-1)}$$

$$V(a_X) = \int_0^{a_D} a^{1-\sigma} dG(a) = ca_X^{k-(\sigma-1)}$$

From here, we can find that

$$\frac{V(a_D)}{V(a_X)} = \left(\frac{f_X}{f_D}\tau^{\sigma-1}\right)^{\frac{k-\sigma-1}{\sigma-1}}$$

As a result,

$$\rho = \frac{1}{\tau^{\sigma-1}}\left(\frac{f_D}{f_X\tau^{\sigma-1}}\right)^{\frac{k-\sigma+1}{\sigma-1}} < 1$$

Unlike Helpman and Krugman (1987)'s model in which ρ depends only on trade costs and the elasticity of substitution, here ρ depends on two additional additional characteristics of the industry, namely, fixed costs and productivity dispersion.

From equation (1.4), we have:

$$\frac{\partial\left(n_i/n_j\right)}{\partial\lambda} = \frac{1-\rho^2}{(1-\lambda\rho)^2} > 0 \tag{1.5}$$

Equation (1.5) states that the difference in the number of firms (or products) of industry (h) between two countries has a positive relationship with the difference in size of two countries. If λ is larger than 1 ($\lambda > 1$), it can be shown that $\frac{1-\rho^2}{(1-\lambda\rho)^2} > 1$, indicating that the larger market attracts a disproportionate share of firms in industry h (the home market effects). The coefficient $\frac{1-\rho^2}{(1-\lambda\rho)^2}$ shows the level of difference in the number of products of an industry h between the large country and the small country. Let $g(\rho) = \frac{1-\rho^2}{(1-\lambda\rho)^2}$, we have additionally the following result:

$$\frac{\partial g}{\partial\rho} = \frac{2(\lambda-\rho)(1-\rho\lambda)}{(1-\rho\lambda)^4} > 0 \tag{1.6}$$

Equation (1.6) indicates that the coefficient $\frac{1-\rho^2}{(1-\lambda\rho)^2}$ is not uniform across industries: this coefficient will be larger if ρ is larger. In other words, higher the value of ρ, the larger would be the difference in the number of products between two countries or the home market effect of an industry. Since ρ depends on the characteristics of industries, the difference in the number of products (or the distribution of firms across industries) depends on industry characteristics. To find the effects of an industry characteristic on (ρ), we assume that the other characteristics are constant.

The impact of trade costs: The derivative of ρ with respect to trade costs shows that:

$$\frac{\partial \rho}{\partial \tau} = \left(\frac{f_d}{f_x}\right)^{\frac{k-\sigma+1}{\sigma-1}} \left(\frac{-k}{\tau^{k+1}}\right) < 0 \tag{1.7}$$

When trade costs decrease across industries, the difference in the number of products between two countries become wider. It suggests that firms of industries with low trade costs will concentrate more in the large country. Since the production costs of firms in the large country are lower than those in the small country because of economics of scale, making the prices of products of the large country cheaper. When trade costs are low, low-priced products of the large country will easily penetrate into the small country market. Consequently, high-priced products of the small country can not compete with low-priced products of the large country and firms of the small country can exit markets when trade liberalization occurs.

The impact of fixed costs: Derivatives of ρ with respect to fixed domestic costs and fixed export costs yield:

$$\begin{aligned} \frac{\partial \rho}{\partial f_d} &= \left(\frac{k-\sigma+1}{\sigma-1}\right) \frac{1}{\tau^k} (f_x)^{-\frac{k-\sigma+1}{\sigma-1}} (f_d)^{\frac{k}{\sigma-1}-2} > 0 \\ \frac{\partial \rho}{\partial f_x} &= \left(-\frac{k-\sigma+1}{\sigma-1}\right) \frac{1}{\tau^k} (f_d)^{\frac{k-\sigma+1}{\sigma-1}} (f_x)^{-\frac{k}{\sigma-1}} < 0 \end{aligned} \tag{1.8}$$

An increase in the fixed domestic costs leads to a higher value of ρ, while the increase of fixed export costs makes ρ decrease. This implies that high fixed domestic costs and low fixed export costs induce firms to locate more in the large country in order to take advantage of economies of scale.

The impact of the productivity dispersion and the elasticity of substitution: The derivatives of ρ with respect to the productivity dispersion and the elasticity of substitution yield:

$$\begin{aligned}\frac{\partial \rho}{\partial k} &= \left(\frac{1}{\sigma-1}\right)\left(\frac{1}{\tau^{\sigma-1}}\right)\left(\frac{f_d}{f_x\tau^{\sigma-1}}\right)^{\frac{k-\sigma+1}{\sigma-1}} ln\left(\frac{f_d}{f_x\tau^{\sigma-1}}\right)\\ \frac{\partial \rho}{\partial \sigma} &= \left(\frac{-k}{(\sigma-1)^2}\right)\left(\frac{1}{\tau^{k}}\right)\left(\frac{f_d}{f_x}\right)^{\frac{k-\sigma+1}{\sigma-1}} ln\left(\frac{f_d}{f_x}\right)\end{aligned} \tag{1.9}$$

Since we assume that only some firms with high productivity can export to foreign markets, this implies that $f_d < f_x\tau^{\sigma-1}$ and hence $\frac{\partial\rho}{\partial k} < 0$. The negative correlation between ρ and the productivity dispersion indicates that industries with high productivity dispersion (low k) will locate more in the large country. Although firms with low productivity can not operate in the small country due to high competitive pressures, firms with low productivity can still operate in the large country because of the diversity of consumer demand in the large country. So, industries with high productivity dispersion prefer concentrating in the large country to concentrating in the small country.

If the fixed domestic costs are smaller than the fixed export costs ($f_d < f_x$), $\frac{\partial\rho}{\partial\sigma} > 0$ implies that industries with high elasticity of substitution (high σ) will locate more in the large country. If fixed domestic costs are larger than fixed export costs ($f_d > f_x$), $\frac{\partial\rho}{\partial\sigma} < 0$ implies industries with low elasticity of substitution (low σ) will concentrate more in the large country. In this study, we assume that ($f_d < f_x$): industries with high elasticity of substitution should locate more in the large country. Industries with high substitution elasticity have less differentiated goods or few substitutes, and when trade liberalization occurs, consumers choose and buy cheaper goods from large countries. Firms of the small country which cannot compete with firms of the large country may exit market. This explains why industries with high elasticity of substitution tend to concentrate in the large country.

1.3.4 The model of homogenous firms for many differentiated product industries

When we assume that all domestic firms are homogeneous, all these firms can participate in export markets. In this case, $f_d = f_x\tau^{\sigma-1}$ and our model of heterogeneous firms becomes the model of homogeneous firms (like Helpman and Krugman (1987)) but for many industries. In this case, ρ of industries depends only on trade costs and elasticity of substitution of industries: $\rho = \tau^{1-\sigma}$. As τ and σ increase across industries, ρ decreases across industries, and so does $\frac{n_i}{n_j}$ (the difference in the number of firms (or products) between the large country and the small country). It should be noted that the impact of trade costs across industries on the home market effect in this model is the opposite of the one predicted by Hanson and Xiang (2004).

This difference in the impact of trade costs on the home market effects can be explained by differences in assumptions of the models. Both models are the models with homogeneous firms. The model of homogeneous firms in our paper has the appearance of the homogeneous product sector, this leads to wages equal between the large country and the small country. In contrast, there is not the homogeneous product sector in Hanson and Xiang (2004), and the wage in the large country is higher than the one in the small country. Moreover, in Hanson and Xiang's model, the effects of trade costs on home market effect across industries are not uniform. Their proposition doesn't not hold true for industries with very high trade costs.

1.4 Conclusion

We build a model based on the model of heterogeneous firms (Helpman et al. (2004)) to study the impact of industry characteristics on the arrangement of firms across industries between the large country and the small country. Our model finds that industries with low trade costs, high fixed domestic costs, low fixed export costs, and high productivity dispersion tend to concentrate in large countries, or that the home market effects of these industries will be bigger than other industries.

The results of this study can provide useful lessons for both developed and developing countries (especially small countries) to understand which industries should receive priority for development. From the results of the study, we think that small countries should produce industries with high trade costs, low fixed domestic costs, low economics of scale, and low productivity dispersion. In next chapter, we will build an empirical model to examine the theoretical predictions for the distribution of four-digit manufacturing industries ISIC in 28 developed countries.

Chapter 2

The home market effect and the industrial characteristics across developed countries

2.1 Introduction

In Chapter 2, we empirically test the predictions of our model developed in Chapter 1. Our model predicts that industries with low trade costs, high domestic-fixed costs, low export-fixed costs, and high productivity dispersion tend to concentrate in large countries. As we want to examine how industry characteristics affect the arrangements of firms between large and small countries, we must assume that they are similar across countries. To ensure that we make a reasonable assumption in our empirical study, we only use the sample of developed countries to test the above predictions.

We use the direct relationship between the number of firms and the size of the country from Chapter 1 to build the empirical model. Due to limited data availability on the number of firms across countries and industries, we use the extensive margin of export as measured in Hummels and Klenow (2002) to represent the countries' number of firms (or products). This approach differs from the approach used by Hanson and Xiang (2004). Instead of studying the relationship between the number of firms (or products) and the size of a country, authors build the empirical relationship between the export volume and the size of the country. They then use the method of difference-in-difference to study the impact of industry characteristics (trade costs and substitution elasticity) on home-market effects. One disadvantage of the difference-in-difference model is that it is not convenient when studying the combinative effect of many industry characteristics (as in our study) on the distribution of firms across industries. Hanson and Xiang's method uses industrial characteristics to choose two types of groups: treatment and control. When there are many industrial characteristics, it is difficult to choose which groups satisfy all industrial characteristics. Hanson and Xiang's model only find two industrial characteristics affecting the home market effect, so it can be easy to choose treatment and control groups in their study, whereas our study finds four industry characteristics, it will be difficult to consider all cases. In addition, the difference-in-difference method cannot incorporate industry variables in the regression model. Therefore, we are not able to observe the impact level of industry characteristics on the distribution of firms across industries. However, our alternative empirical method can overcome these limitations.

We use the ISIC classification to classify manufacturing industries of the sample countries. Since the data of industrial characteristics is not available for every country except the US, we use data on US industrial characteristics to represent the industrial characteristics in our study. We also employ a variety of alternative proxies for industrial characteristics to check the robustness of our results.

In brief, our empirical results are consistent with the predictions from Chapter 1. Industries with low trade costs, low export-fixed costs, high domestic-fixed costs, and high productivity dispersion are more likely to concentrate in large countries.

The remainder of this chapter is organized as follows: Section 2 discusses the empirical model; Section 3 describes data and empirical results; and Section 4 concludes.

2.2 Empirical model

2.2.1 Empirical method

Equation (4) in the theoretical part suggests a positive relationship between $\frac{n_i}{n_j}$ and $\lambda \left(= \frac{Y_i}{Y_j}\right)$. Expressing this relation in a log linear form is as follows::

$$log\left(\frac{n_{ih}}{n_{jh}}\right) = \beta_h log\left(\frac{Y_i}{Y_j}\right) + u_{ij} \tag{2.1}$$

From the theoretical part, we know that industries with larger home-market effects (larger

ρ_h) will have larger β_h. It means that $\rho_1 > \rho_2 > ... > \rho_h > ...$, then $\beta_1 > \beta_2 > ... > \beta_h > ...$, where, β_1, β_2, β_h denote coefficients of the above regression equation for industries 1, 2,...h.

We have already shown that industries with lower trade costs, higher domestic-fixed costs, lower-export fixed costs, and high productivity dispersion will concentrate more in the large countries. This implies that we will have $\alpha_2 < 0$, $\alpha_3 > 0$, $\alpha_4 > 0$, and $\alpha_5 < 0$ in the following relationship:

$$\beta_h = \alpha_1 + \alpha_2\tau_h + \alpha_3 disp_h + \alpha_4 f_{dh} + \alpha_5 f_{xh} \tag{2.2}$$

Where τ_h denotes trade costs, $disp_h$ the productivity dispersion, f_{dh} and f_{xh} the fixed costs in domestic and export markets. Since the productivity dispersion effect includes the elasticity of substitution effect, we do not study the separate effect of the substitution elasticity on the distribution of industries. We will explain this issue in more detail later.

Substituting equation (2.2) into the regression equation (2.1) yields:

$$log\left(\frac{n_{ih}}{n_{jh}}\right) = \alpha_0 + \alpha_1 log\left(\frac{Y_i}{Y_j}\right) + \alpha_2(\tau_h) log\left(\frac{Y_i}{Y_j}\right) + \alpha_3(disp_h) log\left(\frac{Y_i}{Y_j}\right) + \alpha_4(f_{dh}) log\left(\frac{Y_i}{Y_j}\right) + \alpha_5(f_{xh}) log\left(\frac{Y_i}{Y_j}\right) + u_{ijh}$$

We predict that $\alpha_1 > 0$, $\alpha_2 < 0$, $\alpha_3 > 0$, $\alpha_4 > 0$, and $\alpha_5 < 0$.

Data for the number of firms or establishments is not available for many countries. According to this model, the ratio of the number of exporting firms (or products) for industry (h) in two countries is equivalent to the ratio of firms (or products) in two countries. So, we use the ratio of the number of exporting firms (products) $\left(\frac{EM_{ih}}{EMjh}\right)$ to represent the ratio of firms (products) $\left(\frac{n_{ih}}{n_{jh}}\right)$ of two countries ($\frac{n_{ih}}{n_{jh}} \equiv \frac{EM_{ih}}{EMjh}$).

EM_{ih}, the extensive margin of export of country i in industry h, is measured by the method used by Hummels and Klenow (2002) (or Hummels and Klenow (2005)). As a result, we have the following regression model to empirically assess the impact of industry characteristics on the distribution of industries between the large country and the small country:

$$log\left(\frac{EM_{ih}}{EMjh}\right) = \alpha_0 + \alpha_1 log\left(\frac{Y_i}{Y_j}\right) + \alpha_2(\tau_h) log\left(\frac{Y_i}{Y_j}\right) + \alpha_3(disp_h) log\left(\frac{Y_i}{Y_j}\right) + \alpha_4(f_{dh}) log\left(\frac{Y_i}{Y_j}\right) + \alpha_5(f_{xh}) log\left(\frac{Y_i}{Y_j}\right) + u_{ijh} \tag{2.3}$$

It is predicted that $\alpha_1 > 0$, $\alpha_2 < 0$, $\alpha_3 > 0$, $\alpha_4 > 0$, and $\alpha_5 < 0$.

2.2.2 The extensive margins of export

In studying the role of new varieties in price indexes, Feenstra (1994) showed how to use the data of expenditure to measure the product-variety changes of each country across time. Many studies have adopted this method to compare product varieties or export varieties across countries.[1] Hummels and Klenow (2002) (or Hummels and Klenow (2005)) used this method to define the extensive and intensive margins of countries' exports and imports.[2] In this study, we use their methods to measure the relative number of export products of two countries.

Using the method of Feenstra (1994), Hummels and Klenow (2002) define the extensive margins of exports of country i as follows:

$$EM_t^{i,exp} = \frac{\sum_j \sum_{s \in I_t^{ij}} X_t^{Wjs}}{X_t^W} \tag{2.4}$$

$EM_t^{i,exp}$ is the extensive margin of an exporter i in year t. I_t^{ij} is the set of products s exported from country i to country j. X_t^{Wjs} is the value of export of product s from the world to country j. $\sum_{s \in I_t^{ij}} X_t^{Wjs}$ is the total value of export of the world to country j in products that country i exports to country j ($s \in I_t^{ij}$). X_t^W is the total export of all countries. The extensive margin of exports employs a weighted count of the number of categories to measure the extensive margins of countries in year t with the weights to be the world trade in each category.

[1] i.e. Feenstra et al. (1997a); Feenstra and Kee (2004); Hummels and Klenow (2002); Hummels and Klenow (2005); and Feenstra and Kee (2008)

[2] Hummels and Klenow (2002) is a working paper, while Hummels and Klenow (2005) is a version of Hummels and Klenow (2002) published in the AER. Hummels and Klenow (2002) measures the extensive and intensive margins of export of a country at all destinations, while Hummels and Klenow (2005) measure them at each destination, then get the average value to represent the extensive margin of exports of countries

Hummels and Klenow (2005) use a similar approach but they calculate the extensive margin of exporter at each destination. They then determined an average value of all destinations to calculate the extensive margin of exports for each country. In this case, the extensive margin of export of country i at destination d is:

$$EM_t^{id,exp} = \frac{\sum_{s \in I_t^{id}} X_t^{Wds}}{\sum_{s \in I_t^{Wd}} X_t^{Wds}}$$

To measure the extensive margins of an export country to all countries, Hummels and Klenow (2005) use the geometric mean of the extensive margin over all destinations to represent the extensive margin of each export country. In particular, the extensive margin of country i is calculated at each destination ($d \in M_{-i}$), where M_{-i} is the set of countries for which import data from country i is available. We then take the geometric average of country i's extensive margin across the M_{-i} markets to calculate the extensive margin of export for country i:

$$EM_t^{i,exp} = \prod_{d \in M_{-i}} \left(EM_t^{id,exp} \right)^{w_{id}} \tag{2.5}$$

w_{id} is weights which are measured as follows:

$$w_{id} = \frac{\frac{s_{id} - s_{Wd}}{log(s_{id}) - log(s_{Wd})}}{\sum_{d \in M_{-i}} \frac{s_{id} - s_{Wd}}{log(s_{id}) - log(s_{Wd})}}$$

Here w_{id} is the logarithmic mean of s_{id} and s_{Wd} and $\sum_{d \in M_{-i}} w_{id} = 1$. s_{id} is the share of export of country i to country d relative to the total export of country i $\left(s_{id} = \frac{X_i^d}{\sum_{d \in M_{-i}} X_i^d} \right)$, and s_{Wd} is the share of export of the other countries (except to country i) to country d relative to the total export of these countries $s_{Wd} = \frac{\sum_{l \in M_{-i-d}} X^{ld}}{\sum_{l \in M_{-i-d}} X^{lW}}$.

2.3 Data and empirical results

2.3.1 Data for variables of regression models

Since this paper is on how characteristics of industries affect the distribution of firms across industries between a large country and a small country, the characteristics of an industry are assumed to be homogeneous across countries. We choose a sample of 28 industrial countries (Table (B.1) in Appendix) with the assumption that industry characteristics of these countries are similar. In addition, 4-digit ISIC classification with 125 manufacturing industries is used to classify the manufacturing industries in these countries. If data on an industrial characteristic is available for all countries, we use the average value across countries to represent the industrial characteristic (i.e., import tariff barriers). However, we cannot approach most of data on industrial characteristics of countries except for the U.S. So, we use data on U.S. industrial characteristics to represent the industrial characteristics in our study. The U.S. is a large market, so firms (or products) in industries are diverse. In addition, technology and technique for industries in the U.S. are also typical for these in other industrial countries. Therefore, we think that the industrial characteristics of the U.S. can suitably represent those of other industrial countries.

Dependent variable: Trade flow data at HS6 level from CEPII[3] is used to measure the extensive margin of export for a country as presented (2.4) (or (2.5)).

GDP: From the results of the theoretical part, the GDP of countries is used to represent a country'size. GDP Data (at constant prices of 2000) is from the World Development Indicator.

Variable trade costs (τ_h): The simple average tariffs (t) of high income countries are used to represent trade costs of industries and is the ratio between the sum of all the tariff rates and the number of import categories. This data is from TRAINS database. We assume that goods in an industry have equal importance, so we use simple average tariffs to represent trade costs of industries instead of using the weighted average tariffs. We know that the weighted average tariffs tend to be down-biased since the amount of low-tariff goods is higher than high-tariff goods. Therefore, the trade-weighted average tariff cannot be a good proxy for the trade costs of all goods in an industry.

Fixed domestic and export costs (f_{dh} and f_{xh}): Fixed domestic costs (f_{dh}) are considered the overhead costs that refer to ongoing expenses of a firm's operation such as management salaries, advertising, insurance, rent, and utilities. We use expense data from the Annual Survey

[3] www.cepii.org

of Manufacturers (1997) to calculate these costs. The expense categories are presented in the Appendix. Fixed domestic costs for a firm in industry h (f_d) are calculated by dividing the total of these costs by the total number of firms in the industry (h).

We are not able to measure fixed-export costs directly (f_{xh}). However, the studies of multinational firms show that industries with high firm-level economies of scale encourage FDI, not the concentration of production within a single country. This implies that industries with high firm-level economics of scale tend to produce in many countries so the number of firms (products) of a large country relative to that of a small country are lower. Based on this idea, we consider firm-level economies of scale to represent fixed-export costs. As a result, firm-level economies of scale are expected to have a negative relationship with the dependent variable. Following the approach in previous studies (i.e. Brainard (1997)), we use the average ratio of the number of nonproduction workers relative to the total employment in each industry to represent firm-level economies of scale of that industry. This data is from the Annual Survey of Manufacturers (1997).

