AN ABSTRACT OF THE DISSERTATION OF

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Firms' participation in exporting or foreign direct investment is an extremely rare behavior: only 4 percent of over 5.5 million U.S. firms were exporters in 2000. Exporters are generally larger (e.g. output and employment) and more productive than firms serving only domestic markets. Such heterogeneity within a narrowly defined industry cannot be fully explained by either comparative advantage arguments or the presence of scale economies and consumers' love of variety. Recent studies of heterogeneous firms show that a reduction in trade costs, i.e. policy, geographic and institutional barriers, has two effects within an industry previously not recognized in trade literature: (i) exit of low productivity firms, and (ii) resource reallocation in favor of high productivity firms. These two effects combine to raise an industry's average productivity and overall welfare, but can adversely affect some regions of an economy with firm closures or job losses.

The objective of this dissertation is to examine the effects of trade costs on firm entry, exit, and employment at a regional level in the United States. For this

purpose, industry-specific trade costs by U.S. regions are derived and their underlying sources are examined. The chosen trade-costs measure, based on the gravity equation, captures the variation over time in trade fictions among countries. Data from the Census Bureau and the World Bank are employed to quantify trade costs by U.S. industries and regions. Results show that a single measure of trade costs for the United States does not adequately represent the large number of and diverse regions through which trade in agriculture and manufacturing occurs. Moreover, geographic factors appear to be relatively more important than policy barriers in explaining the level of trade costs faced by U.S. regions.

Drawing on recent heterogeneous firms models, this dissertation specifies an empirical framework to examine: (i) firm entry or exit arising from changes in trade costs, i.e. extensive margin, and (ii) changes in employment of surviving firms creation arising from changes in trade costs, i.e. intensive margin. These two hypotheses are tested using regional business dynamics data from the Census Bureau and trade cost measures derived earlier. Results show that trade cost changes affect firm exit and employment as hypothesized. That is, lowering trade costs increases the likelihood of firm exit, presumably of the low-productivity ones. Thus, trade costs, by way of the extensive margin, affect an industry's average productivity. Similarly, trade costs appear to affect the employment of surviving firms suggesting that the intensive margin also operates to improve average productivity of an industry, such as through resource reallocation towards high-productivity firms.

The intra-industry reallocation of resources to high productivity firms is an important source of gains from trade to the whole economy. Nonetheless, some regions face firm exit and job losses. In assessing the gains from trade, attention must be paid to the distributional consequences of resource reallocation within an industry as well as a country.

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Qian Wu, Author

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CONTRIBUTION OF AUTHORS

Dr. Munisamy Gopinath was involved with the design, analysis, and writing of every chapter.

Dr. Jeffrey Reimer was involved with in the analysis and writing of Chapter 2 and Chapter 3.

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CHAPTER 1

1. INTRODUCTION AND OVERVIEW

Globalization is increasingly integrating economies, yet not every component of most nations' economies is participating. At the firm level, export participation and overseas sales remain highly concentrated: only 4 percent of over 5.5 million U.S. firms were exporters in 2000. Exporters are generally larger (e.g. output and employment) and more productive than firms serving only domestic markets (Bernard *et al.*, 1995; Clerides *et al.*, 1998; Aw *et al.*, 2000). Such heterogeneity within a narrowly defined industry cannot be fully explained by either comparative advantage arguments or the presence of scale economies and consumers' love of variety (Krugman, 1980). In a seminal article, Melitz (2003) models an industry characterized by firm heterogeneity arising from productivity differentials among firms. In such an industry, Melitz (2003) shows that trade liberalization has two important effects: (i) increases in average industry productivity, and (ii) resource reallocation in favor of high productivity firms. Further extending the heterogeneous firms model, Melitz and Ottaviano (2008) derive the spatial pattern of firm entry, exit and survival within a country with specific attention to the effects of declining international trade costs, i.e. trade and geographic barriers, and regional competition. The examination of trade-cost induced spatial reorganization of resources is important for a better understanding of globalization's effects on regional economic development.

The objective of this dissertation is to examine the effects of trade costs on firm entry, exit, and employment at a regional level in the United States. For this purpose, Chapters 2 and 3 derive a measure of industry-specific trade costs by U.S. regions and examine its sources, respectively. The chosen trade-costs measure is based on the micro-founded gravity equation from a general equilibrium framework (Anderson and van Wincoop, 2003). It not only captures the variation over time in trade fictions among countries, but also allows for further examination of their underlying sources: policy, geographical and institutional factors. Data from the Census Bureau's U.S. *Exports of Merchandise* and *U.S. Imports of Merchandise* and *WISERTrade* database are employed to quantify trade costs by U.S. regions. These two chapters show that a single measure of trade costs may not adequately represent the large number of and diverse regions through which trade in agriculture and manufacturing occurs. Moreover, geographic factors appear to be important than policy barriers in explaining the level of trade costs faced by U.S. regions.

Chapter 4 lays out a conceptual framework to examine the effect of trade costs, computed in Chapters 2 and 3, on firm entry, exit and employment patterns. This framework draws on Melitz (2003) and Melitz and Ottaviano (2008) to specify an empirical framework in Chapter 5 for examining: (i) firm entry or exit arising from changes in trade costs, i.e. extensive margin, and (ii) changes in employment of surviving firms arising from changes in trade costs, i.e. intensive margin. Chapter 5 also shows how these two hypotheses are tested using regional business dynamics data from the Census Bureau and corresponding trade cost measures. Results show that trade cost changes affect firm entry, exit and employment as hypothesized. That is, lowering trade costs increases the likelihood of firm exit, presumably of the low-productivity ones. Thus, trade costs, by way of the extensive margin, affect an industry's average productivity. Similarly, trade costs appear to affect the employment of surviving firms suggesting that the intensive margin also operates to improve average productivity of an industry, such as through resource reallocation towards high-productivity firms.

This thesis is organized in eight additional chapters after the introduction. In Chapter 2, bilateral trade costs at the region level are derived. In addition, Chapter 2 illustrates the variation over 1998-2009 in trade frictions among three-digit NAICS industries, major U.S. customs districts, and major U.S. trade partners. Chapter 3 examines the underlying sources of bilateral trade costs. Chapter 4 illustrates the conceptual framework of intra-industry extensive margin and intensive margin in the presence of heterogeneous firms. Chapter 5 presents available data for examining the extensive and intensive margin changes at the U.S. state level. The estimation framework and results on trade cost effects on these two margins, controlling for market size and other related factors, are discussed in Chapter 6 and 7, respectively. A discussion of welfare effects of trade reform and the contribution of this dissertation is made in Chapter 8. Summary and conclusions are provided in Chapter 9.

CHAPTER 2

2. MEASURING BILATERAL TRADE COSTS OF U.S. REGIONS

Over the past few decades, globalization has changed the costs of exchanging goods and services among nations. In some industries, lower trade costs arise from either declining tariffs and related policy barriers or falling transportation, communication and information costs. For instance, Hummels (2007) finds that declining international transportation costs led to a rapid growth in global manufacturing trade in the last few decades. In contrast, other industries may experience increasing trade costs due to a variety of reasons, e.g. regulatory or tariff policy changes. For example, following the 2001 terrorist attacks on the United States, substantial security and other regulations have likely raised the cost of trading for the United States and its trade partners (Peterson and Treat, 2008). Moreover, changes in trade costs may vary by partner country and port of entry. For example, the Economist (2004) notes that several U.S. ports face considerable infrastructural problems. Measuring trade costs and the effect of their changes on resource reallocation across and within countries is receiving significant research attention due to their implications for economic growth and development (Baier and Bergstrand, 2001; Anderson and van Wincoop, 2004; Bernard *et al.*, 2006; Jacks *et al.*, 2011).

Previous research has measured trade costs directly from data on tariffs and freight rates (Bernard *et al.*, 2006; Hummels, 2007; Blonigen and Wilson, 2008). For instance, Bernard *et al.* (2006) construct U.S. industry-level trade costs, which are equal to the sum of costs associated with ad valorem duty and ad valorem freight and insurance. The former is measured by the ratio of collected duties over the free-on-board (*fob*) customs value of import, and the latter is measured by the difference between cost-insurance-freight (*cif*) value and *fob* value relative to the *fob* value. Unlike aggregate policy-based barriers, the above measure of trade costs accounts for heterogeneity among industries. However, data constraints continue to hamper the measurement of trade costs at the industry level (Chen and Novy, 2009). For example, Bernard *et al.* (2006) measure only import trade costs since comparable data on the export side remain elusive. Additionally, previous measures are constrained in accounting for institutional factors, e.g. customs regulations or port operations/efficiency, which affect trade costs (Hausman *et al.*, 2005; Blonigen and Wilson, 2008). Thus, the lack of time series data on applied tariffs as well as systematic cross-country information on logistics limits direct measurement of trade cost levels and changes. Such measures are almost always incomplete.

This study focuses on measuring region-level trade costs faced by U.S. agricultural and manufacturing industries using an indirect approach. Trade costs here refer to all factors limiting the movement of goods and services across countries, including handling and transportation costs, tariffs and other barriers (Eaton and Kortum, 2002; Bernard *et al.*, 2006). To overcome the data constraints noted earlier, the gravity approach of Jacks *et al.* (2011) is applied here to measure trade costs for U.S. industries and regions (Anderson and van Wincoop, 2003; Head and Ries, 2001;

Chen and Novy 2009). Anderson and van Wincoop (2003) show that trade flows depend on not only bilateral trade frictions but also on average trade barriers with other countries, i.e. multilateral resistance. Chen and Novy (2009) provide an analytical solution to multilateral resistance which allows for the derivation of bilateral trade frictions or costs relative to domestic trade costs from a parsimonious gravity specification. Furthermore, this approach captures the variation over time in bilateral trade costs and allows for an examination of their sources: policy, geographic, and institutional factors.