Productivity dispersion ($disp_h$): Productivity is assumed to have a Pareto distribution with shape parameter k. However, we cannot measure this parameter directly. According to Helpman et al. (2004), a Pareto distribution of productivity implies that a firms' sales also have the same distribution with shape parameter $k-\sigma+1$. This parameter can be measured by the standard deviation of the logarithm of firm sales and is used to represent the productivity dispersion. If the standard deviation of the logarithm of firm sales ($disp$) in an industry is large, the productivity dispersion of that industry is high ($k - \sigma + 1$ low).

As mentioned in the theoretical part, we assume that $f_d < f_x$. This implies that industries with high productivity dispersion (k low) and high elasticity of substitution (σ high) (low $k-\sigma+1$) will locate more often in a large country. Since $k - \sigma + 1$ is measured by the standard deviation of the logarithm of firm sales ($disp$), $disp$ can represent both the productivity dispersion and the elasticity of substitution.

We use the output of 10-digit NAICS U.S. products (about 7500 products) to calculate the industry-productivity dispersions. In this case, we consider each firm that produces a product;

thus, the product output is also the firm's sale. The method of using product sales to calculate the productivity dispersion is similar to the method used by Nunn and Treffer (2008). They don't approach firm-level data and use the export sale of U.S. products to calculate the productivity dispersion of industries.

2.3.2 Data analysis

As mentioned above, industries which are disproportionately located in large countries (or have higher home market effects) will have higher β_1 in the following difference regression:

$$log\left(\frac{EM_{ih}}{EMjh}\right) = \beta_0 + \beta_1 log\left(\frac{Y_i}{Y_j}\right) + u_{ij} \tag{2.6}$$

We call (β_1) the coefficient that shows the strength of the home-market effect of industry h or level of the distribution of firms of industry h. The 4-digit ISIC classification has 125 manufacturing industries. However, due to the limited availability of export data, we only estimate the coefficient (β_1) for 118 industries.[4]

The predictions of the theoretical model imply that this coefficient (β_1) should have a negative relationship with trade costs and fixed-export costs and a positive relationship with fixed domestic costs and productivity dispersion. First, we use graphs to visually summarize the relationships between the industry characteristics and this coefficient. When we combine industrial characteristics and the coefficient (β_1), only 110 industries have available data on all industrial characteristics. Figure (2.1) shows the relationship between the industry characteristics on the vertical axis and the home-market effect coefficients of industries on the horizontal axis. From the graphs, we can see that there are some outliers in the relationship between industry characteristics and the home market-effect coefficients; for example, one outlier in the relationship between firm scale and the coefficients (β_1), and two outliers in the relationship between the fixed domestic costs and coeffi-

[4] The data of the following industries are not available- 1911: Tanning and dressing of leather; 2892: Treatment & coating of metals; 3720: Recycling of non-metal waste and scrap; 1712: Finishing of textiles; 3710: Recycling of metal waste and scrap; 2731: Casting of iron and steel; 2230: Reproduction of recorded media; 2891: Metal forging/pressing/stamping/roll-forming; 2732: Casting of non-ferrous metals

cients[5] . Therefore, we drop these observations. Figure (2.2) shows the relationships after dropping these outliers. The results of the figures are consistent with the predictions from the theoretical model: industries with low trade costs (or low tariff barriers), high productivity dispersion, high domestic fixed costs, and high firm-level economics of scale (which represents export fixed costs) tend to concentrate in large countries. The results of the following simple relationship (Table 2.1) seem to affirm the results from the figure's analysis:

$$\beta_h = \alpha_1 + \alpha_2 \tau_h + \alpha_3 disp_h + \alpha_4 f_{dh} + \alpha_5 f_{xh}$$

In brief, the impact of fixed domestic costs, fixed export costs, productivity dispersion, and trade costs on the home-market effect of industries have the predicted signs.

2.3.3 Results of the main regression model

We use the export data to measure the firm (or variety) ratio across industries of a country pair. One country pair can have different characteristics from another pair. Two countries are in economic unity or have a free trade agreement or are in similar geographical locales and thus industries in these countries may have some common group effects. As a result, u_{ijh} (in model 2.3) can be decomposed into two parts: $u_{ijh} = \nu_{ij} + \epsilon_{ijh}$, where ν_{ij} is the country pair-level fixed effects or an unobserved (group) cluster effect ($\nu_{ij} \sim [0, \sigma_\nu^2]$) and ϵ_{ijh} is the idiosyncratic error ($\epsilon_{ijh} \sim [0, \sigma_\epsilon^2]$). In addition, we can consider each industry as a cluster since countries can produce these industries due to some similar reasons- for example, technology-intensive industries or high economic-value industries. So, u_{ijh} can be decomposed into three parts: $u_{ijh} = \nu_{ij} + e_h + \epsilon_{ijh}$, here ($e_h \sim [0, \sigma_e^2]$) represents an unobserved cluster effect at industry level. As a result, the model (2.3) can be rewritten as follow:

$$\begin{aligned} log\left(\frac{EM_{ih}}{EMjh}\right) &= \alpha_0 + \alpha_1 log\left(\frac{Y_i}{Y_j}\right) + \alpha_2(\tau_h) log\left(\frac{Y_i}{Y_j}\right) + \alpha_3(disp_h) log\left(\frac{Y_i}{Y_j}\right) + \alpha_4(f_{dh}) log\left(\frac{Y_i}{Y_j}\right) + \\ &+ \alpha_5(f_{xh}) log\left(\frac{Y_i}{Y_j}\right) + \nu_{ij} + e_h + \epsilon_{ijh} \end{aligned} \tag{2.7}$$

[5] 2109: Other articles of paper and paperboard, 2221:Printing, 2927:Weapons and ammunition,

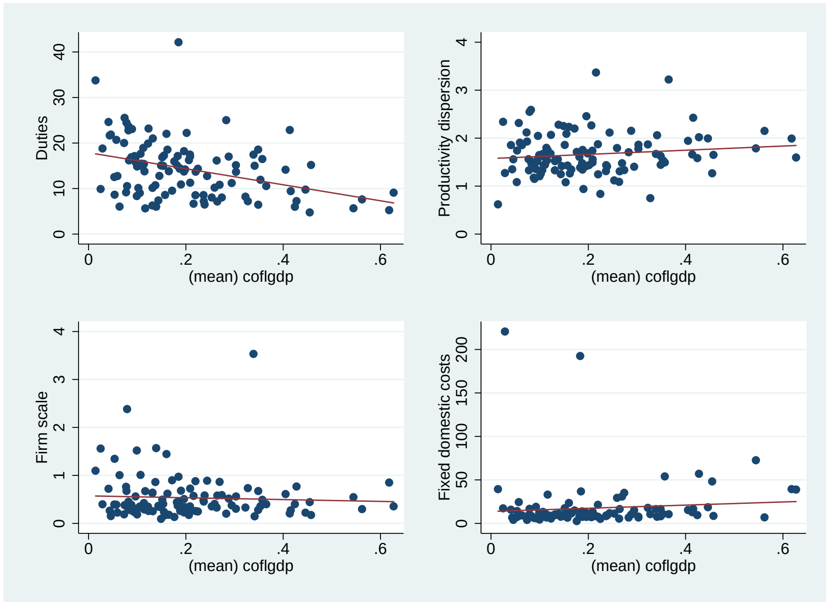

Figure 2.1: The relationship of industrial characteristics

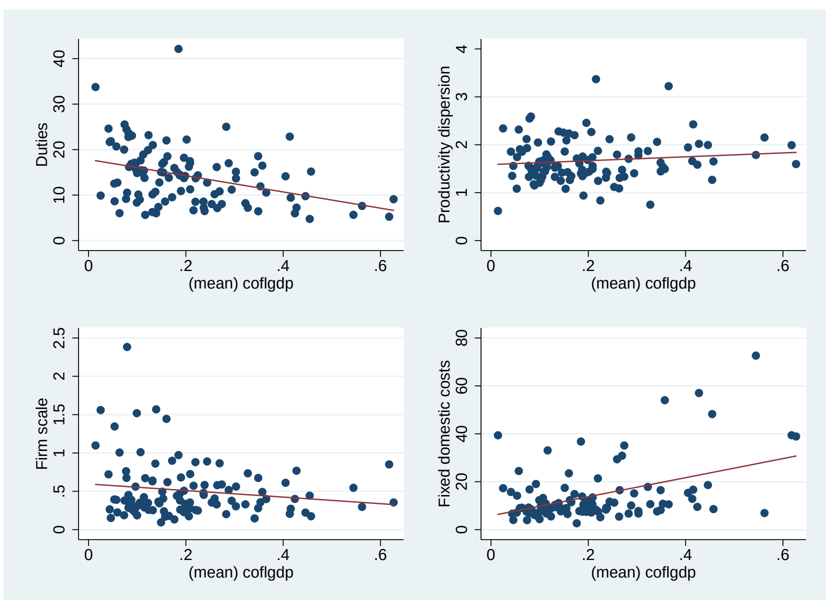

Figure 2.2: The relationship of industrial characteristics

Table 2.1: The relationship of industrial characteristics

VARIABLES	(1)	(2)	(3)	(4)	(5)
Firm level economies of scale (-)	-0.054**				-0.117***
	(0.021)				(0.000)
Fixed domestic costs (+)		0.005***			0.005***
		(0.000)			(0.000)
Productivity dispersion (+)			0.033		0.036*
			(0.218)		(0.080)
Trade costs (-)				-0.008***	-0.008***
				(0.000)	(0.000)
Constant	0.217***	0.123***	0.127***	0.298***	0.218***
	(0.000)	(0.000)	(0.006)	(0.000)	(0.000)
Observations	112	112	107	112	107
R-squared	0.047	0.172	0.014	0.156	0.452

pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

This table is results of the relationships of industrial characteristics

Since the regression model has common group effects in the error terms or the intracluster correlation, the usual OLS standard errors can be seriously biased (Moulton (1990)). In particular, the standard errors of the usual OLS method may be remarkably low. The bias in conventional standard errors become increasingly large in absolute value as the number of clusters decrease and the intracluster correlation increases. If other hypotheses of classical regression are still satisfied, the usual OLS estimator of coefficients remains unbiased and normally distributed. However, the usual OLS estimator is not efficient and the standard errors are incorrectly estimated. Consequently, tests based on the usual standard errors are no longer valid, which is why we need to control the presence of clusters in the regression model.

According to Cameron and Trivedi (2005), we can use the following estimation techniques to control for clustering: the OLS estimator with cluster-corrected standard errors, the GLS estimator (the random-effects model), and the within estimator (the fixed-effects model). When the unobserved cluster effects (ν_{ij} and e_h) are uncorrelated with the model's explanatory variables, the OLS estimator with cluster-corrected standard errors and the random-effect estimator are consistent. In this case, the cluster-robust standard errors of the OLS estimator converges to the true standard error as the number of clusters is large and the cluster size is fixed. In addition, when the unobserved cluster effects are independent of the explanatory variables, the GLS estimator (the random-effects model) also gives an efficient estimator, which is even more efficient than the cluster-corrected OLS estimator. If ν_{ij} (or e_h) are correlated with other dependent variables, the OLS estimator and the random-effect estimator are inconsistent. In this case, the fixed estimators should be used instead. However, the fixed-effects estimator drops all cluster-invariant regressors.

Table (2.2) presents the regression results when country pairs are randomly chosen from all countries in the sample (i.e. not based on any pre-determined criteria). In general, coefficients of different regression methods have predicted signs and statistical significance across different regression methods. Since industry characteristics are assumed to be similar across countries in our study, the industry characteristics are also similar across country pairs. Consequently, the estimation coefficients of OLS, random-effects, or fixed-effects estimations are quite similar. As the variable ($log\left(\frac{Y_i}{Y_j}\right)$) is invariant across industries, its effect is removed from the model in the fixed-effects estimator (Column (8)).

We find that there is a relatively minor change in standard errors from the usual OLS method to the heteroscedastic-corrected OLS (Column (1) and (2)). However, when the cluster-robust variance estimator for country pairs and industries are used, there is a substantial change in the standard errors of coefficients. All t-ratios become significantly smaller (Columns (3) and (4) compared with columns (1)). For example, the t-ratio for *lgdp* in the usual OLS is 25.05, whereas this value for OLS with standard errors corrected for country pairs is 17.44 and 4.66 for industries. When the standard errors are corrected for both country pairs and industries, the t-ratio decreases to 4.59. These results suggest that ignoring intracluster correlation causes inflation in the OLS t-ratios and the cluster effects at the industry level are stronger than those at the country-pair level.

The Breusch-Pagan tests for the country-pair and industry random-effects models reject the null hypothesis that the random variation in the intercept is zero. This indicates that the country-pair and industry-RE models are an improvement over the OLS regression (Columns (6) and (7) compared with Column (1)). However, the standard errors of the country pair-RE model don't result in a significant change when compared with those of the OLS estimator since the t-values of some variables in the country-pair random-effects estimator are larger than these in the usual OLS estimator (Column (6) compared with Column (1)). While, all t-values of variables in the industry random effects estimator are smaller than these in OLS estimator (column (7) and column (1)). This implies that the standard errors of the industry RE model are larger than those of the usual OLS estimators across all variables.

To compare the random-effects and fixed-effects estimators, the Hausman test shows that the industry fixed-effects regression does not change significantly from the industry random-effects regression Ccolumn (9) and (7)). We donot compare these estimators at the country-pair level because the variable ($log\left(\frac{Y_i}{Y_j}\right)$) is removed from the fixed-effects estimator.

In the above case, the country pairs are all built without any particular criteria from sample countries. However, if we choose any two countries to build a pair, it can sometimes be difficult to find common characteristics between the two countries. For example, we can observe the common features between the US and Canada, but not between Canada and Australia. This implies that the comparison between the U.S. and Canada pair and the Canada and Australia pair might not be reasonable. To eliminate these potential problems, we form pairs from a set of countries that belong to a preferential trade arrangement of some kind. In particular, we divide countries into four groups: members of European Union (19 countries), Canada and the US (the US-Canada Free Trade Agreement), New Zealand and Australia (British Commonwealth), and Japan and Korea (a group of Asian countries) (Sample 2 of Table (B.1) in Appendix). Country pairs are then built within each group. The regression results are shown in Table (2.3), which are quite similar to the ones of the previous case and the cluster effects across country pairs and industries are still significant. The random-effects model is still preferred to the OLS model although the results of this method donot change much in comparison. We can see this by comparing the t-values of variables of Columns (7) and (8) with Column (1). In this case, the Hausman test shows the fixed-effects regression at the industry level is an improvement over the random-effects regression at the industry level (p-value=0.015).

The above empirical results show that the impact of variables not only have predicted signs but also have high statistical significance. As a result, these results confirm the predictions of the theoretical model that industries with low trade costs (low tariff barriers), high domestic fixed costs, high firm-level economics of scale (which represent export fixed costs), and high productivity dispersion tend to concentrate in large countries. As discussed above, the productivity dispersion measured in this paper includes not only the productivity dispersion (k) but also the elasticity of substitution (σ). When the productivity dispersion increases ($k - \sigma + 1$ decreases), it can be equivalent with k decreased and σ increased (high elasticity of substitution). As a result, the positive relationship between the productivity dispersion as measured above and the distribution of firms across industries might imply that industries with high-productivity dispersion and high elasticity of substitution are more likely to locate in large countries as predicted by the theoretical model.

2.3.4 Robustness check

The UNIDO industrial database provides data on the number of establishments. However, this data is only available for a limited number of countries and industries, so we are not able to use it as a proxy for the dependent variable. Therefore, we use the ratio of the extensive margin of exports between two countries to represent the dependent variable as mentioned above. In this part, we use the data on the number of establishments from UNIDO to test the robustness of some model results. From this database, we choose 14 OECD countries (Table (B.1) in Appendix) which have over 80 industries. However, the number of common industries across the countries in the sample is only 51. From those countries, we demonstrate two cases. In the first case, we use all available industries to estimate the model. As there are many industries that do not exist in every country, the estimated results can be biased. Therefore, in the second case, we estimate the model by using only the industries that exist in all countries (51 industries). The regression results across the different methods are presented in Table (2.4) for the first case and in Table (2.5) for the second case.

The signs of the explanatory variables for both cases are still consistent with our predictions across different estimation methods. The statistical significance of the explanatory variables in the second case (with 51 industries) are more significant. For example, the effect of firm-level economics of scale in the second case is statistically significant in most of the cases, while in the first case, this effect is not significant in any of the cases. In addition, by looking at the t-values of the explanatory variables, we can see that the cluster effects in the country-pair levels are not as important as in the above cases, while the cluster effects at industry levels remain strong. This suggests that intracluster correlations exist at the industry level.

Moreover, instead of calculating the extensive margin of exports as Hummels and Klenow (2002), we also use Hummels and Klenow (2005) (equation (2.5)) to calculate the extensive margin of export. The results in this case are not much different from the ones that were estimated in

Table 2.2: The impact of industry characteristics on the distribution of firms across industries

	OLS					Random effects		Fixed effects	
VARIABLES	Usual	Het	Country	Industry	Both	Country	Industries	Country	industry
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LGDP (+)	0.21***	0.21***	0.21***	0.21***	0.21***	0.21***	0.22***		0.22***
	(22.94)	(24.98)	(11.89)	(4.55)	(4.34)	(12.32)	(15.62)		(15.15)
Duties*LGDP (-)	-0.75***	-0.75***	-0.75***	-0.75***	-0.75***	-0.75***	-0.76***	-0.75***	-0.76***
	(-26.26)	(-25.03)	(-16.77)	(-4.28)	(-4.23)	(-30.00)	(-16.68)	(-30.00)	(-16.10)
Fixed domestic cost*lGDP (+)	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
	(36.37)	(25.51)	(17.21)	(6.43)	(6.22)	(41.54)	(20.99)	(41.54)	(20.01)
Firm scale*lGDP (-)	-0.14***	-0.14***	-0.14***	-0.14***	-0.14***	-0.14***	-0.12***	-0.14***	-0.12***
	(-26.75)	(-31.98)	(-17.03)	(-5.92)	(-5.70)	(-30.56)	(-14.59)	(-30.56)	(-13.80)
Productivity dispersion*lGDP (+)	0.04***	0.04***	0.04***	0.04**	0.04**	0.04***	0.04***	0.04***	0.04***
	(10.59)	(11.16)	(13.83)	(2.06)	(2.08)	(12.10)	(5.73)	(12.10)	(5.42)
Constant	0.06***	0.06***	0.06**	0.06***	0.06**	0.06**	0.06***	0.34***	0.06***
	(11.26)	(10.99)	(2.15)	(12.08)	(2.16)	(2.21)	(3.81)	(32.24)	(11.62)
Observations	37,557	37,557	37,557	37,557	37,557	37,557	37,557	37,557	37,557
R-squared	0.14	0.14	0.14	0.14	0.14			0.08	0.11
Number of Industries							107		107
Hausman test (p-value)									0.901
Number of Country-pairs						351		351	
Breusch-Pagan test(p-value)						0	0		

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Country pairs are chosen from all countries in the sample without based on any pre determined criteria.
The dependent variable is measured by the ratio of the extensive margin of exports (equation (2.4)).
Columns (1)-(5) are the OLS estimators.
Columns (6)-(7) are the random-effects estimators.
Columns (8)-(9) are the fixed-effects estimators.

Table 2.3: The impact of industry characteristics on the distribution of firms across industries

	OLS					Random effects		Fixed effects	
VARIABLES	Usual	Het	Country	Industry	Both	Country	Industries	Country	industry
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LGDP (+)	0.24***	0.24***	0.24***	0.24***	0.24***	0.24***	0.25***		0.25***
	(19.44)	(23.06)	(11.93)	(4.54)	(4.34)	(14.34)	(19.72)		(19.79)
Duties*LGDP (-)	-0.67***	-0.67***	-0.67***	-0.67***	-0.67***	-0.67***	-0.69***	-0.67***	-0.69***
	(-16.61)	(-16.65)	(-8.52)	(-3.26)	(-3.11)	(-18.98)	(-16.80)	(-18.98)	(-16.84)
Fixed domestic cost*LGDP (+)	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
	(28.10)	(22.88)	(16.67)	(6.70)	(6.49)	(32.11)	(26.93)	(32.11)	(26.33)
Firm scale*LGDP (-)	-0.13***	-0.13***	-0.13***	-0.13***	-0.13***	-0.13***	-0.13***	-0.13***	-0.13***
	(-17.47)	(-21.79)	(-24.50)	(-4.62)	(-4.66)	(-19.96)	(-17.16)	(-19.96)	(-16.97)
Productivity dispersion*LGDP (+)	0.04***	0.04***	0.04***	0.04*	0.04*	0.04***	0.04***	0.04***	0.04***
	(7.44)	(8.51)	(12.28)	(1.82)	(1.85)	(8.50)	(7.25)	(8.50)	(7.15)
Constant	-0.02***	-0.02***	-0.02	-0.02**	-0.02	-0.02	-0.02***	-0.10***	-0.02***
	(-4.63)	(-4.58)	(-0.93)	(-2.39)	(-0.89)	(-0.91)	(-2.60)	(-20.06)	(-4.67)
Observations	18,511	18,511	18,511	18,511	18,511	18,511	18,511	18,511	18,511
R-squared	0.35	0.35	0.35	0.35	0.35			0.08	0.35
Number of industries							107		107
Hausman test (p-value)									0.0155
Number of countrypairs						173		173	
Breusch-Pagan test(p-value)						0	0		

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Country pairs are chosen from countries in the same region.
The dependent variable is measured by the ratio of the extensive margin of exports (equation (2.4)).
Columns (1)-(5) are the OLS estimators.
Columns (6)-(7) are the random effects estimators.
Columns (8)-(9) are the fixed-effects estimators.

equation (2.4).

Most of the industry characteristics in our study model are not directly observable, therefore proxy variables employed. Many studies have shown that an industry characteristic can be represented by different proxies. We use several alternative proxies to check the robustness of the above results. In addition, as we cannot obtain the industry-level or firm-level data for other developed countries, we still use these proxies from US data to represent industry characteristics.

In our main regression result, the number of non-production workers is used as a proxy for firm-level economics of scale (which represents export-fixed costs). However, firm-level economics of scale can also be measured by other proxies such as advertising intensity and research and development (R&D) intensity (Navaretti et al. (2004)). When we use the ratio of industry-aggregate advertising and R&D expenses to industry-aggregate sales to represent firm-level economics of scale, the results remain statistically consistent with our prediction. Industries with low firm-level economics of scale tend to locate in large countries.

For the productivity dispersion, instead of using the industry aggregate-product output to proxy for the productivity dispersion as above, we use the industry average of firm product output to estimate the productivity dispersion of industries. The results of this are still consistent with the above findings.

Table (2.6) presents the regression results across different methods when we measure the dependent variable by equation (2.5) (Hummels and Klenow (2005)), the firm-level economics of scale as measured by the ratio of aggregate-industry advertising and R&D expenses to industry sales, and the productivity dispersion is calculated from the output per company. Other explanatory variables (trade costs and domestic-fixed costs) are still unchanged. The results of the regression methods still appear consistent with our model predictions.

2.3.5 Discussion

As mentioned above, our model finds two factors similar to the ones in Hanson and Xiang (2004) that influence the distribution of firms across industries: trade costs and elasticity of sub-

Table 2.4: The impact of industry characteristics with data of the dependent variable from UNIDO

	OLS					Random effects		Fixed effects	
VARIABLES	Usual	Het	Country	Industry	Both	Country	Industries	Country	industry
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LGDP (+)	0.64***	0.64***	0.64***	0.64***	0.64***	0.62***	0.67***		0.69***
	(13.44)	(14.21)	(6.58)	(6.05)	(4.72)	(6.52)	(10.18)		(8.63)
Duties*LGDP (-)	-0.50***	-0.50***	-0.50**	-0.50	-0.50	-0.43***	-0.37*	-0.43***	-0.29
	(-3.47)	(-3.31)	(-2.12)	(-1.51)	(-1.34)	(-3.71)	(-1.85)	(-3.70)	(-1.14)
Fixed domestic cost*LGDP (+)	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00**
	(5.31)	(6.55)	(6.97)	(3.13)	(3.19)	(6.36)	(3.19)	(6.35)	(2.13)
Firm scale*LGDP (-)	-0.00	-0.00	-0.00	-0.00	-0.00	-0.02	-0.04	-0.02	-0.06
	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.28)	(-0.35)	(-0.29)	(-0.46)
Productivity dispersion*LGDP (+)	0.04**	0.04**	0.04**	0.04	0.04	0.05***	0.02	0.05***	0.01
	(2.08)	(2.20)	(2.27)	(0.92)	(0.93)	(2.93)	(0.85)	(2.94)	(0.32)
Constant	-0.13***	-0.13***	-0.13	-0.13***	-0.13	-0.12	-0.12***	0.81***	-0.13***
	(-4.69)	(-4.63)	(-0.80)	(-6.79)	(-0.81)	(-0.75)	(-3.17)	(14.59)	(-4.85)
Observations	8,326	8,326	8,326	8,326	8,326	8,326	8,326	8,326	8,326
R-squared	0.20	0.20	0.20	0.20	0.20			0.01	0.20
Number of industries							108		108
Hausman test (p-value)									0.929
Number of countrypairs						91		91	
Breusch-Pagan test(p-value)						0	0		

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results are estimated for all industries of countries
Columns (1)-(5) are the OLS estimators
Columns (6)-(7) are the random effects estimators
Columns (8)-(9) are the fixed-effects estimators

Table 2.5: The impact of industry characteristics with data of the dependent variable from UNIDO

	OLS					Random effects		Fixed effects	
VARIABLES	Usual	Het	Country	Industry	Both	Country	Industries	Country	industry
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LGDP (+)	0.66***	0.66***	0.66***	0.66***	0.66***	0.66***	0.69***		0.71***
	(9.66)	(9.92)	(6.02)	(3.83)	(3.45)	(6.44)	(7.01)		(6.17)
Duties*LGDP (-)	-0.92***	-0.92***	-0.92***	-0.92	-0.92	-0.92***	-0.83**	-0.92***	-0.77*
	(-3.92)	(-4.01)	(-2.94)	(-1.64)	(-1.55)	(-5.01)	(-2.43)	(-5.01)	(-1.92)
Fixed domestic cost*LGDP (+)	0.01***	0.01***	0.01***	0.01	0.01	0.01***	0.00	0.01***	0.00
	(3.73)	(4.08)	(3.83)	(1.36)	(1.36)	(4.76)	(1.55)	(4.76)	(0.74)
Firm scale*LGDP (-)	-0.29**	-0.29***	-0.29***	-0.29	-0.29	-0.29***	-0.29*	-0.29***	-0.29
	(-2.55)	(-2.69)	(-2.69)	(-1.26)	(-1.27)	(-3.26)	(-1.74)	(-3.26)	(-1.49)
Productivity dispersion*LGDP (+)	0.07***	0.07***	0.07***	0.07	0.07	0.07***	0.06*	0.07***	0.06
	(2.63)	(2.76)	(3.89)	(1.09)	(1.15)	(3.36)	(1.68)	(3.36)	(1.37)
Constant	-0.10***	-0.10***	-0.10	-0.10***	-0.10	-0.10	-0.10*	0.87***	-0.10***
	(-2.78)	(-2.73)	(-0.61)	(-4.55)	(-0.62)	(-0.61)	(-1.81)	(11.36)	(-2.84)
Observations	4,641	4,641	4,641	4,641	4,641	4,641	4,641	4,641	4,641
R-squared	0.20	0.20	0.20	0.20	0.20			0.02	0.20
Number of industries							51		51
Hausman test (p-value)									0.844
Number of countrypairs						91		91	
Breusch-Pagan test(p-value)						0	0		

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The dependent variable uses number of establishments from UNIDO
The model is estimated for industries appearing across all countries
Columns (1)-(5) are the OLS estimators
Columns (6)-(7) are the random effects estimators
Columns (8)-(9) are the fixed-effects estimators

Table 2.6: The impact of industry characteristics-Robustness check

	OLS					Random effects		Fixed effects	
VARIABLES	Usual	Het	Country	Industry	Both	Country	Industries	Country	industry
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LGDP (+)	0.17***	0.17***	0.17***	0.17***	0.17***	0.17***	0.16***		0.16***
	(27.89)	(28.57)	(11.87)	(6.52)	(5.86)	(13.42)	(17.83)		(17.15)
Duties*LGDP (-)	-0.53***	-0.53***	-0.53***	-0.53***	-0.53***	-0.53***	-0.49***	-0.53***	-0.48***
	(-27.53)	(-25.63)	(-17.95)	(-5.41)	(-5.32)	(-31.23)	(-15.98)	(-31.23)	(-15.24)
Fixed domestic cost*lGDP (+)	0.00***	0.00***	0.00***	0.00**	0.00**	0.00***	0.00***	0.00***	0.00***
	(15.19)	(10.20)	(11.35)	(2.01)	(2.02)	(17.23)	(8.96)	(17.23)	(8.56)
Firm scale*lGDP (-)	-0.29***	-0.29***	-0.29***	-0.29**	-0.29**	-0.29***	-0.28***	-0.29***	-0.28***
	(-10.72)	(-12.34)	(-10.60)	(-2.37)	(-2.37)	(-12.17)	(-6.49)	(-12.17)	(-6.23)
Productivity dispersion*lGDP (+)	0.03***	0.03***	0.03***	0.03	0.03	0.03***	0.03***	0.03***	0.03***
	(6.81)	(6.84)	(10.44)	(1.41)	(1.43)	(7.73)	(4.47)	(7.73)	(4.33)
Constant	0.03***	0.03***	0.03	0.03***	0.03	0.03	0.03**	0.26***	0.03***
	(7.44)	(7.23)	(1.43)	(7.13)	(1.43)	(1.50)	(2.52)	(36.98)	(7.68)
Observations	37,206	37,206	37,206	37,206	37,206	37,206	37,206	37,206	37,206
R-squared	0.11	0.11	0.11	0.11	0.11			0.04	0.09
Number of industries							106		106
Hausman test (p-value)									0.991
Number of countrypairs						351		351	
Breusch-Pagan test(p-value)						0	0		

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The dependent variable is measure by (2.5)
The advertising and R&D intensity is used as a proxy of firm-level economics of scale
The productivity dispersion is measured from output per company
Columns (1)-(5) are the OLS estimators
Columns (6)-(7) are the random effects estimators
Columns (8)-(9) are the fixed-effects estimators

stitution. However, the impacts of these variables in our model differ from the ones in Hanson and Xiang (2004). The discrepancy can be attributed to different approaches in building the models. We use the heterogeneous-firm model with the presence of the homogeneous-product sector, while they use the homogeneous-firm model with the nonexistence of the homogeneous product sector. We find that industries with low trade costs concentrate more in large countries and this impact on the home-market effects in our model is consistent, while Hanson and Xiang (2004) show that industries with high trade costs tend to concentrate in large countries. However, this impact in their model is not monotonic. They show that when trade costs of industries are very high, the home-market effects of these industries will decrease. Regarding the elasticity of substitution, Hanson and Xiang (2004) find that industries with low-substitution elasticities tend to concentrate in large countries and this impact is monotonic whereas the impact of this parameter in our model depends on the relationship between domestic-fixed costs and export-fixed costs. As our model assumes that domestic-fixed costs are smaller than export-fixed costs, industries with high substitution elasticities tend to locate in large countries. Hanson and Xiang have the opposite result.

In our empirical study, we use average duty rates of countries to represent trade costs of industries, while Hanson and Xiang (2004) use freight rates of the US imports to represent trade costs. Our empirical study doesnot examine directly the effect of the substitution elasticity on the distribution of industries as the productivity dispersion of industries in our study includes the substitution elasticity. From the method of measuring the productivity dispersion as mentioned above, the positive impact of the productivity dispersion on the distribution of firms across industries might imply that industries with high productivity dispersion and/or high elasticity of substitution will tend to locate in large countries.

As we explained above, due to economics of scale, production costs of large countries are usually lower than those of small countries; therefore, if an industry's trade costs are low, firms are more likely to locate in large countries to save production costs. Similarly, industries with high substitution elasticities tend to concentrate in large countries as products in these industries are quite similar and these products produced by small countries cannot compete with those from large countries due to high production costs. As a result, firms in industries with high substitution elasticities are more likely to concentrate in large countries.

Hanson and Xiang (2004) argue that although large countries have higher production costs than small countries, firms in industries with high trade costs still want to move to large countries as the benefits from savings in trade costs are larger than the increase in production costs. However, when trade costs of an industry are very high, goods in this industry are not traded, so the industry's home market effect decreases. The authors didn't provide clear explanations as why industries with a low-substitution elasticity locate more frequently in large countries.

From the home market-effect coefficients estimated in equation 2.2, we select two groups of industries with the highest home-market effects (HME) and industries with the lowest home-market effects (Table 2.7). As shown in our results, industries with high home-market effects tend to concentrate in large countries, while industries with low home-market effects locate in both large and small countries. In Table 2.7, we can see some examples that industries with high home market effects such as basic chemicals, or basic iron and steel tend to locate in large countries, while industries with low home-market effects such as furniture or electronics locate in both large and small countries.

2.4 Conclusion

Based on the model of heterogeneous firms in Helpman et al. (2004), we build a model to study the impact of industry characteristics on the arrangement of firms across industries between large countries and small countries. Our model predicts that industries with low trade costs, high fixed-domestic costs, low fixed export costs, and high productivity dispersion tend to concentrate in large countries, or that the home-market effects of these industries will be higher than with other industries.

An empirical model is then developed to examine these theoretical predictions using the data of 4-digit manufacturing industries ISIC in 28 high income countries. Our empirical evidence

Table 2.7: Groups of industries with high and low home market effects

ISIC	HME	Low HME industries	ISIC	HME	High HME industries
2211	0.008	Publishing of books and other publications	2699	0.286	Other non-metallic mineral products n.e.c.
3000	0.017	Office, accounting and computing machinery	3591	0.286	Motorcycles
3313	0.019	Industrial process control equipment	1512	0.288	Processing/preserving of fish
3220	0.030	TV, radio transmitters; line comm. apparatus	3692	0.317	Musical instruments
1552	0.030	Wines	1531	0.322	Grain mill products
3120	0.032	Electricity distribution , control apparatus	2926	0.333	Machinery for textile, apparel and leather
3610	0.037	Furniture	1711	0.343	Textile fibre preparation; textile weaving
3311	0.039	Medical, surgical and orthopaedic equipment	1532	0.346	Starches and starch products
1730	0.045	Knitted and crocheted fabrics and articles	1514	0.355	Vegetable and animal oils and fats
1553	0.055	Malt liquors and malt	2923	0.380	Machinery for metallurgy
2912	0.056	Pumps, compressors, taps and valves	2927	0.381	Weapons and ammunition
2212	0.057	Publishing of newspapers, journals, etc.	1542	0.388	Sugar
1541	0.059	Bakery products	2411	0.393	Basic chemicals, except fertilizers
3430	0.060	Parts/accessories for automobiles	2710	0.409	Basic iron and steel
3312	0.062	Measuring/testing/navigating appliances, etc.	2412	0.409	Fertilizers and nitrogen compounds
1912	0.062	Luggage, handbags, etc.; saddlery, harness	2692	0.420	Refractory ceramic products
3130	0.063	Insulated wire and cable	3511	0.448	Building and repairing of ships
2520	0.070	Plastic products	2430	0.452	Man-made fibres
3110	0.071	Electric motors, generators and transformers	2813	0.459	Steam generators
3230	0.072	TV and radio receivers and associated goods	2320	0.514	Refined petroleum products

From coefficients in equation 2.2, two groups of industries with high and low home market effects are chosen supports the predictions from the theoretical model. Economies of scale can be a key factor to explain why the industries will locate more in large countries.

This study can provide useful lessons in determining which industries should be most highly prioritized in both developed and developing countries (especially small countries). From the results, we think that small countries should promote the development of industries with high trade costs, low fixed domestic costs, low economics of scale, and low productivity dispersion. For example, a small country may want to focus on developing a furniture industry. If small countries develop industries such basic steel, they will not be able to compete with large countries in terms of production costs.

Chapter 3

The effects of trade barriers on the extensive and intensive margins of trade in developing countries

3.1 Introduction

The paper studies the impact of trade policy barriers on the extensive and intensive margins of trade of developing countries. The extensive margin is the number of export/import products, while the intensive margin is the volume of an export/import product. Prior trade theories assume that all firms are homogeneous, so all firms can export their products when countries participate in international trade. As a result, the change of trade barriers only affects trade volume through the adjustments of the intensive margin.

Recent trade theories (i.e. Melitz (2003)) assume that firms are heterogenous and must face sunk costs in order to export goods to other countries, thus, only firms with high productivity are able to export, and changes in trade barriers significantly impact the number of firm (or products) in trade (extensive margin). In addition, Ruhl (2008) finds that the response of extensive margin to high frequency transitory shocks is not significant, while this response to permanent shock such as trade liberalization is significant. The results of these studies imply that not all adjustments of trade policy barriers can affect the change of the extensive margin of trade flows. Broad changes, such as trade liberalization, can alter the extensive margin. Yearly fluctuations of trade barriers, on the other hand, do not have a significant impact. This paper empirically tests these issues for developing countries: How does the extensive margin of exports and imports in developing countries respond to broad changes of trade barriers (trade liberalization) and the yearly change of trade barriers (tariffs and the real effective exchange rate)?

Changes in the extensive margin of exports and imports have significant effects on countries' economic growth. Broda and Weinstein (2006) show that the expansion of import varieties in the US between 1972-2001 decreased the import-price index by 28%. This fall contributes an equivalent of 2.6% of US GDP in 2001. Similarly, Romer (1994) finds that the number of kinds of import goods has a positive correlation with the welfare of a country. On the export side, Feenstra and Kee (2008) find evidence that the growth of export varieties benefits the aggregate productivity in the exporting country. For the US, they show that the increase in export variety is associated with a 4.5% productivity improvement for exporters between 1980-2000. Therefore, a deeper understanding of the impact of trade barriers is important.

There are several studies of the impact of trade policy barriers (tariff, exchange rate, and trade liberalization) on the extensive and intensive margins of exports and imports of countries. For example, Kehoe and Ruhl (2009), Mukerji (2009), Frensch (2010) show that liberalization significantly affects the extensive margin of exports or imports. Feenstra et al. (2007) and Debaere and Mostashari (2010) find evidence for the impact of the US tariff barriers on the range of import goods of the US. Colacelli (2009) provides examples of the impact of bilateral exchange rate on the extensive and intensive margins of exports in the panel of 136 countries. Our paper differs from these prior studies in several ways, however.

First we use import and export demand functions to examine the impact of trade policy barriers (import duties (export duties), real effective exchange rate, and liberalization) on the extensive and intensive margin of exports and imports. These functions allow us to simultaneously incorporate all the above variables in the model. The above studies don't examine the simultaneous impacts of these variables and only examine the impacts of trade barriers on either exports or imports. Second, our sample includes developing countries. The impact of trade barriers on the extensive margins may be much more important for developing countries, since those with backward technology often have low diversification of products and therefore must import many products from developed countries. In addition, they often maintain high trade barriers. As a result, removing trade barriers (trade liberalization) can remarkably improve the welfare of developing countries through an increase in import and export variety. Finally, this study uses the dynamic panel regressions which have not been employed in the prior studies in studying the effect of trade barriers on the extensive and intensive margin of trade.

Our results show that trade liberalization in developing countries has significant impacts on the extensive margins of both exports and imports, whereas moderate changes in import and export duties significantly improve the intensive margin but do not materially affect the extensive margin. These findings are consistent with the empirical evidence of Kehoe and Ruhl (2009) and the theoretical predictions of Ruhl (2008). However, the impact of the real effective exchange rate in our study is not consistent with the predictions of Ruhl (2008). In the case of imports, the impact of the real effective exchange rate on the intensive margin of import is not statistically significant. In the case of exports, we find that the effect of the real effective exchange rate on the extensive margin of export is statistically significant and stronger than its impact on the intensive margin of export. The data on exports appears to be in line with the findings of Colacelli (2009).

These results of our study imply that developing countries should undertake major reforms in their trade policies to increase the extensive margin of trade and reduce the loss of social welfare because the moderate reduction of trade barriers alone will not have material impact on the extensive margin.

The remainder of this paper is organized as follows: Section 2 discusses import and export demand functions and their applications; Section 3 presents the econometric methods; Section 4 discusses the empirical results; Section 5 summarizes our conclusions.

3.2 Literature review

3.2.1 Import and export demand functions

In this part, we will discuss import (export) demand functions and some of their applications. In the imperfect substitutes model, the domestic demand for imports (foreign export) is assumed to depend on real income and the relative price of imported goods:

$$M = M\left(\frac{eP^*}{P}, Y\right) \tag{3.1}$$

where M^d is the domestic demand for foreign goods, and Y is the level of real income measured in domestic output. $\frac{eP^*}{P}$ is the relative price of imported goods to domestically produced goods, both measured in home currency (real exchange rate). e is the nominal exchange rate, defined as the domestic currency price of foreign exchange. From this formula, the import demand depends negatively on the relative price of the foreign good and depends positively on real income.Thus if the domestic currency depreciates (e is increased), there is a rise in the relative cost of imports and a decline in import demand.

Analogously, the demand for a country's exports (foreign imports) depends on foreign income and the foreign relative price of imports:

$$M^* = M^*(\frac{eP^*}{P}, Y^*) \tag{3.2}$$

Where Y^* is the level of foreign real income. The demand for a country's export good depends negatively on the relative price of the good, and therefore depends positively on the real exchange rate. Thus if the domestic currency depreciates, foreigners experience a fall in the relative cost of their imports, and there is a rise in the demand for the domestic exports.

The main applications of these functions are to measure income and price elasticities. To study these issues, empirical studies use the log-transformation of above equations as follows:

$$log(M_t) = \beta_0 + \beta_1 log\left(\frac{eP^*}{P}\right) + \beta_2 log(Y_t) + \epsilon_t$$
$$log(M_t^*) = \alpha_0 + \alpha_1 log\left(\frac{eP^*}{P}\right) + \alpha_2 log(Y_t) + \upsilon_t$$

As discussed above, we predict that $\beta_1 < 0$, $\beta_2 > 0$ and $\alpha_1 > 0$, $\alpha_2 > 0$. There were many studies which use these functions to study the elasticities or the effect of depreciation policies such as Rittenberg (1986), Marquez and McNeilly (1988), Rose and Yellen (1989), Rose (1991), Rose (1990), and Ostry and Rose (1992), or Reinhart (1995).