In the case of the United States, a national measure of trade costs does not adequately account for the large number of and diverse regions through which trade in agriculture and manufacturing occurs. The United States reports 42 customs districts for export and import of goods, with many in the mid-west, e.g. Minneapolis, St. Louis (Foreign Trade Statistics, U.S. Census Bureau). For instance, trade costs with Canada can be much lower relative to Mexico for the state of Washington, while the opposite scenario may arise for Texas or Arizona. Hence, this study applies the gravity framework for measuring trade costs to a regional setting for both agricultural and manufacturing industries. Moreover, the sources of trade costs -policy, geographic, and institutional factors- are examined. As de Groot *et al.* (2004) note, institutional variation is an important element of informal barriers to trade that has a significant, positive, and substantial influence on bilateral trade volumes. For the determinants of trade costs, this study first considers variables commonly used in the gravity literature including geographic proximity (distance between trading partners, common borders), trade policy (tariffs), and institutional factors (common language). In addition, the effect of port logistics on trade costs, which has received limited attention in the empirical trade literature, is examined. The few studies that focus on logistics explore its relationship to trade volumes, e.g. Hausman *et al.* (2005) report significant and positive effects of port logistics performance on global bilateral trade (Nordas *et al*., 2004; Djankov *et al.*, 2006).

2.1 Conceptual Framework

The basic framework to measure trade costs is Anderson and van Wincoop's (2003) general equilibrium framework for a micro-founded gravity equation. Here, bilateral trade volume is specified as a function of trade barriers (geographic and policy) after controlling for both countries' size (Feenstra *et al.*, 2001). In this study, the above framework is extended to a country with multiple regions as follows. First, the range of all consumers and products in the world is assumed to be in the continuum [0, 1], while there are a finite number of regions. Second, each region i is endowed with the range of differentiated varieties $[n_{i-1}, n_i]$, and each variety is produced by a single firm. Within the product range, $[n_{i-1}, n_{i-1}+s_i(n_i-n_{i-1})]$ is tradable and the rest is non-tradable across countries and regions, where s_i denotes the exogenous fraction of tradable goods.

Based on the constant elasticity of substitution (CES) preference, a Dixit-Stiglitz composite consumption index of region *j* is specified as:

$$(2.1) \qquad C_j \equiv \left(\sum_i \int_{n_{i-1}}^{n_{i-1}+s_i(n_i-n_{i-1})} \left(c_{jk}\right)^{\frac{\sigma-1}{\sigma}} dk \right) + \int_{n_{j-1}+s_j(n_j-n_{j-1})}^{n_j} \left(c_{jk}\right)^{\frac{\sigma-1}{\sigma}} dk$$

where σ denotes the elasticity of substitution between all goods; *k* denotes variety; c_{jk} represents the per capita consumption of variety *k* in region *j*. The total consumption of a representative resident in region *j*, C_j, includes tradable goods from all countries (bracketed term in equation (2.1)) and non-tradable goods from his/her own region.

The budget constraint for each individual in region *j* is as follows:

$$(2.2) \qquad P_j C_j = w_j,$$

where w_j denotes the nominal income per capita at region *j*; and P_j represents a consumption-based price index defined by:

$$(2.3) \quad P_j \equiv \left(\left[\sum_i \int_{n_{i-1}}^{n_{i-1}+s_i(n_i-n_{i-1})} \left(q_{jk}\right)^{1-\sigma} dk \right] + \int_{n_{j-1}+s_j(n_j-n_{j-1})}^{n_j} \left(q_{jk}\right)^{1-\sigma} dk \right)^{\frac{1}{1-\sigma}},$$

where q_{jk} is the price of region *i* goods faced by region *j* consumers. With *q* as the price faced by consumers and *p* as the exporter supply price, the following relationships hold:

$$(2.4) \qquad q_{jk} = p_{ik} t_{ij} \quad \text{where } k \in (n_{i-1}, n_{i-1} + s_i(n_i - n_{i-1})),$$

$$(2.5) \qquad q_{jk} = p_{jk} t_{jj} \quad \text{where } k \in (n_{j-1} + s_j(n_j - n_{j-1}), n_j),$$

where t_{ij} measures trade costs between regions i and j and t_{jj} measures domestic trade costs within region j.

Maximizing the per capita consumption index (2.1) subject to the budget constraint (2.2) yields the nominal individual demand of product k at region j, x_{jk}, as follows:

$$x_{jk} = \left(\frac{q_{jk}}{P_j}\right)^{1-\sigma} w_j = \left(\frac{p_{ik}t_{ij}}{P_j}\right)^{1-\sigma} w_j. \tag{2.6}$$

In the general equilibrium system, the market clearing conditions require that total income equal total consumption for each region:

$$\begin{aligned} y_i &= \left(\sum_j \left(n_j - n_{j-1}\right)\int_{n_{i-1}}^{n_{i-1}+s_i(n_i-n_{i-1})} \left(x_{jk}\right) dk\right) + \left(n_i - n_{i-1}\right)\int_{n_{i-1}+s_i(n_i-n_{i-1})}^{n_i} \left(x_{ik}\right) dk \\ &= \left(\sum_{j\neq i} \left(n_j - n_{j-1}\right)\int_{n_{i-1}}^{n_{i-1}+s_i(n_i-n_{i-1})} \left[\left(\frac{p_{ik}t_{ij}}{P_j}\right)^{1-\sigma} w_j\right] dk\right) \\ &\quad + \left(n_i - n_{i-1}\right)\int_{n_{i-1}}^{n_i} \left[\left(\frac{p_{ik}t_{ii}}{P_i}\right)^{1-\sigma} w_i\right] dk. \end{aligned} \tag{2.7}$$

Furthermore, region i's total income y_i has two parts: sum of nominal consumption by other regions ($\sum_{j\neq i} z_{ij}$), and the total nominal consumption by local residents (z_{ii}) as follows:

$$y_i = \sum_{j\neq i} z_{ij} + z_{ii}, \tag{2.8}$$

Following Deardorff (1998), z_{ij} and z_{ii} are solved for in the general equilibrium structure of the gravity model. For this purpose, supply price p_{ik} is normalized to one. Then, (2.9) $$z_{ij} = \frac{y_i y_j}{y_w}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma},$$

(2.10) $$z_{ii} = \frac{y_i y_i}{y_w}\left(\frac{t_{ii}}{\Pi_i P_i}\right)^{1-\sigma},$$

where y_i, y_j, y_w representative the total income of region *i*, region *j*, and total world as follows:

(2.11) $$y_i = (n_i - n_{i-1})\, w_i$$

(2.12) $$y_j = (n_j - n_{j-1})\, w_j$$

(2.13) $$y_w = \sum_i (n_i - n_{i-1})\, w_i$$

Furthermore, in Anderson and van Wincoop's (2003) terms, Π_i and P_j represents outward and inward multilateral resistance defined by

(2.14) $$\Pi_i = \left\{ \sum_{j \neq i} \left[s_i \left(\frac{t_{ij}}{P_j}\right)^{1-\sigma} \frac{y_j}{y_w} \right] + \left(\frac{t_{ii}}{P_i}\right)^{1-\sigma} \frac{y_i}{y_w} \right\}^{1/(1-\sigma)}$$

and

(2.15) $$\mathrm{P}_j = \left\{ \sum_{i \neq j} \left[s_j \left(\frac{t_{ij}}{\Pi_i}\right)^{1-\sigma} \frac{y_i}{y_w} \right] + \left(\frac{t_{jj}}{\Pi_j}\right)^{1-\sigma} \frac{y_j}{y_w} \right\}^{1/(1-\sigma)},$$

where Π_i is an index of trade costs (t_{ij}'s) that origin *i* faces on its exporting goods shipping to all other regions (outward multilateral resistance). Likewise P_j, consumer price index, is also an index of trade costs (t_{ij}'s) that destination *j* faces on importing goods shipped from all other regions (inward multilateral resistance). Hence, t_{ij} represents bilateral resistance, while $\Pi_i P_j$ represents multilateral resistance, and the ratio of t_{ij} and $\Pi_i P_j$ can measure the relative multilateral resistance.

In empirical applications, appropriate proxies for multilateral resistance variables have eluded previous research, e.g. some studies use country fixed effects. However, Jacks *et al.* (2011) provide a solution to $\Pi_i P_j$ that allows for empirical application of equations (2.9) and (2.10). First, z_{ji} and z_{jj} are derived as follows:

$$z_{ji} = \frac{y_i y_j}{y_w}\left(\frac{t_{ij}}{\Pi_j P_i}\right)^{1-\sigma}, \tag{2.16}$$

$$z_{jj} = \frac{y_j y_j}{y_w}\left(\frac{t_{jj}}{\Pi_j P_j}\right)^{1-\sigma}. \tag{2.17}$$

Then,

$$\frac{z_{ij} z_{ji}}{z_{ii} z_{jj}} = \left(\frac{t_{ij} t_{ji}}{t_{ii} t_{jj}}\right)^{1-\sigma}, \tag{2.18}$$

where the right hand side contains the product of relative trade costs between region *i* and *j*. Trade costs is then defined as the geometric average of two trade cost ratios, which captures the bilateral trade costs relative to domestic trade costs:

$$\tau_{ij} \equiv \left(\frac{t_{ij} t_{ji}}{t_{ii} t_{jj}}\right)^{\frac{1}{2}}. \tag{2.19}$$