3.2.2 Exports, imports, and trade barriers

Many studies used these import and export demand functions to study the impact of trade barriers on import and export demand. Faini et al. (1988) argue that when the impact of import controls and/or liberalization policies is included in the above models, the real effects of income and price changes on import behavior are more evident . Thus, import demand studies, which do not evaluate the effect of import policy changes, should be interpreted with caution, as far as the estimates of the income and price elasticities are concerned.

In the case of imports, many studies such as Melo and Vogt (1984), Boylan and Cuddy (1987), Mah (1999), Santos-Paulino (2002) use these functions to study the impact of trade liberalization on import demand or import growth. Besides studying the impact of trade liberalization on Venezuela's import, Melo and Vogt (1984) suggest two hypotheses and find support for their hypotheses from Venezuela: liberalization tends to increase (1) the income elasticity and (2) the price elasticity of import demand. However, Boylan and Cuddy (1987) don't find empirical support for these hypotheses in the case of Ireland, but Mah (1999) finds evidence for the first hypothesis for the case of Thailand. A study of 22 developing countries by Santos-Paulino (2002) also provides evidence supporting these hypotheses. Besides, some studies show that trade liberalization of countries has improved their export performance (e.g. Weiss (1992), Ahmed (2000), Nur et al. (2007)). However, some other studies find little evidence of this relationship (e.g. Greenaway and Sapsford (1994), Shafaeddin (1995)). None of these studies considers the effects of liberalization on intensive and extensive margins.

3.2.3 The extensive and intensive margins and trade barriers

Since prior trade theories (i.e. Krugman (1980)) assume that firms are homogeneous, all firms can export their products abroad when countries participate in international trade. As a results, the changes in trade barriers don't affect the number of export firms (the extensive margin of trade). However, this does not conform with actual statistics, which show that only a small proportion of firms can export (Bernard et al. (2000)). Recent new trade theories (i.e Melitz (2003)) which incorporate fixed export costs and firms with different productivity into the model of monopolistic competition can explain this issue. According to these theories, in order to export products abroad, firms have to pay not only variables costs, but also fixed costs such as sunk costs to set up an export operation, so only high productivity firms can go into markets of other countries. Mark and Tybout (1997), Bernard and Wagner (2001), Bernard and Jensen (2004), and Dennis and Shepherd (2011) provide empirical data on the impact of these sunk costs on firms' export decision.

In addition, Ruhl (2008) shows that not all adjustments of trade barriers can affect the extensive margin of trade. Based on the Melitz model, Ruhl (2008) builds a dynamic model to explain the elasticity puzzle in International Economics. The International Macroeconomic models need small values of substitution elasticity to explain the patterns of business cycles, while the models in International Trade need large values of elasticity to explain the impact of trade liberalization or tariffs on trade. Ruhl (2008) argues that the different responses of the extensive margin of trade flows to the change of trade barriers are factors which explain the elasticity puzzle. Ruhl (2008) finds that the extensive margins respond insignificantly to high frequency transitory shocks in the International Macroeconomic models, whereas the extensive margin responds significantly to permanent shocks such as trade liberalization in the International Trade models.

The theoretical studies of Melitz (2003) and Ruhl (2008) and the empirical findings on sunk costs mentioned above imply that the normal fluctuations of trade policy barriers in countries do not have significant effects on the extensive margin of trade, while broad adjustments such as trade liberalization have significant effects on the extensive margin of trade. Some studies discuss how the extensive and intensive margin of trade flows respond to the changes of trade policy barriers; i.e., Feenstra et al. (2007), Kehoe and Ruhl (2009)[1] , Colacelli (2009), Frensch (2010), Debaere and Mostashari (2010). In these studies, Kehoe and Ruhl (2009), Mukerji (2009), and Frensch (2010) discuss the impact of trade liberalization on the extensive margin of either exports or imports. Feenstra et al. (2007) and Debaere and Mostashari (2010) discuss the impact of tariffs and Colacelli

[1] The first version is 2003

(2009) examines the effect of bilateral real exchange rates.

Kehoe and Ruhl (2009) propose a methodology to measure the change of the extensive margin across time. Using their methodology, they find that countries that undergo trade liberalization or significant structural transformation have large increases on the extensive margin of exports, while countries that don't have large changes in trade policies don't experience increases on the extensive margin of exports. However, their method is only descriptive; they don't use econometric models to investigate the relationship between the extensive margin of countries and trade barriers. Following the method of Kehoe and Ruhl (2009), Mukerji (2009) finds that the liberalization of trade in India in the 1990s had positive effects on the extensive margin in both Indian exports and imports. Through a gravity model with only two independent variables, namely GDP and trade liberalization, Frensch (2010) shows that trade liberalization of OECD and European emerging countries alters the volumes of imports and the extensive and intensive margins of imports of these countries from the rest of the world in the period of 1992-2004.

Both Feenstra et al. (2007) and Debaere and Mostashari (2010) study the impacts of the US tariff barriers on the extensive margin of imports of the US. Their approaches are different, however. Feenstra et al. (2007) studied the effects of US tariff reductions on the import varieties of seven industries from Mexico and China in the period from 1990 to 2001. Their empirical results indicate that the decrease of the US tariff has an important effect in expanding the export variety from these countries to the US. They only consider the simple relationship between the import variety from Mexico (or China) and the US tariffs across seven industries from 1990 to 2001. For the Mexico case study, they add the dummy variable of NAFTA in the regression model. Debaere and Mostashari (2010) study the impact of changes in US tariffs on the range of US import goods from all countries around the world. Specifically, they compare the change of the range of import goods of the US and the change of the US tariff in 1999 with 1989 through a probit model. They find compelling evidence that tariffs do indeed affect the range of goods that countries export to the US, but not by much. At best, 5 percent change in the extensive margin between 1989-1999 is attributed to the change of tariffs. Colacelli (2009) finds evidence that the change in the bilateral real exchange rate has remarkable effects on the extensive margin exports of 136 countries through the gravity model in the period between 1981-1997.

Other studies examine the impact of other determinants such as trade agreements (WTO, NAFTA) or other trade barriers (distance, geography) on the margins. For instance, Felbermayr and Kohler (2007), Liu (2009), Christodoulopoulou (2010), and Dutt et al. (2011) examine the role of WTO on the growth of margins of countries. Felbermayr and Kohler (2007) examine the effect of WTO on the extensive and intensive margins of trade of countries at partner-level. Relying on a Tobit estimation method, they find that WTO increases the extensive and intensive partner margins of trade through the gravity model including zero trade flows. Liu (2007) also studies the effects of WTO in a similar way. However, instead of using Tobit method to estimate the gravity model, Liu uses Possion regression. He says that assumptions about normality and homoskedasticy maintained in Tobit model are unlikely to hold. He finds that the estimators in Possion estimation are more reasonable than the one in Tobit model. Christodoulopoulou (2010) and Dutt et al. (2011) study the effects of WTO at product-level. However, Christodoulopoulou (2010) finds WTO affect significantly both margins, while Dutt et al. (2011) find that WTO has significant effect on the extensive margin, but not on the intensive margin of trade.

Hillberry and McDaniel (2003) show that NAFTA has the significant effect on the growth of the intensive and extensive margins of the partners. Lawless (2010) finds that increasing distance has a negative effect on both margins. Other variables such as language, internal geography, infrastructure and import cost barriers have effects on the extensive margin, but almost none of these variables is found to have a statistically significant relationship with the intensive margin.

In brief, the above studies show that the broad change of trade barriers such as trade liberalization (liberalization of countries, WTO, or NAFTA) have the significant effects on the extensive margin of trade. However, the effects of normal adjustments of trade barriers seem to be inconsistent. The empirical results of Kehoe and Ruhl (2009) are consistent with predictions of Ruhl (2008) that the extensive margin of trade responds significantly to trade liberalization but insignificantly to the yearly fluctuations of trade barriers. While, the results of Feenstra et al. (2007) and Colacelli

(2009) are not consistent with these predictions. Feenstra et al. (2007) find that the yearly change of the US tariff barriers have significant effects on import variety from Mexico and China in the period of 1989-1999. Colacelli (2009) indicates that the bilateral real exchange rate has remarkable impacts on the extensive margin of exports.

This paper also studies the impacts of trade policy barriers on the extensive and intensive margins of trade. However, its approach is different from the above studies in several ways. None of the above studies examine the simultaneous effects of tariffs, real exchange rate, and trade liberalization in the same model, while we can combine all variables in the same model through the import and export demand functions. In addition, this paper studies the impacts of trade policy barriers on the extensive and intensive margins of trade for developing countries which haven't mentioned in prior studies.

3.3 Methodology

3.3.1 Models

As mentioned above, this paper will examine the following issue: the impact of trade liberalization and trade duties on the change of extensive and intensive margins of imports and exports. A dummy variable to show the year in which the reforms of trade policies of countries occurred is used to represent the trade liberalization of countries.

All these issues will be studied through the import and export demand functions. For instance, to study the impact of the above variables on imports, we will add variables of trade liberalization (*lib*) and import duties (*iduty*) into the import demand function. We also know that import demand is usually slow to adjust to changes in trade policies. This can be explained by importers or exporters who depend on contracts or regulations which slows their response to trade policies. As a result, we will use the following dynamic model to study the impact of trade liberalization and import duties on imports:

$$log(M_t^j) = \alpha_1 log(M_{t-1}^j) + \alpha_2 log(Y_t^i) + \alpha_3 log\left(\frac{eP_t^*}{P_t^i}\right) + \alpha_4 log(iduty_{it}) + \alpha_5 log(lib_{it}) + \nu_i + u_{it} \quad (3.3)$$

where M_t^i is the total import of country i in year t, Y_t^i is the real GDP of countries, $\frac{eP_t^*}{P_t^i}$ is the real effective exchange rate, $iduty_{it}$ is the measure of import duties, and lib_{it} is the dummy variable that represents trade liberalization. The expected signs of the variables in the import-demand regression are : $\alpha_1 > 0$; $\alpha_2 > 0$; $\alpha_3 < 0$; $\alpha_4 < 0$, and $\alpha_5 > 0$.

To find the impact of the variables on the extensive and intensive margins of imports, we use the method of Hummels and Klenow (2002) to decompose the volume of import of country i (M_t^i) into the product of the extensive (EM_t^i) and intensive margins (IM_t^i) of imports: $M_t^i = constant(EM_t^i)(IM_t^i)$. The effect of trade liberalization and import duties on the extensive and intensive margins of imports will be studied through the following models:

$$log(EM_t^{i,imp}) = \gamma_1 log(EM_{t-1}^{i,imp}) + \gamma_2 log(Y_t^i) + \gamma_3 log\left(\frac{eP_t^*}{P_t^i}\right) + \gamma_4 log(iduty_{it}) + \gamma_5 lib_{it} + \nu_i + u_{it} \quad (3.4)$$

$$log(IM_t^{i,imp}) = \delta_1 log(IM_{t-1}^{i,imp}) + \delta_2 log(Y_t^i) + \delta_3 log\left(\frac{eP_t^*}{P_t^i}\right) + \delta_4 log(iduty_{it}) + \delta_5 lib_{it} + \nu_i + u_{it} \quad (3.5)$$

Since $M_t^j = constant(EM_t^j)(IM_t^j)$, we predict that when import volume (M) increases, the extensive and intensive margins of import should also increase. The expected signs of explanatory variables in regression models of the extensive and intensive margins of imports are: $\gamma_1, \delta_1 > 0$, $\gamma_2, \delta_2 > 0$, $\gamma_3, \delta_3 < 0$, $\gamma_4, \delta_4 < 0$, and $\gamma_5, \delta_5 > 0$.

Similarly, the impacts of trade liberalization and export duties ($eduty$) on exports and their margins are studied through the following models:

$$log(X_t^i) = \alpha_1 log(X_{t-1}^i) + \alpha_2 log(Y_t^w) + \alpha_3 log\left(\frac{eP_t^*}{P_t^i}\right) + \alpha_4 log(eduty_{it}) + \alpha_5 log(lib_{it}) + \nu_i + u_{it} \quad (3.6)$$

$$log(EM_t^{i,exp}) = \gamma_1 log(EM_{t-1}^{i,exp}) + \gamma_2 log(Y_t^w) + \gamma_3 log\left(\frac{eP_t^*}{P_t^i}\right) + \gamma_4 log(eduty_{it}) + \gamma_5 lib_{it} + \nu_i + u_{it} \quad (3.7)$$

$$log(IM_t^{i,exp}) = \delta_1 log(IM_{t-1}^{i,exp}) + \delta_2 log(Y_t^w) + \delta_3 log\left(\frac{eP_t^*}{P_t^i}\right) + \delta_4 log(eduty_{it}) + \delta_5 lib_{it} + \nu_i + u_{it} \quad (3.8)$$

where Y_t^w is the world real GDP, $eduty_{it}$ is export duties. The expected signs of the explanatory variables are still similar to the case of import except the impact of the relative price on the dependent variables which is opposite with the case of import: $\alpha_3, \delta_3, \gamma_3 > 0$.

3.3.2 Methodology to estimate the models

In the above models, there is a relationship between lagged dependent variables and the individual specific effects (i.e. the relationship between M^j_{t-1} and ν_j in the import demand function) and therefore the OLS estimator or fixed-effects estimators are biased. The OLS estimator shows positive bias, while the fixed-effects estimators are biased downwards. The fixed-effects estimator bias gets smaller for a larger T. To avoid these biases, we use some other consistent estimators to estimate the dynamic-panel models including: the first difference GMM estimators (Arellano and Bond (1991)), system GMM estimators(Arellano and Bover(1995) and Blundell and Bond(1998)), and a biased-corrected fixed effects estimator (or corrected LSDV[2]) (Kiviet (1995), Bun and Kiviet (2003), and Bruno (2005)). We use the regression model of import demand to illustrate these methods:

$$log(M^i_t) = \alpha_1 log(M^i_{t-1}) + \alpha_2 log(Y^i_t) + \alpha_3 log\left(\frac{eP^*_{t-1}}{P^i_t}\right) + \alpha_4 log(iduty_{it}) + \alpha_5 lib_{it} + \nu_i + u_{it}$$

or

$$m_{it} = \alpha_1 m_{it-1} + \alpha_2 y_{it} + \alpha_3 reer_{it} + \alpha_4 iduty_{it} + \alpha_5 lib_{it} + \nu_i + u_{it}$$

3.3.2.1 A first-difference estimator

The first difference estimator is mentioned first by Anderson and Hsiao (1981). They use the first difference method to eliminate the correlation of the lagged dependent variable with the individual specific effects. However, Arellano and Bond (1991) notes that the Anderson-Hsiao estimator is inefficient because it doesn't use all available instruments. Arellano and Bond (1991) improved this method through GMM framework with using all available instruments. To simplify in explaining their method, we assume that the lagged variable is the only explanatory variable in

[2] Least square dummy variable

the model and the above equation is written under the first difference:

$$\Delta m_t^i = \alpha \Delta m_{t-1}^i + \Delta u_t^i \tag{3.9}$$

In this first difference equation, the variable of individual-specific effects is excluded. The correlation between m_{t-1}^i and ν_i is also excluded. However, estimators of the above model are still biased since the error term (u_{t-1}^i) in $\Delta u_{it} = u_{it} - u_{it-1}$ is correlated with m_{it-1} in Δm_{it-1}. If u_{it} is iid, Δu_{it} is correlated with m_{it-1}, but it is not correlated with $m_{it-2}, m_{it-3}, ...$ We can use value of m at $t-2$ and before are valid instruments to estimate α . As a result, we can build following moment conditions:

$$E[m_{it-s}\Delta u_{it}] = 0 \text{where } s \geq 2 \text{ and } t = 3, \ldots, T \tag{3.10}$$

Or we can write under matrix

$$E[Z_i' \Delta u_i] = 0 \text{ for } i = 1, 2, \ldots, N^3$$

The coefficients of the model will be estimated from minimizing the following criterion:

$$S = argmin \left(\frac{1}{N} \sum_{i=1}^{N} \Delta u_i' Z_i \right) \hat{\Omega}^{-1} \left(\frac{1}{N} \sum_{i=1}^{N} Z_i' \Delta u_i' \right)$$

Where $\hat{\Omega}$ is a consistent estimator of $\Omega = E(Z_i \Delta u_i \Delta u_i' Z_i)$. Under assumption that u_{it} is iid over time, $\Omega = E(Z_i \Delta U_i \Delta U_i' Z_i') = \sigma_u^2 E(Z_i H Z_i')$, where H is the (T-2)x(T-2) matrix with 2's on the main diagonal, -1's on the first off-diagonals and zeros elsewhere. If we use this H matrix to estimate α, this method is called the first stage GMM estimators.

Next, if we use the residuals estimated from the first-stage to calculate

$$\hat{\Omega} = N^{-1} \Sigma_{i=1}^{N} Z_i \Delta \hat{u}_i \Delta \hat{u}_i Z_i'$$

Using this, we can estimate α again. This is a second-stage GMM estimator.

[3]
$$Z_i = \begin{pmatrix} m_{i1} & 0 & 0 & \cdots & 0 & \cdots & 0 \\ 0 & m_{i1} & m_{i2} & \cdots & 0 & \cdots & 0 \\ . & . & . & \cdots & . & \cdots & 0 \\ 0 & 0 & 0 & \cdots & m_{i1} & \cdots & m_{iT-2} \end{pmatrix}$$

and $\Delta u_i = (\Delta u_{i3}, \Delta u_{i4}, ..., \Delta u_{iT})'$.

The first stage estimators are only correct when u_{it} is *iid*. So, if the disturbances are heteroskedastic, the two step estimator is more efficient. However, simulation studies (Arellano and Bond (1991) and Blundell and Bond (1998)) have suggested that the asymptotic standard errors for the one-step estimator appear to be more reliable for making inferences in small samples. Windmeijer (2005) also found this issue and proposes a finite-sample correction for the asymptotic variance of the two-step GMM estimator.

When there are other explanatory variables in the model, we still use the above method to estimate the model. In this case, different assumptions about the properties of x_{it} will imply different sets of moment conditions. Assume we have the dynamic model with explanatory variable X as follow:

$$\Delta m_{it} = \alpha \Delta m_{it-1} + \beta \Delta x_{it} + \Delta u_{it}$$

If X regressors are strictly exogenous, they are used as instruments for themselves. As a result, we have the moment conditions:

$$E[m_{it-s}\Delta u_{it}] = 0 \ s \geq 2 \text{ and } t = 3 \ldots T$$

$$E\left[x_{i,s}\Delta u_{it}\right] = 0 \ s = 1 \ldots T \text{ and } t = 3 \ldots T$$

If X regressors are predetermined or weakly exogenous variables, regressors are correlated with past errors but uncorrelated with future errors: $E(x_{it}u_{is}) \neq 0$ for $s < t$ and $E(x_{it}u_{is}) = 0$ for $s \geq t$. These regressors can be instrumented in the same way that m_{it-1} is instrumented using subsequent lags of m_{it-1}. Specially, x_{it} is instrumented by $x_{it-1}, x_{it-2}, \ldots..$

$$E[m_{it-s}\Delta u_{it}] = 0 \ s \geq 2 \text{ and } t = 3 \ldots T$$

$$E\left[x_{i,t-s}\Delta u_{it}\right] = 0 \ s \geq 1 \text{ and } t = 3 \ldots T$$

Finally, if a regressor is contemporaneously endogenous: $E(x_{it}u_{is}) \neq 0$ for $s \leq t$ and $E(x_{it}u_{is}) = 0$ for $s > t$. Now, $E(x_{it}u_{is}) \neq 0$, so x_{it-1} is no longer a valid instrument in the first difference model. The instrument for x_{it} are now $x_{it-2}, x_{it-3}, ...$

$$E[m_{it-s}\Delta u_{it}] = 0 \ s \geq 2 \text{ and } t = 3 \ldots T$$

$$E\left[x_{i,t-s}\Delta u_{it}\right] = 0 \ s \geq 2 \text{ and } t = 3 \ldots T$$

3.3.2.2 System GMM

Arellano and Bover(1995) and Blundell and Bond(1998) found that lagged levels $m_{i,t-2}, ..., m_{i,1}$, when used as instruments for $\Delta m_{i,t-1}$, become weak instrument if the endogenous variable is highly persistent (.i.e the case of unit root). Instrument weakness influences the asymptotic and small-sample performance of the difference estimator. Asymptotically, the variance of the coefficient rises. To reduce the potential biases and imprecision associated with the usual difference estimator, above studies use additional moment conditions built from the regression in levels. Assume that we have AR(1) level model:

$$m_{it} = \alpha m_{it-1} + u^*_{it}$$

where $u^*_{it} = \nu_i + u_{it}$. In this model, we showed that m_{it-1} is correlated to ν_i, so estimators are biased. However, under the assumption that the series is stationary, Blundell and Bond (1998) find that although there may be correlation between the levels of the right hand side variables and the country-specific effect in equation, there is no correlation between the differences of these variables and the country-specific effect. This implies that Δm_{it-1} are valid instruments for the equation in levels. So, if u_{it} is not autocorrelated, then Δm_{it-1} are not correlated with $\nu_i + u_{it}$ and are instruments for $m_{i,t-1}$. From that, we have $T-2$ additional moment conditions

$$E(\Delta m_{it-1}(\nu_i + u_{it})) = 0 \tag{3.11}$$

As a result, coefficients are estimated based on the moment conditions from (3.10) and (3.11). We call this method to be system GMM estimator.

In Monte Carlo studies of Arellano and Bover (1995) and Blundell and Bond (1998), they show that system GMM estimator perform much better than the first-difference GMM, especially when series are persistent (close to unity). The finite sample bias in system GMM is dramatic reduction in comparison with the first difference GMM estimator.

The above GMM estimator performs better when T is small (absolute and relative to N). As the number of periods (T) increases, more and more instruments become available. This instrument proliferation can cause many issues: over-fitting endogenous variables and imprecise estimates of the optimal weighting matrix. These issues can lead to severe downward bias in GMM estimators and weakened specification test (Hansen test).

There still is no general rule to determine what is a relatively safe number of instruments. Most researchers have used two main techniques to limit the number of instruments (Roodman (2009)). The first is to use only certain lags instead of all available lags for instruments. The other one is to reduce the number of instruments by choosing linear combinations of the moment conditions rather than treating them as separate (collapsing).

3.3.2.3 Bias corrected LSDV estimator

Fixed effect estimators (or LSDV) are biased, but they often have a smaller MSE than GMM estimators. Therefore, if the bias of this estimator could be estimated and used to correct the estimate, this method, called bias corrected LSDV estimator, may be superior to GMM estimators, as a study by Judson and Owen (1999) suggests. The study results strongly support the biased corrected LSDV estimator (LSDVC) compared to GMM estimators when N is small. This method uses consistent estimators such as Anderson and Hsiao (1981) or the above-mentioned GMM estimators to estimate the bias of LSDV.

3.3.2.4 Specification tests

The consistency of the GMM estimator depends on the validity of instruments. To address this issue we consider two specification tests suggested by Arellano and Bond (1991). First, we test the overall validity of the instruments since the moment conditions exceed estimated parameters. From that, we need to test the consistency of the set of instruments used. To test this, we use a

Hansen-Sargan test

$$S = \left[\sum_{i=1}^{N} Z_i'(u_i)\right]' \hat{\Omega}^{-1} \left[\sum_{i=1}^{N} Z_i'(u_i)\right]$$

Under the null hypothesis that instruments are valid, the Hansen-Sargan statistic S is distributed as a chi-squared with $H-K$ degrees of freedom. If errors are homoskedastic, the models are estimated by the first-stage GMM, and the S statistic is calculated from H matrix mentioned the above. In this case, S is called the Sargan test. If errors are not homoskedastic, the models are estimated by the second-stage GMM and S is based on the weighting matrix and called a Hansen test. The reasoning behind these tests is that if the moment conditions hold, then the sample moments when evaluated at the parameter estimators should be close to 0. From that, when the value of S is small (p_{value} is large), we should accept the null hypothesis. Limitations of these tests are that Hansen test's size is distorted as the number of instruments grows, while the Sargan test is not appropriate if homoskedasticity fails.

In addition, consistency of estimators depends crucially on the assumption that $u_{i,t}$ in level equation (equation (3.11)) is not serially correlated. Arellano and Bond (1991) suggest tests of AR(1) and AR(2) to examine the first-order serial correlation of $u_{i,t}$. As mentioned in Wawro (2002), these tests are based on the mechanism that if there is no serial correlation in the $u_{i,t}$, residuals in the first-differenced equation $(u_{i,t} - u_{i,t-1})$ display a first-order autocorrelation. On the other hand, if $u_{i,t}$ has the first-order autocorrelation in level equation $(u_{i,t} - \rho u_{i,t-1})$, then the residuals in the first-differenced equation $(u_{i,t} - u_{i,t-1} - \rho(u_{i,t-1} - u_{i,t-2}))$ display the second order autocorrelation. From these results, the residuals in the first-differenced equation should have the first-order serial correlation, but not the second-order serial correlation. AR(1) and AR(2) tests of Arellano and Bond (1991) will test these issues. If p-value of AR(1) is low and p-value of AR(2) is high, this means that residuals in first-differenced equation have the first-order autocorrelation and don't have the second autocorrelation. This result implies that there is not the first-order autocorrelation in disturbances of level-regression model.

3.3.3 The extensive and intensive margins of trade

Feenstra (1994), in studying the role of new varieties in price indexes, demonstrated how to use the data of expenditure to measure the change of each country's product varieties over time. Many studies have adopted this method to compare the product or export varieties across countries. Hummels and Klenow (2002) and Hummels and Klenow (2005) used this method to define the extensive margin of countries' exports[4] . They also introduce a method to measure the intensive margin of exports across countries. In this paper, we will use the approach of Hummels and Klenow (2002) to measure countries' extensive and intensive margins of imports and exports over time.

Using the method of Feenstra (1994), Hummels and Klenow (2002) define the intensive and extensive margins of imports of country j from all exporters in year t as follows:

$$IM_t^{j,imp} = \frac{M_t^j}{\sum_i \sum_{s \in I_t^{ij}} M_t^{iWs}}$$

$$EM_t^{j,imp} = \frac{\sum_i \sum_{s \in I_t^{ij}} M_t^{iWs}}{M_t^W}$$

where M_t^j is the total import value of country j from the world (W) in year t. I_t^{ij} is the set of products exported from country i to country j. M_t^{iWs} is the import of product s of the world from country i (or export of product $s \in I_t^{ij}$ of country i to the world). $\sum_{s \in I_t^{ij}} M_t^{iWs}$ is the total value of world import from country i in products which country i exports to country j (or total export of products $s \in I_t^{ij}$ of country i to the world). M_t^W is the total world import from the export of all countries i in year t.

The extensive margins of import measured as above employ a weighted count of the number of categories to measure the extensive margins of import of countries in year t, where the weights are the world trade in each category. This weighted count measure for the extensive margin is

[4] Hummels and Klenow (2002) is a working paper and Hummels and Klenow (2005) is a version published in the AER. Hummels and Klenow (2002) measures the extensive and intensive margins of countries at all destinations, while Hummels and Klenow (2005) measure them at each destination, then get the average value to represent the extensive margin of countries

more appropriate than the simple count because it allows varieties to be traded in unequal prices and quantities[5] . The intensive margin of a country's import compares its import value with the world's import value on similar products from similar exporters.

Similarly, we define the extensive and intensive margins of exports of a country i as follows:

$$IM_t^{i,exp} = \frac{X_i^t}{\sum_j \sum_{s \in I_t^{ij}} X_t^{Wjs}}$$

$$EM_t^{i,exp} = \frac{\sum_j \sum_{s \in I_t^{ij}} X_t^{Wjs}}{X_t^W}$$

where $EM_t^{i,exp}$ and $IM_t^{i,exp}$ are the extensive and intensive margins of exporter i in year t. X_i^t is the total value of exporter i to the world in year t. I_t^{ij} is the set of products s exported from country i to country j. X_t^{Wjs} is the value of export of product s from the world to country j. $\sum_{s \in I_t^{ij}} X_t^{Wjs}$ is the total value of world export to country j in products that country i exports to country j ($s \in I_t^{ij}$). X_t^W is the total export of all countries. The extensive and intensive margins of exports as measured above are also explained similarly to the case of imports.

The above formulas calculate the extensive and intensive margins across countries in year (t). To compare the extensive and intensive margin of trade across countries and across years (panel data), we have some changes from the above formulas. We can write general formulas for the panel data follows:

$$IM_t^{j,imp} = \frac{M_t^j}{\sum_{i \neq j} \sum_{s \in I_t^{ijs}} M^{iWs}} \tag{3.12}$$

$$EM_t^{j,imp} = \frac{\sum_{i \neq j} \sum_{s \in I_t^{ijs}} M^{iWs}}{M^W} \tag{3.13}$$

where M^{iWs} is the average import value of product s of the world from the country i over T years. The average world import in period T is $M^W = \sum_i \sum_{s \in I^{iW}} M^{iWs}$. These formulas are similar for the case of a country's export.

[5] We can measure exported (imported) varieties as a simple count of categories. However, this simple count assumes that varieties have equal prices and quantities and it gives the same weight to each variety

$EM_t^{j,imp}$, which is calculated by this method, is clearly the extensive margin of import of country j in year t, since the change of EM across time or across countries depends on the number of varieties which this country imports at time t. $IM_t^{j,imp}$ measured as in this case is the intensive margin of import of the country, since its dominator is the world import which is fixed for each products in period T, so the change of IM across time and across countries depends on the import value of that country in year t.

3.4 Data and Results

3.4.1 Data

Our model includes the following explanatory variables: real GDP, real effective exchange rate, trade duties, and trade liberalization. Our main sample includes 36 developing countries with non-missing data from 1970 to 1997 (Table 3.1).

- The extensive (EM) and intensive (IM) margins of imports (exports) are calculated by using the formulas (3.12) and (3.13) for the data on the trade flow of all countries from 1970 to 1997, classified as four-digit SITC. This data is from Feenstra et al. (1997b). The value and the intensive margin of imports and exports are deflated at the constant price of the year 1995.

- The real GDP of countries (at the constant 1995 US$) is from World Development Indicator (2002) (*gdp*95). The world GDP of an exporter is calculated by total GDP of countries subtracting the GDP of the exporter.

- The change in real effective exchange rate (*reer*) is calculated as a geometric weighted average of bilateral real exchange rates between the home country and its trading partners by the following formula:

$$reer_{i,1995}^{t} = \prod_{j} \left(\frac{(E_{ij}CPI_i/CPI_j)_t}{(E_{ij}CPI_i/CPI_j)_{1995}} \right)^{w_{ij}^{t}}$$

where $E_{ij} = \frac{E_{i/us}}{E_{j/us}}$, $E_{i/us}$ is the nominal exchange rate of country i calculated by US dollar per local currency unit from IMF. w_{ij} is the share of country j in country i's total trade with its trading partners. It is calculated from data on trade flow as found in Feenstra et al. (1997b). CPI is consumer price index from the World Development Indicator (2002). An increase of the real effective exchange rate implies an increase in prices of domestic products and a decrease in prices of foreign products. As a result, country i will import more goods from abroad. In the empirical regressions, we will use the $\left(\frac{1}{reer_i^t}\right)$ to represent the real effective exchange rate. This means that the real effective exchange rate in this case has a negative relationship to import and a positive relationship to export in the regression models.

- Export duties (*eduty*, % of exports) and import duties (*iduty*, % of imports) are from the World Development Indicators (2002). Export duties include all levies collected on goods at the point of export. Import duties comprise all levies collected on goods at the point of entry.

- Trade liberalization (*lib*): a dummy variable that indicates the year in which countries reformed their trade policies significantly. The liberalization year of 26 countries in the sample is from Wacziarg and Welch (2008). They use the method of Sachs et al. (1995) to determine the time at which countries perform trade liberalization. According to the method of Sachs et al. (1995), a country is classified as closed (no trade liberalization) if it displayed at least one of the following characteristics: (1) Average tariff rates of 40 percent of more;(2) Nontariff barriers covering 40 percent or more of trade (NTB); (3) A black market exchange rate at least 20 percent lower than the official exchange rate (BMP); (4) A state monopoly on major exports; (5) A socialist economic system. Information on trade liberalization for 9 countries in the rest of the sample[6] is from Greenaway et al. (1997). According to Greenaway et al. (1997), the liberalization year of countries in

[6] Cote d'Ivoire, Indonesia, Korea, Madagascar, Malawi, Malaysia, Pakistan, Thailand, Venezuela

their study is from Dean et al. (1994). Dean et al. (1994) rely on a series of individual measures to identify the commencement of trade liberalization. These include import tariffs, quantitative restrictions, export incentives, and degree of exchange rate misalignment. In these measures, tariff reductions is the principal indicator. The liberalization year of the only country left in the sample (Mauritius) is from Milner and McKay (1996).

3.4.2 Data analysis

In this part, we analyze the relationship between exports, imports, their margins and trade barriers.

Table (C.1) in the Appendix presents the changes of import duties, import value, and margins of imports of developing countries before and after trade liberalization. These results are calculated based on the average values of the above variables before and after trade liberalization episodes. The import duties of some countries go up after a trade liberalization episode. One explanation for this is that these countries removed non-tariff barriers and converted these restrictions into tariffs. In addition, the intensive margin of some countries is decreased, while the extensive margin of import of all countries in the sample is increased after the liberalization. The decrease of the intensive margin of import after the trade liberalization seems to occur in countries that still maintain high import barriers after liberalization.

We use import duties after liberalization to divide countries into three groups: groups with high duties (>=20%), groups with medium duties (duties >=10% but <20%), and group with low duties (<=10%). We observe that the increase of intensive margin is larger than that of extensive margin for groups with medium and low import duties, while the opposite result can be seen in the countries with high import duties (Table (3.2)). Liberalization removes non-tariff barriers or reduces tariff barriers remarkably, so the extensive margin of imports of all countries increases. However, when import duties still remain high after liberalization, importers in countries with high import duties don't increase the amount of products which they were already importing. Consequently,

Table 3.1: Developing countries

	isoc	countryname	region	period	Liberalization year
1	IND	India	1	1974-1997	1994
2	NPL	Nepal	1	1972-1997	1991
3	PAK	Pakistan	1	1973-1997	1988
4	LKA	Sri Lanka	1	1975-1997	1991
5	CMR	Cameroon	2	1975-1997	1993
6	CIV	Cote d'Ivoire	2	1981-1997	1985
7	EGY	Egypt, Arab Rep.	2	1975-1997	1995
8	GMB	Gambia, The	2	1978-1990	1985
9	GHA	Ghana	2	1979-1993	1985
10	KEN	Kenya	2	1977-1997	1993
11	MDG	Madagascar	2	1988-1997	1990
12	MWI	Malawi	2	1980-1990	1988
13	MUS	Mauritius	2	1976-1997	1987
14	MAR	Morocco	2	1975-1997	1984
15	ZAF	South Africa	2	1976-1997	1991
16	TUN	Tunisia	2	1983-1997	1989
17	ARG	Argentina	3	1976-1997	1991
18	BRA	Brazil	3	1981-1997	1991
19	COL	Colombia	3	1971-1997	1991
20	CRI	Costa Rica	3	1977-1997	1986
21	DOM	Dominican Republic	3	1972-1997	1992
22	ECU	Ecuador	3	1976-1994	1991
23	MEX	Mexico	3	1979-1997	1986
24	PRY	Paraguay	3	1972-1993	1989
25	PER	Peru	3	1977-1997	1991
26	URY	Uruguay	3	1979-1997	1990
27	VEN	Venezuela, RB	3	1970-1997	1989
28	IDN	Indonesia	4	1981-1997	1986
29	KOR	Korea, Rep.	4	1976-1997	1987
30	MYS	Malaysia	4	1974-1997	1988
31	PHL	Philippines	4	1977-1997	1988
32	THA	Thailand	4	1975-1997	1989
33	BGR	Bulgaria	5	1988-1997	1991
34	HUN	Hungary	5	1982-1997	1990
35	ROM	Romania	5	1990-1997	1992
36	TUR	Turkey	5	1986-1997	1989

Region 1 is South Asia, region 2 is Africa, region3 is Latin America, region 4 is East Asia, and region 5 is Europe.

Table 3.2: Percentage change of import duties and the margin of imports

Groups	N	Average duties		Percentage change of			
		Before	After	Duty	Import	IM	EM
High duties	8	25.9	23.2	-8.6	25.2	9.7	14.2
Medium duties	12	18.6	14.1	-10.5	97.3	63.0	20.5
Low duties	16	9.5	6.7	-19.7	156.3	113.4	20.0
Total	36	16.2	12.8	-14.2	107.5	73.6	18.8

the intensive margin of import in these countries doesn't increase after liberalization.

In the case of exports, liberalization reduced export duties to virtually nothing for most of the countries (Table C.2 in Appendix). The exports and the margins of exports increase for most of the countries studied after trade liberalization. The exports show an average of 186% increase. The increase of exports is accounted for by similar increases in the extensive and intensive margins of export. These results are different than in the case of imports, where changes can be explained more by the change of the intensive margin.

Figure (3.1) shows the existence of a negative relationship between the percentage change of import duties and the percentage change of intensive margins of import across countries. This means that the greater the decrease in duties in a particular country, the higher the increase in the intensive margin of import. However, we do not observe a clear similar pattern for the relationship between duties and the extensive margin. This result shows that the import barriers have significant effect on the intensive margin of import rather than on the extensive margin of import across countries. The change of the extensive margin of import across countries can depend on other macro factors such as GDP or production technology. The results are similar in the case of exports.

According to the above descriptive statistical analysis, the impact of trade liberalization on the extensive and intensive margins of imports seems to depend on the import duties of a country: for countries with low import duties, liberalization has a significant impact on the intensive margin of imports rather than the extensive margin of imports. The impact is the opposite in countries

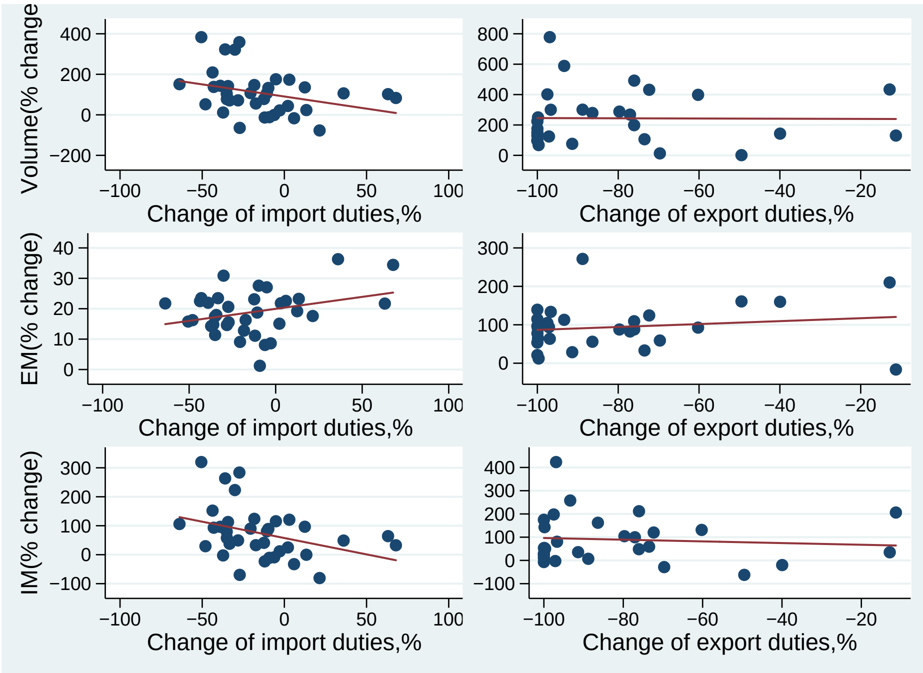

Figure 3.1: The relationship between the percentage change in duties and in imports and export across countries

with high import duties. In the case of exports, however, the effect is quite similar across countries. In sum, trade liberalization has larger effect on the intensive margin than on the extensive margin in the case of imports, while in the case of exports the effect is quite similar for the two margins.

3.4.3 Results of regression models

We use the methods (fixed effects, difference GMM, and system GMM) discussed above to estimate equations (3.3), (3.4), and (3.5) for import activities and equations (3.6), (3.7), and (3.8) for export activities. We have a total of four regressions for each model that includes two fixed-effects, one difference GMM, and one system GMM regressions. In the GMM methods, we assume that all explanatory variables are endogenous since the change in import and export demands of each country across time can affect the change of real GDP, the real exchange rate, tariff barriers, or the time when trade liberalization takes place.

3.4.3.1 Imports

Table (3.3) presents the regression results in the case of imports. The first four columns are the results of import volumes (equation 3.3), the next four columns are the results of the extensive margin of imports (equation 3.4), and the last four columns are the results of the intensive margin of imports (equation 3.5).

In general, the signs and statistical significance of variables in the models are quite consistent across different methods. In the regression results of GMM methods, we present two specification tests as described in our methodology: The first test (Sargan test) examines whether the overidentifying restrictions (the moment conditions) are valid and the second test (AR(1) and AR(2)) examines the first-order serial correlation in disturbances $(u_{i,t})$. As we mention in our methodology, a high p-value of Sargan tests implies that instruments are valid. The results of the Sargan test in system GMM indicate that instruments in system GMM are valid, while the Sargan test rejects this hypothesis in difference GMM method. The results of AR(1) and AR(2) show that the residuals in the first-differenced equations of GMM methods have the first-order serial correlation (low p-value of AR(1)), but not the second-order serial correlation (high p-value of AR(2)), these results imply that residuals in level equation ($u_{i,t}$) don't have the first-order autocorrelation. This shows that estimators in GMM methods seem to be consistent. Since specification tests on the system GMM regression are valid and estimated coefficients in system GMM and corrected fixed-effects methods are relatively consistent, we use the results of these regressions to explain our issues.