In addition, substituting (2.18) into (2.19), yields

$$\tau_{ij} = \left(\frac{z_{ii} z_{jj}}{z_{ij} z_{ji}}\right)^{\frac{1}{2(\sigma-1)}} = \left(\frac{\left(y_i - \sum_{j\neq i} z_{ij}\right)\left(y_j - \sum_{i\neq j} z_{ji}\right)}{z_{ij} z_{ji}}\right)^{\frac{1}{2(\sigma-1)}}, \tag{2.20}$$

where σ is the elasticity of substitution, which is greater than unity. This study employs equation (2.20) to measure U.S. region-level relative bilateral trade costs, broadly defined to include policy, geographic, and institutional factors limiting trade. Intuitively, as the bilateral trade volume between each trade pair increases, controlling for international trade (multilateral resistance), trade frictions are expected to be lower and vice versa. The difference between the total output and total export is interpreted as 'market potential,' which is the potentially tradable output of a region but not yet traded (Coughlin and Novy 2009). When the market potential of region *i* ($OUTPUT_i$-EXP_i) increases with all else equal – which means that the given region absorbs more goods domestically without simultaneously demanding more goods from other countries – trade costs increase as well.

2.2 Trade Costs during 1998-2009

This section first details data used in measuring bilateral trade costs for each major U.S. customs district with each trading partner as in equation (2.20), but extended in two additional dimensions: industry (each three-digit North American Industrial Classification System, NAICS) and time (1998-2009). That is, the trade-costs measure is indexed by: importer (*i/j*), exporter (*j/i*), industry (*s*) and time (*t*). Then, using trade volume as weight, this study examines how trade costs vary during 1998-2009 for each three-digit NAICS industry, each major U.S. customs district and each U.S. trade partner.

2.2.1 Data Description:

For computing trade costs, this study considers 38 major U.S. customs districts located in the contiguous United States, 72 countries and 25 three-digit NAICS level industries during 1998-2009[1]. There are 1426 region-country pairs in total. Equation (2.20) can be rewritten with *y* and *z* referring to total values of output (*OUTPUT*) and exports (*EXP*), respectively, as follows:

$$(2.21) \quad \tau_{ijst} = \left(\frac{\left(OUTPUT_{ist} - EXP_{ist}\right)\left(OUTPUT_{jst} - EXP_{jst}\right)}{EXP_{ijst} IMP_{ijst}} \right)^{\frac{1}{2(\sigma_s - 1)}}$$

where *i* denotes each major U.S. district; *j* denotes foreign countries that are trade partners of district *i*; *s* denotes three-digit NAICS industries; *t* denotes time. For σ_i, this study employs estimates of elasticities for each four-digit NACE rev.1 industry from Chen and Novy (2009). Using the concordance file between four-digit NACE rev.1 and three-digit NAICS industries, the corresponding elasticity of substitution for each three-digit NAICS industry is identified.

Two alternative databases are used to obtain bilateral trade data, denominated in U.S. dollars, between major U.S. district *i* and foreign country *j*. The primary sources are the *U.S. Exports of Merchandise* and *U.S. Imports of Merchandise* from the Foreign Trade Statistics of U.S. Census Bureau. The former database characterizes the current value of commodities identified by the ten-digit Harmonized System (HS) Schedule B Classification from a U.S. customs district (*i*) to each final destination (*j*). The import database provides the value of commodities from the origin to both the entry point and port of unloading. Both databases incorporate the concordance files between ten-digit HS code and six-digit NAICS or five-digit SITC code. According to the concordance files, each ten-digit HS commodity can be mapped into a six-digit NAICS code. Summing up the import and export values from six-digit to three-digit NAICS level, this study derives bilateral trade flows for each trade partner during 1998-2009. A second source of bilateral trade data by U.S. regions or states is the *WISERTrade* database, where the state of origin of movement and state of ultimate destination are recorded (U.S. Census Bureau, Foreign Trade). However, import by state and industry is available for only 2008 and 2009. Hence, we employ the *WISERTrade* data to perform sensitivity analysis of trade costs measured using data from the *U.S. Exports of Merchandise* and *U.S. Imports of Merchandise*.

The numerator of equation (2.21) requires the total output data at the three-digit NAICS industry level for both U.S. regions and their trade partners. For the 72 trade partners, the Industrial Demand-Supply Balance (IDSB) database of United Nations Industrial Development Organization (UNIDO) is the source of output data, dominated in U.S. dollars, at the four-digit ISIC level. Using the concordance files from the U.S. Census Bureau, data from IDSB database are mapped into the three-digit NAICS level to estimate $OUTPUT_{jst.}$ The industry-specific export data of foreign countries (*EXP_{jst}*) is taken from the UN COMTRADE database, which provides trade at the six-digit HS level.