The impacts of trade liberalization (dummy variable, *lib*) on imports and the extensive and intensive margins of imports have predicted signs and statistical significance across all cases. Trade liberalization makes the total imports increase by 9.69%, the extensive margin of imports increase by 3.05%, and the intensive margin of imports go up to 8.05% according to the corrected fixed-effects method. This result shows that trade liberalization has more significant impacts on the intensive margin in the case of imports. The results from system GMM method are quite similar to the one of fixed-effects methods.

The results show that the extensive margin of imports insignificantly responds to the adjustments of import duties, while the response of the intensive margin is very significant (from column 5^{th} to column 12^{th} of Table 3.3). The impact of the real effective exchange rate on the extensive and intensive margins of imports has the expected signs but does not have statistical significance. It seems that the intensive margin of imports responds more strongly to the change of the real effective exchange rate.

The above descriptive analysis shows that the response of the extensive and intensive margin to liberalization depends on the levels of import duties. The regression results in Table (3.4) further support these predictions. Liberalization in countries with high import duties causes an extensive margin increase of 2%, while its impact on the intensive margin of imports is not significant. For groups of countries with medium and low import duties, the impact is the opposite. For instance, liberalization accounts for the increase of the intensive margin by 12.5% and for the increase of the extensive margin by 2.19% in the case of countries with low import duties. We use only the correct fixed effects method to estimate the models in this case since this method gives the best estimators in the case of small sample size (Judson and Owen (1999), Bruno (2005)).

So, the impact of import duties and liberalization on the extensive and intensive margins of imports are consistent with our predictions: The extensive margin of imports only responds significantly to broad changes in trade barriers (trade liberalization) but not significantly to moderate reductions of import duties, while the intensive margin of imports responds significantly to both broad and normal changes of import duties.

3.4.3.2 Exports

Similar to what we did in the case of imports, we use three estimation methods (fixed effects, difference GMM, and system GMM) to estimate the export regression equations. Since some countries (i.e., Korea, Venezuela, Romania, Turkey, Hungary, and Bulgaria) have zero export duties in all years, we exclude these countries. As a result, the sample size for our study of exports includes only 29 countries. The results are presented in Table (3.5). In general, the regression results are consistent across different methods. Since the p-value of Sargan tests in difference and system GMM methods are high, this implies that all instruments in difference GMM and system GMM methods are valid. In addition, the serial correlation tests (AR(1) and AR(2)) in the first-differenced equations also show that the residuals in these equations have the first-order serial correlation, but not the second-order serial correlation. These imply that the residuals in level equations $u_{i,t}$ are not the first-order serial correlation. As a result, the estimators of GMM methods seem to be consistent.

The regression results show that trade liberalization only has significant effect on the extensive margin of exports, while its impact on the intensive margin of exports is not significant. When developing countries undertake trade liberalization, essentially removing import barriers, they are more likely to receive preferential treatment from importers. As a result, these countries can export new products or export products to new markets. As we mentioned in the methodology section, the method used to calculate the extensive margin of exports in this paper considers export products to different countries to be different. So, when countries export products to a new market after trade liberalization, the extensive margin of exports of countries increases. Since the intensive

Table 3.3: Extensive and intensive margins of imports and trade barriers of developing countries

	Volumne				Extensive margin				Intensive margin			
VARIABLES	Usual FE	Corrected FE	DGMM	SGMM	Usual FE	Corrected FE	DGMM	SGMM	Usual FE	Corrected FE	DGMM	SGMM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
L.lagdep	0.740***	0.811***	0.739***	0.897***	0.534***	0.600***	0.379***	0.859***	0.748***	0.828***	0.745***	0.887***
	(27.49)	(28.67)	(16.58)	(61.20)	(17.03)	(15.68)	(4.587)	(20.12)	(27.93)	(29.86)	(15.57)	(55.74)
log(GDP)(+)	0.297***	0.197***	0.298***	0.0873***	0.112***	0.0937***	0.201***	0.0174***	0.233***	0.139***	0.234***	0.0818***
	(5.079)	(3.427)	(2.953)	(6.882)	(7.656)	(5.382)	(4.995)	(3.751)	(4.497)	(2.766)	(2.653)	(6.904)
log(RER)(-)	-0.0513*	-0.0367	-0.0489	-0.00807	-0.00859	-0.00705	-0.0222	0.00649	-0.0468	-0.0332	-0.0432	-0.0187
	(-1.649)	(-1.230)	(-0.868)	(-0.356)	(-1.049)	(-0.781)	(-1.625)	(1.026)	(-1.590)	(-1.170)	(-0.824)	(-0.854)
Imp. duties)(-)	-0.00443**	-0.00369*	-0.00423**	-0.00289***	5.92e-05	8.35e-05	0.000277	-0.000322	-0.00418**	-0.00344*	-0.00389**	-0.00267***
	(-2.523)	(-1.778)	(-2.022)	(-3.003)	(0.119)	(0.177)	(0.418)	(-1.077)	(-2.504)	(-1.739)	(-2.068)	(-2.908)
Liberalization(+)	0.110***	0.101***	0.112***	0.0908***	0.0361***	0.0330***	0.0350***	0.0169**	0.0875***	0.0818***	0.0912***	0.0816***
	(4.471)	(3.849)	(3.815)	(4.760)	(4.980)	(3.701)	(3.128)	(2.426)	(3.759)	(3.320)	(3.405)	(4.579)
Constant	-8.933***			-2.723***	-2.984***			-0.454***	-7.183***			-2.651***
	(-5.606)			(-6.157)	(-8.028)			(-3.278)	(-5.112)			(-6.281)
Observations	705	705	667	705	714	714	677	714	705	705	667	705
R-squared	0.832				0.724				0.793			
Number of countries	36	36	36	36	36	36	36	36	36	36	36	36
Number of instruments			667	705			413	524			667	705
Sargan (p_value)			0.000179	0.0729			0.0000	0.370			0.000776	0.0962
AR(1)			0.000122	0.0000			0.00950	0.0321	.		0.000127	0
AR(2)			0.393	0.171			0.231	0.236	.		0.311	0.147

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

GMM and fixed effects regressions for the case of imports
Sargan is a test of the over-identifying restrictions for the GMM estimators. If p value of this test is big, we should accept the null hypothesis (Instruments are valid)
AR(1) and AR(2) are tests of 1^{st} and 2^{nd} order serial correlation in the first-differenced equations. When $u_{i,t}$ disturbances are independently and identically distributed (i.i.d.), the first differenced errors are first-order serially correlated (p value low), but not second-order serially correlated.

Table 3.4: Extensive and intensive margins of imports and trade barriers for groups of countries

	High import duties			Medium import duties			Low import duties		
VARIABLES	Volume	EM	IM	Volume	EM	IM	Volume	EM	IM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
L.lagdep	0.673***	0.658***	0.683***	0.920***	0.681***	0.941***	0.666***	0.541***	0.666***
	(8.231)	(7.678)	(8.333)	(19.15)	(11.04)	(20.65)	(14.89)	(9.811)	(14.66)
log(GDP)(+)	0.316***	0.0690**	0.241**	-0.0148	0.0600**	-0.0303	0.463***	0.113***	0.381***
	(2.662)	(2.146)	(2.361)	(-0.157)	(2.456)	(-0.353)	(4.911)	(4.464)	(4.208)
log(RER)(-)	-0.0114	0.0282	-0.0345	0.0217	-0.00501	0.0262	-0.148***	-0.0131	-0.141***
	(-0.0856)	(0.744)	(-0.274)	(0.553)	(-0.540)	(0.706)	(-2.632)	(-0.744)	(-2.618)
Imp. duties)(-)	-0.00164	0.00135*	-0.00295	-0.00437*	-0.000346	-0.00384	-0.00769	-0.000716	-0.00641
	(-0.631)	(1.806)	(-1.209)	(-1.678)	(-0.562)	(-1.577)	(-1.530)	(-0.380)	(-1.320)
Liberalization(+)	-0.0152	0.0212*	-0.0339	0.0946**	0.0397***	0.0733*	0.163***	0.0267*	0.147***
	(-0.327)	(1.669)	(-0.769)	(2.101)	(3.576)	(1.763)	(4.101)	(1.713)	(3.828)
Observations	141	141	141	253	255	253	311	318	311
Number of countries	8	8	8	12	12	12	16	16	16
R-squared									

z-statistics in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The above table presents regression results for groups of countries through corrected fixed-effects method. According to Bruno (2005), this method gives the best estimators according to bias and root mean squared error criteria when the number of individuals is small.
The average value of import duties after the liberalization period is used to divide countries into three groups: high, medium, and low import duties

margin of exports can depend on trade barriers of importers, the trade liberalization of export countries doesn't have a significant impact on their intensive margin of exports. Through the regression results of the normal fixed-effects method, the impact of liberalization on the extensive margin of exports is 9.68%, while its impact on the intensive margin is negative and not statistically significant. Like the case of imports, the intensive margin of exports significantly responds to the normal adjustments of the export tariffs (*eduty*), while the extensive margin of exports doesn't. In contrast to imports, the impact of the real effective exchange rate on the extensive margin of exports is more significant than the one on the intensive margin of exports.

The above results show that export duties have remarkable effects on the intensive margin, but not on the extensive margin, while the impact of trade liberalization is the opposite. To test whether the export duties have a role on the effect of liberalization on the intensive margin of exports, we exclude the export duties from the regression models. The results of regressions are presented in Table (3.6) for the sample of 36 countries just as they were for imports. The regression results still show that liberalization doesn't have a significant effect on the intensive margin of exports, while its impact on the extensive margin is still remarkable. The impact of the real effective exchange rate on the extensive margin of exports is still more significant than its effect on the intensive margin of exports.

3.4.3.3 Robustness check

The above results are based on our calculated value of the real exchange rate. The World Development Indicator (WDI) from World Bank also has the real effective exchange rate for the countries in its database. However, data concerning the real effective exchange rate in WDI is missing for many developing countries. Therefore, we estimate the real effective exchange rate to use for as many countries as possible.

In this section, we use the change in real effective exchange rate of countries from WDI (relative to 1995 prices) to examine the robustness of our results given above. The real effective exchange rate in WDI is computed as a weighted geometric average of the level of consumer prices in

Table 3.5: Extensive and intensive margins of exports and trade barriers of developing countries

	Volumne				Extensive margin				Intensive margin			
VARIABLES	Usual FE	Corrected FE	DGMM	SGMM	Usual FE	Corrected FE	DGMM	SGMM	Usual FE	Corrected FE	DGMM	SGMM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
L.lagdep	0.732***	0.802***	0.731***	0.989***	0.433***	0.499***	0.427***	0.935***	0.619***	0.689***	0.617***	0.890***
	(26.59)	(21.59)	(26.81)	(135.6)	(11.57)	(11.26)	(11.54)	(61.11)	(18.95)	(16.72)	(18.89)	(40.80)
log(GDP)(+)	0.775***	0.559***	0.779***	0.00487	0.581***	0.501***	0.574***	0.0164	0.732***	0.605***	0.739***	0.160
	(6.083)	(3.873)	(6.297)	(0.0480)	(5.791)	(4.177)	(5.842)	(0.142)	(5.155)	(3.713)	(5.231)	(1.109)
log(RER)(+)	0.0994***	0.0914***	0.101***	0.0437	0.0667*	0.0650**	0.0634*	0.0612	0.0573	0.0491	0.0657	0.0133
	(2.716)	(2.917)	(2.844)	(1.371)	(1.889)	(2.245)	(1.821)	(1.589)	(1.196)	(1.217)	(1.371)	(0.282)
Exp. duties)(-)	-0.00886***	-0.00847***	-0.00865***	-0.00484**	0.00141	0.00142	0.00275	0.00221	-0.0102***	-0.00996**	-0.00989**	-0.00780**
	(-2.998)	(-2.711)	(-2.866)	(-2.025)	(0.495)	(0.483)	(0.940)	(0.789)	(-2.628)	(-2.428)	(-2.427)	(-2.242)
Liberalization(+)	-0.0137	-0.0183	-0.0122	-0.00376	0.0968***	0.0902**	0.0975***	0.0543	-0.0789	-0.0800	-0.0731	-0.00746
	(-0.362)	(-0.469)	(-0.333)	(-0.0974)	(2.643)	(2.449)	(2.706)	(1.187)	(-1.593)	(-1.601)	(-1.479)	(-0.136)
Constant	-25.18***			0.0859	-18.71***			-0.331	-24.12***			-5.362
	(-6.204)			(0.0273)	(-5.986)			(-0.0925)	(-5.398)			(-1.194)
Observations	589	589	558	589	589	589	558	589	589	589	558	589
R-squared	0.874				0.573				0.638			
Number of wb	29	29	29	29	29	29	29	29	29	29	29	29
Number of instruments			558	589			558	386			558	343
Sargan (p_value)			0.107	0.867			0.276	0.152			0.438	0.0972
AR(1)			0	0			0	0	.		0	0
AR(2)			0.548	0.682			0.561	0.950			0.422	0.634

t-statistics in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

GMM and fixed effects regressions for the case of exports
Sargan is a test of the over-identifying restrictions for the GMM estimators. If p value of this test is big, we should accept the null hypothesis (Instruments are valid)
AR(1) and AR(2) are tests of 1^{st} and 2^{nd} order serial correlation. When $u_{i,t}$ disturbances are independently and identically distributed (i.i.d.), the first-differenced errors are first-order serially correlated (low p-value), but not second-order serially correlated (high p-value)

Table 3.6: Extensive and intensive margins of exports and trade barriers of developing countries

	Volumne				Extensive margin				Intensive margin			
VARIABLES	Usual FE	Corrected FE	DGMM	SGMM	Usual FE	Corrected FE	DGMM	SGMM	Usual FE	Corrected FE	DGMM	SGMM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
L.lagdep	0.769***	0.825***	0.736***	0.989***	0.538***	0.588***	0.465***	0.948***	0.703***	0.765***	0.660***	0.912***
	(37.99)	(34.34)	(31.39)	(173.8)	(19.78)	(17.84)	(15.27)	(92.77)	(29.56)	(27.42)	(25.05)	(60.82)
log(GDP)(+)	0.594***	0.464***	0.687***	0.0371	0.503***	0.430***	0.599***	-0.0428	0.465***	0.409***	0.506***	0.151*
	(7.735)	(6.556)	(8.362)	(0.596)	(7.647)	(6.928)	(8.875)	(-0.650)	(5.729)	(6.027)	(6.039)	(1.800)
log(RER)(+)	0.0931***	0.0840***	0.0480	0.0375	0.0642**	0.0636**	0.0522*	0.0302	0.0588	0.0518	0.0259	0.0674*
	(3.168)	(2.825)	(1.549)	(1.484)	(2.331)	(2.238)	(1.817)	(1.127)	(1.556)	(1.322)	(0.634)	(1.854)
Liberalization(+)	0.0267	0.0156	0.0403	0.00291	0.0734***	0.0677***	0.0746***	0.0438	-0.0225	-0.0317	-0.00745	-0.0109
	(0.885)	(0.584)	(1.350)	(0.0952)	(2.612)	(2.751)	(2.667)	(1.359)	(-0.578)	(-0.931)	(-0.188)	(-0.256)
Constant	-19.42***			-0.962	-16.07***			1.384	-15.51***			-4.755*
	(-7.885)			(-0.499)	(-7.810)			(0.680)	(-6.062)			(-1.819)
Observations	850	850	812	850	850	850	812	850	850	850	812	850
R-squared	0.895				0.719				0.667			
Number of countries	36	36	36	36	36	36	36	36	36	36	36	36
Number of instruments			665	720			665	720			665	594
Sargan (p_value)			0.00995	0.726			0.00529	0.975			0.0417	0.302
AR(1)			0	0			0	0			0	0
AR(2)			0.733	0.604			0.671	0.912			0.373	0.409

t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

GMM and fixed effects regressions for the case of exports without the variable of export duties
Sargan is a test of the over-identifying restrictions for the GMM estimators. If p value of this test is big, we should accept the null hypothesis (Instruments are valid)
AR(1) and AR(2) are tests of 1^{st} and 2^{nd} order serial correlation. When $u_{i,t}$ disturbances are independently and identically distributed (i.i.d.), the first-differenced errors are first-order serially correlated (low p-value), but not second-order serially correlated (high p-value).

the home country relative to that in its trade partners. This method for calculating the real effective exchange rate is similar to our method as mentioned above. From the World Development Indicator, we have 20 developing countries for data involving imports (Table (3.7)). The regression results are presented in Table (3.8). In general, the sign and statistical significance of trade liberalization and import duties are still consistent with our predictions: Both the extensive and intensive margins of imports respond significantly to trade liberalization, but only the intensive margin of imports responds significantly to moderate changes in import duties. Except for the results produced by the system GMM method, the effect of the real effective exchange rate has expected signs and its effect on the intensive margin of imports is more significant than the one on the extensive margin of imports.

In the case of exports, since Romania and Venezuela have zero export duties, we only have 18 countries in the sample. The regression results in Table (3.9) show that the extensive margin of exports responds significantly to trade liberalization, but not to the normal change of export duties, while the intensive margin of exports is the opposite. These results are consistent with the ones of the previous data set. The impact of the real effective exchange rate is also consistent with the above results. The real effective exchange rate has a more significant effect on the extensive margin of exports than on the intensive margin of exports. This result also contrasts with the results in the case of imports.

3.5 Conclusion

This paper examined how the extensive and intensive margins of trade respond to change in trade barriers. We studied these issues through the export and import demand functions for developing countries. We use trade flows classified as four-digit SITC and the method of Hummels and Klenow (2002) to measure the extensive and intensive margin of imports (exports). This method assumes that products imported from different countries are different, and products of a country exported to different countries are also different.

Our results show that profound trade policy reforms (liberalization) of developing countries

Table 3.7: Developing countries- Robustness case

	Code	Country name	Region	Lib. Year	Data period
1	CMR	Cameroon	2	1993	1980-1997
2	COL	Colombia	3	1991	1980-1997
3	CRI	Costa Rica	3	1986	1980-1997
4	CIV	Cote d'Ivoire	2	1985	1981-1997
5	DOM	Dominican Republic	3	1992	1980-1997
6	ECU	Ecuador	3	1991	1980-1994
7	GMB	Gambia, The	2	1985	1980-1990
8	GHA	Ghana	2	1985	1980-1993
9	HUN	Hungary	5	1990	1982-1997
10	MWI	Malawi	2	1988	1980-1990
11	MYS	Malaysia	4	1988	1979-1997
12	MAR	Morocco	2	1984	1980-1997
13	PAK	Pakistan	1	1988	1980-1997
14	PRY	Paraguay	3	1991	1980-1993
15	PHL	Philippines	4	1988	1979-1997
16	ROM	Romania	5	1992	1990-1997
17	ZAF	South Africa	2	1991	1979-1997
18	TUN	Tunisia	2	1989	1983-1997
19	URY	Uruguay	3	1990	1980-1997
20	VEN	Venezuela, RB	3	1989	1980-1997

Region 1 is South Asia, region 2 is Africa, region3 is Latin America, region 4 is East Asia, and region 5 is Europe.

Table 3.8: Extensive and intensive margins of imports and trade barriers of developing countries

	Volumne				Extensive margin				Intensive margin			
VARIABLES	Usual FE	Corrected FE	DGMM	SGMM	Usual FE	Corrected FE	DGMM	SGMM	Usual FE	Corrected FE	DGMM	SGMM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
L.lagdep	0.700***	0.790***	0.700***	0.915***	0.328***	0.395***	0.328***	0.603***	0.704***	0.814***	0.704***	0.923***
	(16.06)	(17.07)	(17.70)	(36.79)	(6.736)	(8.790)	(6.768)	(14.39)	(16.57)	(16.49)	(18.57)	(37.18)
log(GDP)(+)	0.528***	0.402***	0.528***	0.0681***	0.0984***	0.0850***	0.0984***	0.0609***	0.507***	0.375***	0.507***	0.0491**
	(4.268)	(3.670)	(4.704)	(2.947)	(3.445)	(3.104)	(3.461)	(8.518)	(4.593)	(3.813)	(5.148)	(2.485)
log(RER)(-)	-0.136**	-0.0962**	-0.136**	0.0387	-0.0199	-0.0192	-0.0199	-0.0154	-0.129**	-0.0773*	-0.129***	0.0555
	(-2.327)	(-2.010)	(-2.564)	(0.982)	(-1.444)	(-1.516)	(-1.451)	(-1.320)	(-2.399)	(-1.697)	(-2.689)	(1.501)
Imp. duties)(-)	-0.00718**	-0.00637**	-0.00718**	-0.00539***	-0.000866	-0.000835	-0.000866	-5.00e-05	-0.00667**	-0.00561*	-0.00667**	-0.00489***
	(-2.181)	(-1.972)	(-2.404)	(-2.901)	(-0.930)	(-0.911)	(-0.934)	(-0.0850)	(-2.200)	(-1.886)	(-2.466)	(-2.827)
Liberalization(+)	0.113***	0.103***	0.113***	0.0967***	0.0510***	0.0470***	0.0510***	0.0387***	0.0835***	0.0778**	0.0835***	0.0848***
	(3.231)	(2.698)	(3.561)	(3.494)	(5.038)	(4.441)	(5.061)	(4.297)	(2.634)	(2.262)	(2.952)	(3.371)
Constant	-14.99***			-1.903**	-2.793***			-1.738***	-14.27***			-1.294*
	(-4.573)			(-2.385)	(-3.966)			(-8.218)	(-4.887)			(-1.847)
Observations	317	317	297	317	317	317	297	317	317	317	297	317
R-squared	0.799				0.517				0.786			
Number of countries	20	20	20	20	20	20	20	20	20	20	20	20
Number of instruments			297	317			297	316			297	281
Sargan (p_value)			0.00710	0.395			0.445	0.822			0.00192	0.249
AR(1)			0	0.0000			0	0.0209			0.0000	0.0000
AR(2)			0.540	0.497			0.0726	0.143			0.706	0.711

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The results in this table are based on the real effective exchange rate from the World Development Indicator.

GMM and fixed effects regressions for the case of imports.

Sargan is a test of the over-identifying restrictions for the GMM estimators. If p value of this test is big, we should accept the null hypothesis (Instruments are valid)

AR(1) and AR(2) are tests of 1^{st} and 2^{nd} order serial correlation. When $u_{i,t}$ disturbances are independently and identically distributed (i.i.d.), the first differenced errors are first-order serially correlated (low p-value), but not second-order serially correlated (high p-value).

Table 3.9: Extensive and intensive margins of exports and trade barriers of developing countries

	Volumne				Extensive margin				Intensive margin			
VARIABLES	Usual FE	Corrected FE	DGMM	SGMM	Usual FE	Corrected FE	DGMM	SGMM	Usual FE	Corrected FE	DGMM	SGMM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
L.lagdep	0.696***	0.786***	0.695***	0.978***	0.427***	0.511***	0.421***	0.934***	0.641***	0.750***	0.645***	0.891***
	(16.32)	(16.98)	(16.22)	(67.08)	(7.406)	(8.791)	(7.711)	(48.43)	(13.78)	(14.26)	(14.26)	(28.66)
log(GDP)(+)	0.843***	0.664***	0.851***	0.0545	0.499***	0.441***	0.523***	0.225*	0.639***	0.503***	0.622***	0.242
	(4.296)	(3.873)	(4.318)	(0.350)	(3.597)	(3.741)	(3.979)	(1.773)	(3.019)	(2.843)	(3.025)	(1.398)
log(RER)(+)	0.0146	0.0168	0.0128	0.0186	0.0958*	0.0880*	0.0966*	0.00611	-0.0508	-0.0397	-0.0458	0.0251
	(0.216)	(0.256)	(0.188)	(0.293)	(1.722)	(1.676)	(1.832)	(0.110)	(-0.624)	(-0.506)	(-0.579)	(0.342)
Exp. duties)(-)	-0.0175***	-0.0168***	-0.0176***	-0.00994**	-0.000403	6.32e-05	-0.000496	0.000345	-0.0174***	-0.0173***	-0.0172***	-0.00806*
	(-4.159)	(-3.876)	(-4.170)	(-2.534)	(-0.118)	(0.0179)	(-0.154)	(0.102)	(-3.491)	(-3.398)	(-3.554)	(-1.797)
Liberalization(+)	-0.0490	-0.0593	-0.0534	0.0125	0.0919*	0.0793*	0.0770*	0.00733	-0.115*	-0.115*	-0.104	-0.0505
	(-0.838)	(-1.054)	(-0.904)	(0.241)	(1.910)	(1.766)	(1.683)	(0.163)	(-1.652)	(-1.672)	(-1.531)	(-0.856)
Constant	-27.86***			-1.642	-16.08***			-6.979*	-21.55***			-7.780
	(-4.444)			(-0.336)	(-3.713)			(-1.765)	(-3.222)			(-1.420)
Observations	289	289	270	289	289	289	270	289	289	289	270	289
R-squared	0.795				0.571				0.569			
Number of countries	18	18	18	18	18	18	18	18	18	18	18	18
Number of instruments			270	276			269	276			270	246
Sargan (p_value)			0.495	0.891			0.133	0.964			0.231	0.444
AR(1)			0	0			0	1.30e-07			0	0
AR(2)			0.227	0.233			0.716	0.756			0.250	0.631

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The results in this table are based on the real effective exchange rate from the World Development Indicator
GMM and fixed effects regressions for the case of exports
Sargan is a test of the over-identifying restrictions for the GMM estimators. If p value of this test is big, we should accept the null hypothesis (Instruments are valid)
AR(1) and AR(2) are tests of 1^{st} and 2^{nd} order serial correlation. When $u_{i,t}$ disturbances are independently and identically distributed (i.i.d.), the first differenced errors are first-order serially correlated (low p-value), but not second-order serially correlated (high p-value).

have a significant impact on the extensive margin of imports and exports of these countries. In addition, this study finds that the yearly adjustment of import and export duties has a significant impact on the intensive margin, but not on the extensive margin. These results seem to be consistent with the results of Kehoe and Ruhl (2009) and the theoretical predictions of Ruhl (2008). However, the effect of the real effective exchange rate on the extensive and intensive margin are inconsistent across the cases of imports and exports. For imports, while real effective exchange rate does not have statistically a significant impact for imports generally, it seems to have a greater impact on the intensive margin of imports. For exports, however, the impact of the real effective exchange rate on the extensive margin of exports is stronger and statistically significant; this is similar to the results shown in Colacelli (2009).

This paper provides evidence that trade liberalization significantly affects the extensive margin of imports and exports of developing countries, while ordinary adjustments of tariffs have unremarkable effects on the extensive margin of imports and exports. These findings suggest several implications for economic policies of developing countries. Since the minimal adjustments of tariffs will not have significant impact on the extensive margin of trade, developing countries should undertake significant reforms in their trade policies to increase the extensive margin of trade and as a result, reduce the loss of social welfare. The results of this paper are consistent with new trade theories which suggest that not all products can be traded when countries participate in international trade and the extensive margin changes significantly during trade liberalization (i.e. Melitz (2003), Ruhl (2008)).

Bibliography

Ahmed, N. (2000) 'Export response to trade liberalization in Bangladesh: a cointegration analysis.' *Applied Economics* 32(8), 1077–1084

Amiti, M. (1998) 'Inter-industry trade in manufactures: Does country size matter?' *Journal of International Economics* 44(2), 231–255

Amurgo-Pacheco, A., and M.D. Pierola (2008) 'Patterns of export diversification in developing countries: intensive and extensive margins.' *World*

Anderson James, E., and E. van Wincoop (2003) 'Gravity with Gravitas: a Solution to the Border Puzzle.' *American Economic Review* 93(1), 170–192

Anderson, TW, and C. Hsiao (1981) 'Estimation of dynamic models with error components.' *Journal of the American Statistical Association* 76(375), 598–606

Ardelean, A., and V. Lugovskyy (2007) 'When are variety gains from trade important? domestic productivity and the cost of protectionism.' *working paper*

Arellano, M., and O. Bover (1995) 'Another look at the instrumental variable estimation of error-components models* 1.' *Journal of econometrics* 68(1), 29–51

Arellano, M., and S. Bond (1991) 'Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations.' *The Review of Economic Studies* 58(2), 277–297

Bahmani-Oskooee, M., and A. Mirzai (2000) 'Real and nominal effective exchange rates for developing countries: 1973: 1-1997: 3.' *Applied Economics* 32(4), 411

Baldwin, R., and V. Di Nino (2006) 'Euros and zeros: The common currency effect on trade in new goods'

Barro, R.J., and J.W. Lee (2001) 'International data on educational attainment: updates and implications.' *Oxford Economic Papers* 53(3), 541–563

Bergin, P., and C.Y. Lin (2008) 'Exchange Rate Regimes and the Extensive Margin of Trade'

Bergoeing, R., and T.J. Kehoe (2003) 'Trade Theory and Trade Facts.' *Federal Reserve Bank of Mineapolis, Research Department Staff Report 284*

Bernard, A., and B. Jensen (2004) 'Why Some Firms Export.' *Review of Economics and Statistics* 86(2), 561

Bernard, A., J. Eaton, J.B. Jenson, and S.S. Kortum (2000) 'Plants and productivity in international trade'

Bernard, A.B., and C.I. Jones (1996a) 'Productivity Across Industries and Countries: Time Series Theory and Evidence.' *The Review of Economics and Statistics* 78(1), 135–146

_ (1996b) 'Productivity and convergence across US States and industries.' *Empirical Economics* 21(1), 113–135

Bernard, A.B., and J. Wagner (2001) 'Export entry and exit by German firms.' *Review of World Economics* 137(1), 105–123

Bernard, A.B., and S.N. Durlauf (1995) 'Convergence in International Output.' *Journal of Applied Econometrics* 10(2), 97–108

Bernard, A.B., J.B. Jensen, and P.K. Schott (2003) 'Falling trade costs, heterogeneous firms, and industry dynamics.' *NBER Working Paper*

Bernard, A.B., J.B. Jensen, S.J. Redding, and P.K. Schott (2007) 'Firms in international trade.' *Journal of Economic Perspectives* 21(3), 105–130

Berthou, A., and L. Fontagne (2008) 'The euro and the intensive and extensive margins of trade: Evidence from french firm level data.' *Working Papers*

Bertola, G., and R. Faini (1990) 'Import demand and non-tariff barriers: the impact of trade liberalization: an application to Morocco.' *Journal of Development Economics* 34(1-2), 269–286

Blundell, R., and S. Bond (1998) 'Initial conditions and moment restrictions in dynamic panel data models.' *Journal of econometrics* 87(1), 115–143

Bond, S.R. (2002) 'Dynamic panel data models: a guide to micro data methods and practice.' *Portuguese Economic Journal* 1(2), 141–162

Boylan, TA, and MP Cuddy (1987) 'Elasticities of import demand and economic development: the Irish experience.' *Journal of Development Economics* 26(2), 301–309

Brainard, S.L. (1997) 'An Empirical Assessment of the Proximity-Concentration Trade-off Between Multinational Sales and Trade.' *The American Economic Review* 87(4), 520–544

Breitung, J. (2000) 'The local power of some unit root tests for panel data.' *Nonstationary Panels, Panel Cointegration, and Dynamic Panels*

Broda, C., and D.E. Weinstein (2006) 'Globalization and the Gains from Variety.' *Quarterly Journal of Economics*

Bruno, G.S.F. (2005) 'Estimation and inference in dynamic unbalanced panel-data models with a small number of individuals.' *Stata Journal* 5(4), 473

Bun, M.J.G., and J.F. Kiviet (2003) 'On the diminishing returns of higher-order terms in asymptotic expansions of bias.' *Economics Letters* 79(2), 145–152

Cameron, A.C., and P.K. Trivedi (2005) *Microeconometrics: methods and applications* (Cambridge Univ Pr)

Chaney, T. (2006) 'Distorted Gravity: Heterogeneous Firms, Market Structure and the Geography of International Trade.' *Manuscript, MIT, January*

_ (2008) 'Distorted gravity: The intensive and extensive margins of international trade.' *The American Economic Review* 98(4), 1707–1721

Chinn, M. (2002) 'Incomes, exchange rates and the US trade deficit, once again.' *UC Santa Cruz: Center for Global, International and Regional Studies. Retrieved from: http://www. escholarship. org/uc/item/0tc442fc*

Choi, I. (2001) 'Unit root tests for panel data.' *Journal of International Money and Finance* 20(2), 249–272

Christodoulopoulou, S. (2010) 'THE Effects of Multilateral Trade Liberalization on the Extensive and the Intensive Margins of Trade.' *MPRA Paper*

Colacelli, M. (2009) 'Intensive and Extensive Margins of Exports and Real Exchange Rates.' *Working Papers*

Davis, D.R. (1998) 'The Home Market, Trade, and Industrial Structure.' *The American Economic Review* 88(5), 1264–1276

Davis, D.R., and D.E. Weinstein (1999) 'Economic geography and regional production structure: An empirical investigation.' *European Economic Review* 43(2), 379–407

_ (2003) 'Market access, economic geography and comparative advantage: an empirical test.' *Journal of International Economics* 59(1), 1–23

Dean, J.M., S. Desai, and J. Riedel (1994) *Trade policy reform in developing countries since 1985: a review of the evidence* (World Bank Publications)

Debaere, P. (2005) 'Monopolistic competition and trade, revisited: testing the model without testing for gravity.' *Journal of International Economics* 66(1), 249–266

Debaere, P., and S. Mostashari (2010) 'Do tariffs matter for the extensive margin of international trade? An empirical analysis.' *Journal of International Economics* 81(2), 163–169

Debaere, P.M., and S. Mostashari (2008) 'Do tariffs matter for the extensive margin of international trade? An empirical analysis'

Dennis, A., and B. Shepherd (2011) 'Trade Facilitation and Export Diversification.' *The World Economy* 34(1), 101–122

Dornbusch, R., S. Fischer, and PA Samuelson (1977) 'Comparative advantage, trade, and payments in a Ricardian model with a continuum of goods.' *The American Economic Review* pp. 823–839

Dutt, P., I. Mihov, and T. Van Zandt (2011) 'Does WTO Matter for the Extensive and the Intensive Margins of Trade?'

Eaton, J., and S. Kortum (2002) 'Technology, geography, and trade.' *Econometrica* pp. 1741–1779

Faini, R., L. Pritchett, and F. Clavijo (1988) *Import demand in developing countries*

Feenstra, R., and H.L. Kee (2004) 'On the measurement of product variety in trade.' *American Economic Review* pp. 145–149

— (2008) 'Export variety and country productivity: estimating the monopolistic competition model with endogenous productivity.' *Journal of International Economics* 74(2), 500–518

Feenstra, R.C. (1994) 'New product varieties and the measurement of international prices.' *The American Economic Review* 84(1), 157–177

Feenstra, R.C., D. Madani, T.H. Yang, and C.Y. Liang (1997a) *Testing Endogenous Growth in South Korea and Taiwan* (National Bureau of Economic Research Cambridge, Mass., USA)

Feenstra, R.C., H.L. Kee, and O.S. Drive (2007) 'Trade liberalisation and export variety: a comparison of Mexico and China.' *The World Economy* 30(1), 5–21

Feenstra, R.C., J. Romalis, and P. Schott (2002) 'US Imports, Exports, and Tariff Data, 1989-2001'

Feenstra, R.C., J.R. Markusen, and A.K. Rose (2001) 'Using the gravity equation to differentiate among alternative theories of trade.' *The Canadian Journal of Economics/Revue canadienne d'Economique* 34(2), 430–447

Feenstra, R.C., R.E. Lipsey, and H.P. Bowen (1997b) 'World trade flows, 1970-1992, with production and tariff data.' *NBER working paper*

Feenstra, R.C., R.E. Lipsey, H. Deng, A.C. Ma, H. Mo, and O.S. Drive (2005) 'World trade flows: 1962-2000.' *NBER working paper*

Felbermayr, G.J., and W. Kohler (2007) 'Does WTO Membership Make a Difference at the Extensive Margin of World Trade?' *Working Papers*

Flam, H., and H. Nordstrom (2006) *Euro effects on the intensive and extensive margins of trade* (CESifo)

Frensch, R. (2010) 'Trade Liberalization and Import Margins.' *Emerging Markets Finance and Trade* 46(3), 4–22

Gaulier, G., C. Hurlin, and P. Jean-Pierre (1999) 'Testing Convergence: A Panel Data Approach.' *Annales déconomie et de statistique* 56, 411–427

Goldstein, M., and M.S. Khan (1985) 'Income and price effects in foreign trade.' *Handbook of international economics* 2, 1041–1105

Greenaway, D., and D. Sapsford (1994) 'What does liberalisation do for exports and growth?' *Review of World Economics* 130(1), 152–174

Greenaway, D., W. Morgan, and P. Wright (1997) 'Trade liberalization and growth in developing countries: Some new evidence.' *World Development* 25(11), 1885–1892

Grubel, H.G., and P.J. Lloyd (1975) *Intra-industry trade: the theory and measurement of international trade in differentiated products* (Halsted Press)

Hadri, K. (2000) 'Testing for stationarity in heterogeneous panel data.' *The Econometrics Journal* 3(2), 148–161

Hanson, G.H., and C. Xiang (2004) 'The Home-Market Effect and Bilateral Trade Patterns.' *The American Economic Review* 94(4), 1108–1129

Harb, N. (2005) 'Import demand in heterogeneous panel setting.' *Applied Economics* 37(20), 2407

Harrigan, J. (1993) 'OECD imports and trade barriers in 1983.' *Journal of International Economics* 35(1-2), 91–111

_ (1996) 'Openness to Trade in Manufactures in the OECD.' *Journal of international economics* 40(1-2), 23–39

Head, K., and J. Ries (2001) 'Increasing Returns versus National Product Differentiation as an Explanation for the Pattern of US-Canada Trade.' *The American Economic Review* 91(4), 858–876

Helpman, E. (1999) 'The structure of foreign trade.' *The journal of economic perspectives* pp. 121–144

Helpman, E., and P.R. Krugman (1985) 'Market structure and foreign trade'

_ (1987) *Market structure and foreign trade: Increasing returns, imperfect competition, and the international economy* (The MIT press)

Helpman, E., M. Melitz, and Y. Rubinstein (2007) 'Trading Partners and Trading Volumes.' *Harvard and Tel Aviv Universities Working Paper*

Helpman, E., M.J. Melitz, and S.R. Yeaple (2004) 'Export Versus FDI with Heterogeneous Firms.' *The American Economic Review* 94(1), 300–316

Helpman, Elhanan (1987) 'Imperfect competition and international trade: Evidence from fourteen industrial countries.' *Journal of the Japanese and International Economies* 1(1), 62–81

Hillberry, R., and C. McDaniel (2003) 'A decomposition of north american trade growth since nafta.' *International Trade*

Holmes, T.J., and J.J. Stevens (2005) 'Does home market size matter for the pattern of trade?' *Journal of International Economics* 65(2), 489–505

Hong, P. 'Import elasticities revisited'

Hummels, D., and J. Levinsohn (1993) 'Product Differentiation as a Source of Comparative Advantage?' *The American Economic Review* 83(2), 445–449

_ (1995) 'Monopolistic Competition and International Trade: Reconsidering the Evidence.' *The Quarterly Journal of Economics* 110(3), 799–836

Hummels, D., and P.J. Klenow (2005) 'The variety and quality of a nation's exports.' *American Economic Review* pp. 704–723

Hummels, D.L. (1999) 'Toward a geography of trade costs.' *Mimeo, University of Chicago*

Hummels, D.L., and P.J. Klenow (2002) 'The variety and Quality of a Nation's Trade.' *NBER Working Paper*

Im, K.S., M.H. Pesaran, and Y. Shin (1997) 'Testing for Unit Roots in Heterogeneous Panels.' *Cambridge: University of Cambridge*

— (2003) 'Testing for unit roots in heterogeneous panels.' *Journal of Econometrics* 115(1), 53–74

Jensen, Paul E (2006) 'Trade, entry barriers, and home market effects.' *Review of International Economics*

John, R. (2007) 'NAFTAs and CUSFTAs Impact on International Trade.' *Review of Economics and Statistics* 89(3), 416–435

Ju, J., Y. Wu, and L. Zeng (2010) 'The Impact of Trade Liberalization on the Trade Balance in Developing Countries.' *IMF Staff Papers* 57(2), 427–449

Judson, R.A., and A.L. Owen (1999) 'Estimating dynamic panel data models: a guide for macroeconomists* 1.' *Economics Letters* 65(1), 9–15

Kehoe, T.J., and K.J. Ruhl (2009) 'How important is the new goods margin in international trade?' *Federal Reserve Bank of Minneapolis Staff Report*

Kehoe, T.J., K.J. Ruhl, and Federal Reserve Bank of Minneapolis. Research Dept (2009) *How important is the new goods margin in international trade?* (Citeseer)

Khan, M.S. (1974) 'Import and export demand in developing countries.' *IMF Staff Papers* 21(3), 678–693

Khan, M.S., and J.D. Ostry (1992) 'Response of the equilibrium real exchange rate to real disturbances in developing countries.' *World Development* 20(9), 1325–1334

Kiviet, J.F. (1995) 'On bias, inconsistency, and efficiency of various estimators in dynamic panel data models* 1.' *Journal of econometrics* 68(1), 53–78

Krugman, P. (1980) 'Scale Economies, Product Differentiation, and the Pattern of Trade.' *The American Economic Review* 70(5), 950–959

Krugman, P.R., R.E. Baldwin, B. Bosworth, and P. Hooper (1987) 'The persistence of the US trade deficit.' *Brookings Papers on Economic Activity* 1987(1), 1–55

Kwiatkowski, D., P.C.B. Phillips, P. Schmidt, and Y. Shin (1992) 'Testing the null hypothesis of stationarity against the alternative of a unit root.' *Journal of Econometrics* 54(1-3), 159–178

Laussel, Didier, and Thierry Paul (2007) 'Trade and the location of industries: Some new results.' *Journal of International Economics* 71(1), 148–166. available at http://ideas.repec.org/a/eee/inecon/v71y2007i1p148-166.html

Lawless, M. (2008) 'Deconstructing Gravity: Trade Costs and Extensive and Intensive Margins.' *Ireland Central Bank Research Technical Paper*

— (2010) 'Deconstructing gravity: trade costs and extensive and intensive margins.' *Canadian Journal of Economics/Revue canadienne d'économique* 43(4), 1149–1172