For each U.S. region, the total export data (*EXP_{ist}*) is readily obtained by aggregating bilateral trade volume (*EXP_{ijst}*) over 72 partner countries from *U.S. Exports of Merchandise* (and *WISERTrade*). However, data on industry-specific output for each U.S. region are not available. Hence, this study estimates *$OUTPUT_{ist}$* in two steps. In the first step, annual regional GDP, i.e. value added, by industry are obtained from the Bureau of Economic Analysis of U.S. Department of Commerce for 1998-2009. In the second step, the *Manufacturing Industry Productivity Database* from the National Bureau of Economic Research (NBER) is used to convert value added into gross output. The NBER database has both value-added and total shipping data at six-digit NAICS level, which provides the ratio of total output relative to value added for aggregate United States. Assuming that the national ratio applies to each region (i.e. identical intermediate input cost shares across regions), the product of annual GDP data and the output to value-added ratios is used to estimate *$OUTPUT_{ist}$* in equation (2.21). The summary statistics of data employed in measuring bilateral trade costs are displayed in the top panel of table 2.1.

2.2.2 Trade Costs of Three-Digit NAICS Industries

Table 2.2 presents relative trade costs weighted by total trade volume (total imports and exports) as average levels and growth rates for three periods, 1998-2001, 2002-2009 and 1998-2009, for each U.S. three-digit NAICS industry. Focusing first on levels, note that on average the U.S. agricultural industries (NAICS 111, 112, 113 and 114) face much higher weighted average trade costs than manufacturing industries. A level of 2.203 for NAICS 111 indicates that international trade costs are about 220.3 percent of the domestic trade costs[2]. While the level of relative trade costs for agricultural industries appears to be high, recall that it includes transportation costs, trade policy and institutional factors including port efficiency and logistics. From this point forward, the term 'relative' is dropped in the following discussion to focus on levels, changes and trends. Since most agricultural commodities are either bulky or perishable or both, they tend to have high transportation costs per unit value and are subject to delivery time constraints, and hence, face high trade costs. Moreover, agricultural industries tend to have higher border protection relative to others (Reimer and Li, 2010). In addition, high trade costs may arise from policies protecting natural resources (e.g., the Endangered Species Act). Among agricultural industries, the forest products industry (113) and the animal production industry (112) has the highest and lowest average trade costs, respectively.

The heterogeneity of trade costs among the manufacturing industries is apparent in table 2.2. Trade costs range from a high of 1.752 for NAICS 312, beverages and tobacco, to 1.292 for NAICS 333, machinery manufacturing. Industries categorized by bulky products (not necessarily perishable) include beverages and tobacco, paper (322), chemicals (325) and non-metallic mineral products (327), e.g. stone, clay, glass and concrete products, face high trade costs. Most other industries appear to have trade costs of about 1.450, which, as noted earlier include transportation costs, trade policy and institutional factors. The relatively lower ratio of international trade costs to domestic trade costs in manufacturing industries (1.450) likely contributed to the increased volume and value of trade among developed countries in such goods, as noted by Hummels (2007).

The growth rate of weighted average trade costs during 1998-2009 is shown in the last column of table 2.2 accompanied by that in two sub-samples: 1998-2001 and 2002-2009. The growth rate is calculated in terms of the percent change in trade costs of the present period relative to the past period. The reason for choosing 2001 as the threshold is the change in the regulatory environment following the terrorist attacks on United States (Peterson and Treat, 2008). During 1998-2001, most three-digit NAICS industries witnessed falling trade costs, e.g. leather and allied products industry (316), and paper manufacturing industry (322). Only a few industries faced increasing trade costs during 1998-2001, e.g. petroleum and coal products (324), and forestry products (113). By contrast, during 2002-2009 most industries faced increasing trade costs, e.g. transportation equipment (336), and computers and electronic product (334). In general, the trade cost levels appear consistent with what we might expect given the type of industry. In turn, most industries experience decreasing (increasing) relative trade costs during 1998-2001 (2002-2009).

Reasons for increasing trade costs during 2002-2009 may include increased local sourcing due to regulatory changes, especially at entry ports after 2001, high energy costs, and port logistics performance. In a review of post-9/11 global regulatory framework, Peterson and Treat (2008) discuss the establishment of new protocols for tracking and screening cargo entering the United States through road, railway, airport and sea port. Early adopters of U.S. protocols, now incorporated into World Customs Organization, include Australia, Canada, New Zealand, and Sweden. While listing the new U.S. framework, Peterson and Treat (2008) also outline concerns on its costs to business and effects on cross-border trade. Moreover, the Economist (2004) outlined significant infrastructural problems at congested U.S. ports raising concerns on free flow of goods between the United States and its trade partners.

2.2.3 Trade Costs of Major U.S. Customs Districts

Table 2.3 displays trade costs weighted by total trade volume (total imports and exports) for each major U.S. customs district and the percentage change during 1998-2001, 2002-2009, and 1998-2009. In total, there are 38 major U.S. customs districts spread over 28 states. Among the west coast locations, the Seattle customs district in Washington has lower trade costs (1.409 relative trade costs). Its closeness to Canada and Japan, which are two major U.S. trade partners, likely explains the lower trade costs. Of the three customs districts in California, Los Angeles and San Diego have trade costs comparable to Seattle. Meanwhile, San Francisco and Columbia-Snake River (Oregon) customs districts have the highest trade costs on the west coast.

In the southern United States, Laredo and El Paso customs districts have lower trade costs (1.116 and 1.255, respectively). This is likely since they are the second and the third largest cities on the U.S.-Mexican border, and trade with Mexico is the major source of Laredo's economy. These two customs districts are not only close to the manufacturers in North Mexico, but also have many transportation facilities. In contrast, Nogales in Arizona (1.401) and New Orleans in Louisiana (1.730) have relatively high trade costs.

Among the northern and eastern customs districts, trade costs through Detroit are relatively low (1.087). This may be because the Detroit River connecting the Great Lakes plays a critical role in U.S.-Canada (and U.S.-European) trade. Furthermore, Buffalo, Ogdensburg and Pembina also have lower trade costs, likely due to their position on the border with Canada. However, inland cities such as St. Louis (2.263), Milwaukee (2.378) and Minneapolis (2.088) face high trade costs. Along the east coast, the average trade costs of customs districts are relatively larger than that of customs districts located in the northern, southern and western United States.

A further issue is how the bilateral trade costs of major U.S. districts vary over time. Table 2.3 provides a comparison over three sub-sample periods. During 1998-2001, 26 out of 38 U.S. customs districts experience decreasing relative trade costs, with a weighted average decline of 3.61 percent. Providence had the largest decline, at -33.53%. However, during 2002-2009, the relative trade costs of 17 customs districts were higher, e.g. Pembina, Baltimore, and Laredo. Similar to results in table 2.2, most customs districts witnessed falling (rising) trade costs during 1998-2001 (2002-2009). While the temporal variation in trade costs among U.S. customs district mimics that of U.S. industries, some of this variation arises from the pattern of trade partners' adaptation of the post-9/11 U.S. regulatory framework, which is discussed in the following.

2.2.4 Bilateral Trade Costs with Major U.S. Trade Partners

Table 2.4 describes the weighted average U.S. trade costs with 72 partners, which include 7, 21, 20 and 13 destinations in Africa, Asia, Europe and North/South America, respectively. The weighted average of trade costs for Africa, Asia, Europe and North/South America are 1.947, 1.543, 1.711, and 1.246, respectively.

Among the 72 countries, Canada and Mexico have the lowest trade costs with the United States (1.168 and 1.215), respectively. Location advantages combined with NAFTA are likely to be important sources of lower trade costs of the United States with Canada and Mexico. Furthermore, U.S. trade costs with Canada are lower than those with Mexico. So, institutional factors such as common language and trading/regulatory environment are likely to contribute to Canada's advantage over Mexico. Most developed countries from Europe have lower trade costs with the United States, e.g. Germany (1.603), France (1.695) and United Kingdom (1.625). However, less developed European countries such as Lithuania (2.152) and Slovenia (2.216) experience relatively larger trade barriers with the United States.

Among the Asian countries, the four major trade partners – China (1.466), Japan (1.532), Korea (1.580) and Malaysia (1.498) – have lower trade costs, when compared to some of the European countries (United Kingdom and France). China also has the lowest trade costs with the United States among all Asian countries. Other emerging economies, e.g. India, Indonesia and Israel, have relatively higher trade costs in comparison to China. Note that Kyrgyzstan (2.409), a landlocked and mountainous country, faces one of the highest trade costs with the United States. All seven African countries in the sample have high trade costs likely due to geographical, political and institutional factors. An example of this is South Africa (2.935). Other countries from North America and South America, except Canada and Mexico, have similar but relatively high trade costs. Among them, Brazil (1.687) and Panama (1.720) have low trade costs relative to other South American countries such as Ecuador.

With regard to time series variation of bilateral trade costs, about 60 percent of sample countries experienced declining relative trade costs during 1998-2001. However, 49 out of 72 countries faced increasing relative trade costs during 2002-2009. The two largest U.S. trade partners, Canada and Mexico, illustrate the above trend. Their respective annual trade costs fell by 2.69 and 1.16 percent during 1998-2001, but increased by 2.86 and 0.38 percent during 2002-2009. The regulatory reasoning noted earlier also explains the relatively lower increases in trade costs' levels for Canada and Mexico. The Free and Secure (FAST) program, signed by the United States, Canada and Mexico in 2002/2003, expedites customs clearance for firms operating on U.S.-Canadian and U.S.-Mexican border (Peterson and Treat, 2008). Most developed countries from Europe, e.g. United Kingdom, France and Ireland, and several Asian trade partners, e.g. Japan, and Korea, show trends similar to Canada and Mexico. Again, the 2004 U.S.-EU Mutual Assistance program aims at recognizing and harmonizing each other's customs procedures. While U.S. trade costs with China fell by 2.81 percent during 1998-2001, they only rose slightly during 2002-2009 (0.41 percent). As a result, trade costs with China declined by 1.78 percent between 1998 and 2009. Trade costs declined (increased) throughout

1998-2009 for only a few countries such as Brazil, Chile, Panama and Norway (Israel, Senegal and Ukraine).