Lawrence, R.Z., and P. Krugman (1987) 'Imports in Japan: Closed Markets or Minds?' *Brookings Papers on Economic Activity* pp. 517–554

Leamer, E.E. (1986) ‘Cross section estimation of the effects of trade barriers.’ *UCLA Economics Working Papers*

_ (1990) ‘Latin America as a target of trade barriers erected by the major developed countries in 1983.’ *Journal of Development Economics* 32(2), 337–368

Lee, J.W., and P. Swagel (1997) ‘Trade barriers and trade flows across countries and industries.’ *Review of Economics and Statistics* 79(3), 372–382

Levin, A., and C.F. Lin (1993) *Unit Root Tests in Panel Data: New Results* (Department of Economics, University of California)

Levin, A., C.F. Lin, and C.S. James Chu (2002) ‘Unit root tests in panel data: asymptotic and finite-sample properties.’ *Journal of Econometrics* 108(1), 1–24

Liu, X. (2009) ‘GATT/WTO promotes trade strongly: sample selection and model specification.’ *Review of International Economics* 17(3), 428–446

Maddala, GS, and S. Wu (1999) ‘A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test: Evidence From Simulations and the Bootstrap.’ *Oxford Bulletin of Economics and Statistics* 61(63), 1–652

Mah, J.S. (1999) ‘Import demand, liberalization, and economic development.’ *Journal of Policy Modeling* 21(4), 497–503

Mark, R., and J.R. Tybout (1997) ‘The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs.’ *American Economic Review* 87(4), 545–563

Marquez, J., and C. McNeilly (1988) ‘Income and price elasticities for exports of developing countries.’ *The Review of Economics and Statistics* 70(2), 306–314

Melitz, M. (2003) ‘The Impact of Trade on Aggregate Industry Productivity and Intra-Industry Reallocations.’ *Econometrica* 71(6), 1695–1725

Melo, O., and M.G. Vogt (1984) ‘Determinants of the demand for imports of Venezuela.’ *Journal of Development Economics* 14(3), 351–358

Milner, C., and A. McKay (1996) ‘Real exchange rate measures of trade liberalisation: some evidence for mauritius.’ *Journal of African Economies* 5(1), 69

Moulton, B.R. (1990) ‘An illustration of a pitfall in estimating the effects of aggregate variables on micro units.’ *The Review of Economics and Statistics* 72(2), 334–338

Mukerji, P. (2009) ‘Trade Liberalization and the Extensive Margin.’ *Scottish Journal of Political Economy* 56(2), 141–166

Navaretti, G.B., A. Venables, and F. Barry (2004) *Multinational firms in the world economy* (Princeton Univ Pr)

Nicita, A., and M. Olarreaga (2007) ‘Trade, Production, and Protection Database, 1976-2004.’ *The World Bank Economic Review* 21(1), 165

Nur, M., A. Wijeweera, and B. Dollery (2007) 'Estimation of the export demand function using bilateral trade data.' *South Asia Economic Journal* 8(2), 249

Ostry, J.D., and A.K. Rose (1992) 'An empirical evaluation of the macroeconomic effects of tarrifs.' *Journal of International Money and Finance* 11(1), 63–79

Press, S. (2007) 'Stata longitudinal/panel data reference manual release 10'

Rauch, J.E. (1999) 'Networks versus markets in international trade.' *Journal of International Economics* 48(1), 7–35

Ray, E.J. (1981) 'Tariff and nontariff barriers to trade in the United States and abroad.' *The Review of Economics and Statistics* 63(2), 161–168

Reinhart, C.M. (1995) 'Devaluation, relative prices, and international trade: evidence from developing countries.' *Staff Papers-International Monetary Fund* 42(2), 290–312

Rittenberg, Libby (1986) 'Export growth performance of less-developed countries.' *Journal of Development Economics* 24(1), 167–177

Romer, P. (1994) 'New goods, old theory, and the welfare costs of trade restrictions.' *Journal of Development Economics* 43(1), 5–38

Roodman, D. (2009) 'A note on the theme of too many instruments.' *Oxford Bulletin of Economics and Statistics* 71(1), 135–158

Rose, A.K. (1990) 'Exchange rates and the trade balance: some evidence from developing countries.' *Economics Letters* 34(3), 271–275

_ (1991) 'The role of exchange rates in a popular model of international trade: Does the'Marshall-Lerner'condition hold?' *Journal of International Economics* 30(3-4), 301–316

Rose, A.K., and J.L. Yellen (1989) 'Is there a J-curve?' *Journal of Monetary Economics* 24(1), 53–68

Ruhl, K.J. (2008) 'The international elasticity puzzle.' *University of Texas-Austin unpublished manuscript*

Sachs, J.D., A. Warner, and S. Fischer (1995) 'Economic reform and the process of global integration.' *Brookings papers on economic activity* 1995(1), 1–118

Sandrey, R., and D. van Seventer (2004) 'Has the New Zealand/Australian Closer Economic Relationship (CER) Been Trade Widening or Deepening?' TIPS/DPRU/Cornell University Forum

Santos-Paulino, A., and A.P. Thirlwall (2004) 'The impact of trade liberalisation on exports, imports and the balance of payments of developing countries.' *Economic Journal* 114(493), 50–72

Santos-Paulino, A.U. (2002) 'The effects of trade liberalization on imports in selected developing countries.' *World Development* 30(6), 959–974

Schaffer, M.E., and S. Stillman (2006) 'XTOVERID: Stata module to calculate tests of overidentifying restrictions after xtreg, xtivreg, xtivreg2, xthtaylor.' *Statistical Software Components*

Senhadji, A.S., and C.E. Montenegro (1999) 'Time series analysis of export demand equations: a cross-country analysis.' *IMF staff papers* 46(3), 259–273

Shafaeddin, S.M. (1995) 'The impact of trade liberalization on export and GDP growth in least developed countries.' *UNCTAD Review* 1995, 1–6

Syverson, C. (2004) 'Product substitutability and productivity dispersion.' *Review of Economics and Statistics* 86(2), 534–550

Trefler, D. (1993) 'Trade liberalization and the theory of endogenous protection: an econometric study of US import policy.' *The Journal of Political Economy* 101(1), 138–160

Wacziarg, R., and K.H. Welch (2008) 'Trade liberalization and growth: New evidence.' *The World Bank Economic Review* 22(2), 187

Wawro, G. (2002) 'Estimating dynamic panel data models in political science.' *Political Analysis* 10(1), 25

Weder, R. (1995) 'Linking Absolute and Comparative Advantage to Intra-Industry Trade Theory.' *Review of International Economics* 3(3), 342–354

Weiss, J. (1992) 'Export response to trade reform: recent Mexican experience.' *Development Policy Review* 10(1), 43–60

Wu, Y., and L. Zeng (2008) 'The impact of trade liberalization on the trade balance in developing countries.' *IMF Working Paper*

Yoichi, M., and H. Shigeyuki (2009) 'Empirical Analysis of Import Demand Behavior of Least Developed Countries.' *MPRA Paper*

Ziliak, J.P. (1997) 'Efficient estimation with panel data when instruments are predetermined: an empirical comparison of moment-condition estimators.' *Journal of Business & Economic Statistics* 15(4), 419–431

Appendix A

Chapter 1

Assume that the productivity of firms in industry h in country i has the Pareto distribution, then $dG(a) = ka^{k-1}da$. The price index of industry h in country i is

$$\begin{aligned} P_h^i &= \int_0^{n_i^e} p(v)^{1-\sigma} \\ &= n_i \int_0^{a_D^i} p_{ii}(v)^{1-\sigma} dG(a) + n_j \int_0^{a_X^j} p_{ji}(v)^{1-\sigma} dG(a) \\ &= \frac{k}{\alpha^{1-\sigma}(k-\sigma+1)} (n_i (a_D^i)^{k-\sigma+1} + n_j \tau^{1-\sigma} (a_X^j)^{k-\sigma+1}) \end{aligned}$$

We have $x_{ii} = \frac{\beta_h Y_i (p_{ii}(v))^{-\sigma_h}}{\int_0^{n_i^e} p(v)^{1-\sigma_h} dv}$ and $x_{ij} = \frac{\beta_h Y_j (p_{ij}(v))^{-\sigma_h}}{\int_0^{n_j^e} p(v)^{1-\sigma_h} dv}$

A firm with the productivity a_d^i has zero profit in the domestic market and a firm with the productivity a_X^i has zero profit in the exporting market.

$$\pi_d^i = p_{ii}(v) x_{ii}^h(v) - (a_d^i x_{ii}^h(v) + f_d) = 0$$

$$\pi_x^i = p_{ij}(v) x_{ij}^h(v) - (a_x^i \tau x_{ij}^h(v) + f_x) = 0$$

Substituting P_h^i, $x_{ii}(v)$, $x_{ij}(v)$ of country i into above equations:

$$\pi_d^i = \frac{\beta Y_i (k-\sigma+1)(1-\alpha)(a_d^i)^{1-\sigma}}{k(n_i (a_d^i)^{k-\sigma+1} + n_j \tau^{1-\sigma} (a_x^j)^{k-\sigma+1})} - f_d = 0$$

$$\pi_x^i = \frac{\beta Y_j (k-\sigma+1)(1-\alpha)\tau^{1-\sigma}(a_x^i)^{1-\sigma}}{k(n_j (a_d^j)^{k-\sigma+1} + n_i \tau^{1-\sigma} (a_x^i)^{k-\sigma+1})} - f_e = 0$$

It is similar for country j:

$$\pi_d^j = \frac{\beta Y_j(k-\sigma+1)(1-\alpha)(a_d^j)^{1-\sigma}}{k(n_j^h(a_d^j)^{k-\sigma+1} + n_j\tau^{1-\sigma}(a_x^i)^{k-\sigma+1})} - f_d = 0$$

$$\pi_x^j = \frac{\beta Y_i(k-\sigma+1)(1-\alpha)\tau^{1-\sigma}(a_x^j)^{1-\sigma}}{k(n_i(a_d^i)^{k-\sigma+1} + n_j\tau^{1-\sigma}(a_x^j)^{k-\sigma+1})} - f_e = 0$$

From these questions, the following relationships are withdrawn:

$$\frac{a_d^i}{a_x^j} = \tau\left(\frac{f_d}{f_x}\right)^{\frac{1}{1-\sigma_h}} \tag{A.1}$$

$$\frac{a_d^j}{a_x^i} = \tau\left(\frac{f_d}{f_x}\right)^{\frac{1}{1-\sigma_h}} \tag{A.2}$$

We also get the value of a_d^i and a_d^j

$$(a_d^i)^k = \frac{1}{f_d}\frac{(1-\alpha)\beta_h Y_i(k-\sigma+1)}{k\left(n_i + n_j\tau^{-k}\left(\frac{f_d}{f_x}\right)^{\frac{k-\sigma+1}{\sigma-1}}\right)}$$

$$(a_d^j)^k = \frac{1}{f_d}\frac{(1-\alpha)\beta_h Y_j(k-\sigma+1)}{k\left(n_j + n_i\tau^{-k}\left(\frac{f_d}{f_x}\right)^{\frac{k-\sigma+1}{\sigma-1}}\right)}$$

If we call the f_e is the entry cost in country i

$$\int_0^{a_d^i}(p_{ii}(v)x_{ii}(v) - f_d)dG(a) + \int_0^{a_x^i}(p_{ij}(v)x_{ij}(v) - f_x)dG(a) = f_e$$

$$\frac{(1-\alpha)\beta_h Y_i(a_d^i)^{k-\sigma+1}}{n_i(a_d^i)^{k-\sigma+1} + n_j\tau^{1-\sigma}(a_x^j)^{k-\sigma+1}} - f_d(a_d^i)^k +$$

$$+\frac{(1-\alpha)\beta_h Y_j(a_d^i)^{k-\sigma+1}}{n_j(a_d^j)^{k-\sigma+1} + n_i\tau^{1-\sigma}(a_x^i)^{k-\sigma+1}} - f_x(a_x^i)^k = f_e$$

$$\left(\frac{\sigma-1}{k-\sigma+1}\right)(f_d(a_d^i)^k + f_x(a_x^i)^k) = f_e \tag{A.3}$$

It is similar for country j:

$$\left(\frac{\sigma-1}{k-\sigma+1}\right)(f_d(a_d^j)^k + f_x(a_x^j)^k) = f_e$$

From (A.1), (A.2), (A.3), we have the following results

$$a_d^i = a_d^j = a_d$$

$$a_x^i = a_x^j = a_x$$

and

$$B_i = B_j = B$$

$$A_i = A_j = A$$

Appendix B

Chapter 2

B.1 Fixed domestic costs

We use some expense costs in Annual Manufacturing of Survey to represent fixed domestic costs. These costs include:

- costs of electricity
- temporary staff and leased employee expenses
- Costs of software, computers, communication services
- Repair and maintenance services of building and machinery
- Advertising and promotional services
- Purchased professional and technical services
- Taxes and licenses fees

Table B.1: Groups of industries with high and low home market effects

Order	ISOC	Country	Regions	UNIDO Sample
1	CAN	Canada	1	Canada
2	USA	USA	1	
3	AUS	Australia	2	Australia
4	NZL	New Zealand	2	New Zealand
5	HKG	China, Hong Kong SAR		
6	JPN	Japan	3	Japan
7	KOR	Rep. of Korea	3	Rep. of Korea
8	SGP	Singapore		
9	AUT	Austria	4	Austria
10	BEL	Belgium	4	
11	CZE	Czech Rep.	4	
12	DNK	Denmark	4	Denmark
13	FIN	Finland	4	Finland
14	FRA	France	4	
15	DEU	Germany	4	Germany
16	GRC	Greece	4	
17	HUN	Hungary	4	
18	IRL	Ireland	4	
19	ISR	Israel		
20	ITA	Italy	4	
21	NLD	Netherlands	4	
22	NOR	Norway	4	
23	PRT	Portugal	4	Portugal
24	ESP	Spain	4	Spain
25	SWE	Sweden	4	Sweden
26	CHE	Switzerland	4	
27	TUR	Turkey	4	Turkey
28	GBR	United Kingdom	4	United Kingdom

Sample 1 is the main sample of our study (28 countries). In this case, country pairs are chosen from all countries in the sample ($C_{28}^2 = 378$ pairs)
Sample 2 is separated by regions. Region 1: US and Canada, region 2: Australia and New Zealand, region 3: Japan and Korea, and region 4: 19 countries in European Union. Country-pairs are formed from different regions ($1 + 1 + 1 + C_{19}^2 = 174$ pairs)
Unido sample is countries in the sample when UNIDO database is used (C_{14}^2=91 pairs)

Appendix C

Chapter 3

Table C.1: Change of import duties, extensive and intensive margins of imports

			Duties		Change of			
ISOC	Country name	Region	Before	After	Duty	Import	IM	EM
	High duties							
IND	India	1	36.2	23.5	-35.1	104.3	79.5	17.5
CIV	Cote d'Ivoire	2	27.2	24.0	-11.9	-13.0	-23.2	11.1
TUN	Tunisia	2	27.0	19.4	-28.2	71.6	49.4	14.6
PAK	Pakistan	1	24.9	25.4	2.2	43.8	25.0	15.1
GMB	Gambia, The	2	23.6	26.7	13.4	23.6	-0.2	23.2
MWI	Malawi	2	23.5	22.1	-6.2	-0.7	-9.1	8.1
MDG	Madagascar	2	22.6	24.0	5.9	-16.7	-32.7	22.6
CMR	Cameroon	2	22.4	20.4	-9.1	-11.4	-10.9	1.2
	Medium duties							
BRA	Brazil	3	45.5	16.5	-63.8	151.4	106.1	21.8
EGY	Egypt, Arab Rep.	2	25.6	16.1	-37.3	11.5	-2.5	14.3
GHA	Ghana	2	21.1	15.4	-27.2	-64.4	-69.7	15.5
MAR	Morocco	2	19.2	16.8	-12.4	78.3	41.0	23.1
PER	Peru	3	18.8	12.5	-33.3	71.3	37.8	23.5
DOM	Dominican Republic	3	18.7	15.3	-18.3	147.2	123.9	12.8
MUS	Mauritius	2	17.2	16.3	-5.1	175.6	115.5	27.1
KEN	Kenya	2	16.1	12.8	-20.6	107.4	90.0	9.1
PHL	Philippines	4	14.2	14.6	3.0	173.5	120.8	21.8
LKA	Sri Lanka	1	13.2	11.8	-10.6	107.0	80.8	18.7
HUN	Hungary	5	7.5	10.2	36.1	105.9	48.8	36.3
CRI	Costa Rica	3	6.7	10.9	63.1	102.1	64.1	21.7
	Low duties							
ECU	Ecuador	3	16.2	8.4	-48.0	52.1	29.4	16.2
URY	Uruguay	3	15.5	8.7	-43.7	209.2	152.1	22.5
COL	Colombia	3	14.9	8.5	-43.0	137.8	93.1	23.5
NPL	Nepal	1	14.7	9.7	-34.3	142.1	112.9	17.9
THA	Thailand	4	12.8	9.3	-27.4	358.7	283.8	20.6
ARG	Argentina	3	10.1	9.1	-9.8	132.7	88.8	27.6
VEN	Venezuela, RB	3	10.1	9.8	-2.8	21.8	11.7	8.6
KOR	Korea, Rep.	4	8.7	6.1	-30.1	321.9	223.3	30.9
MYS	Malaysia	4	8.7	4.3	-50.5	383.4	319.9	15.8
PRY	Paraguay	3	8.6	5.5	-36.0	323.0	263.5	14.8
MEX	Mexico	3	8.1	4.9	-39.0	143.5	96.3	22.0
TUR	Turkey	5	6.3	4.1	-35.0	77.5	57.9	11.4
ZAF	South Africa	2	5.5	4.6	-17.3	55.9	32.8	16.3
IDN	Indonesia	4	4.1	4.7	12.5	135.6	96.6	19.2
BGR	Bulgaria	5	3.6	4.4	21.4	-77.0	-80.7	17.6
ROM	Romania	5	3.4	5.7	67.9	83.4	32.5	34.4
	All countries					107.5	73.6	18.8

Region 1 is South Asia, region 2 is Africa, region3 is Latin America, region 4 is East Asia, and region 5 is Europe.

Table C.2: Change of export duties, extensive and intensive margins of exports

			Duties		Change of			
isoc	countryname	Region	Before	After	Duty	Imports	EM	IM
IND	India	1	1.2	0.2	-86.4	241.3	145.9	47.7
NPL	Nepal	1	3.0	1.1	-61.5	398.5	131.3	93.3
PAK	Pakistan	1	4.6	0.0	-100.0	200.4	158.5	18.9
LKA	Sri Lanka	1	12.9	0.3	-97.5	294.6	154.4	72.4
CMR	Cameroon	2	3.8	3.3	-11.3	107.5	170.6	-15.0
CIV	Cote d'Ivoire	2	6.7	7.3	8.4	9.7	-39.0	79.1
EGY	Egypt, Arab Rep.	2	2.3	0.0	-100.0	128.9	33.6	72.5
GMB	Gambia, The	2	4.7	1.1	-76.0	141.7	57.1	81.8
GHA	Ghana	2	27.8	14.0	-49.5	-23.0	-66.2	114.8
KEN	Kenya	2	1.3	0.0	-99.9	110.9	61.1	66.1
MDG	Madagascar	2	6.0	3.0	-49.0	24.6	-9.0	33.3
MWI	Malawi	2	0.5	0.0	-100.0	-13.0	-57.4	99.0
MUS	Mauritius	2	7.4	2.1	-72.3	283.0	100.0	73.8
MAR	Morocco	2	2.1	0.5	-77.1	225.2	76.2	82.6
ZAF	South Africa	2	0.2	0.0	-100.0	84.9	31.8	43.5
TUN	Tunisia	2	1.2	0.2	-79.7	215.7	106.1	53.8
ARG	Argentina	3	5.8	0.8	-87.1	65.7	22.3	33.5
BRA	Brazil	3	1.9	0.0	-99.7	75.0	56.2	13.2
COL	Colombia	3	4.5	0.1	-96.7	286.3	76.1	128.7
CRI	Costa Rica	3	7.5	4.5	-39.9	104.0	1.1	95.0
DOM	Dominican Republic	3	5.3	0.0	-99.8	226.0	137.2	54.8
ECU	Ecuador	3	1.6	0.2	-88.8	156.4	-16.7	201.1
MEX	Mexico	3	2.0	0.1	-96.9	506.2	307.8	40.4
PRY	Paraguay	3	0.6	0.0	-100.0	91.3	32.7	68.7
PER	Peru	3	5.4	0.2	-97.1	103.5	26.1	54.3
URY	Uruguay	3	0.9	0.2	-73.5	63.8	47.5	12.2
IDN	Indonesia	4	0.6	0.5	-12.8	473.3	149.7	121.2
MYS	Malaysia	4	6.9	1.7	-76.0	419.6	207.9	66.9
PHL	Philippines	4	1.2	0.0	-100.0	111.7	40.6	48.6
THA	Thailand	4	2.3	0.2	-93.4	452.1	203.2	91.7
	All countries				**-77.1**	**185.5**	**78.2**	**68.3**

Region 1 is South Asia, region 2 is Africa, region3 is Latin America, region 4 is East Asia, and region 5 is Europe.