2.2.5 A Sensitivity Analysis

The *Merchandise Imports* and *Exports* databases report where cargo entered or exited the United States, but this may not correspond to where the goods were produced or consumed. In other words, the state of origin of movement and state of ultimate destination are unknown. Los Angeles, for example, trades a quantity of goods that exceeds its production of those goods. To address this concern, this study employs the *WISERTrade* database, which makes a better attempt to attribute trade flows to origin/destination states. Due to limited availability of import data, this study can only measure relative trade costs between each U.S. state and its trading partner by three-digit NAICS industries during 2008-2009. So, trade costs measured from the *WISERTrade* database are compared to those from the *Merchandise Imports* and *Exports* databases for a sensitivity analysis.

Simple correlation between $\tau^{M}_{ijs,2008}$ from the *Merchandise Imports and Exports* database and $\tau^{W}_{ijs,2008}$ from *WISERTrade* database is 0.69 (0.71 for 2009). To further examine these correlations, measures in Table 2.2, 2.3 and 2.4 are compared with similar measures derived using the *WISERTrade database*. The two measures of three-digit NAICS industry trade costs (Table 2.2) are highly correlated for both

2008 and 2009, with the correlation coefficient 0.97 and 0.96, respectively. In addition, the two measures of trade costs for major trade partners are also highly correlated (Table 2.4). The correlation coefficients in the case of trade partners' measures are 0.89 and 0.77 for 2008 and 2009, respectively. However, the two measures for customs districts are not highly correlated during 2008 and 2009 (correlation coefficient 0.30 and 0.34, respectively). The relatively lower correlation between these two sets of trade costs for customs district is expected since the two databases differ in how they record origins and destinations of shipped goods. Overall, the sensitivity analysis suggests that employing the *Merchandise Imports* and *Exports* databases for computing trade costs by partner or industry produces results qualitatively similar to those from the WISERTrade database. Improved tracking of origin and final destination, as in the WISERTrade database, is needed for precision in measuring regional trade costs in the United States.

Table 2.1. Summary Statistics

Panel a: for measuring TC_{ij}[3]

	Mean	Standard Deviation	Minimum[4]	Maximum
Merchandise imports of major U.S. districts (billion) [IMP_{ijs}]	0.049	0.586	0.000	54.783
Merchandise exports of major U.S. districts (billion) [EXP_{ijs}]	0.027	0.310	0.000	38.712
Total values of output of major U.S. districts (billion) [$OUTPUT_{is}$]	7.785	11.807	0.001	126.101
Total exports of major U.S. districts (billion) [EXP_{is}]	1.293	3.166	0.000	40.723
Total values of output of U.S. trade partners (billion) [$OUTPUT_{js}$]	21.634	52.992	0.000	997.033
Total exports of U.S. trade partners (billion) [EXP_{js}]	7.668	19.684	0.000	422.829
Elasticity of substitution [σ_s]	10.969	2.083	7.100	14.858

Panel b: for sources of TC

	Mean	Standard Deviation	Minimum	Maximum
Bilateral trade costs	2.509	0.927	0.001	9.812
Distance(mile)	5423.170	2081.870	546	10610
Tariff rate of U.S. (%)	2.328	3.902	0	75.141
Tariff rate of foreign countries (%)	7.412	5.783	0	852.6
Common border*	0.024	0.152	0	1
Common language*	0.184	0.388	0	1
Land locked*[5]	0.071	0.257	0	1
Time to import	17.887	10.322	4	76

Table 2.2. The Industry-Specific Trade Costs During 1998-2009

Three-digit NAICS	Industry	Average TC 1998-2009	Percentage change (%)		
			1998-2001	2002-2009	1998-2009
111	Crop production	2.203	-2.373	0.023	-1.914
112	Animal production	1.905	-4.674	5.742	4.866
113	Forestry and logging	2.270	2.547	5.429	10.163
114	Fishing, hunting and Trapping	2.089	-0.457	-2.075	-2.219
311	Food manufacturing	1.452	-1.186	4.013	2.222
312	Beverage and tobacco product	1.752	1.475	0.524	2.045
313	Textile mills	1.494	-0.371	-1.433	-1.315
314	Textile product mills	1.495	-1.019	-1.159	-1.887
315	Apparel manufacturing	1.400	-0.387	0.652	2.183
316	Leather and allied product	1.470	-5.368	-6.848	-7.685
321	Wood product	1.507	0.995	-0.554	1.180
322	Paper manufacturing	1.716	-5.466	-0.167	-4.900
323	Printing and related activities	1.489	-0.708	-2.752	-3.204
324	Petroleum and coal products	1.587	3.586	2.093	12.545
325	Chemicals manufacturing	1.731	-0.620	1.273	2.877
326	Plastics and rubber products	1.443	-2.233	-0.152	-2.108
327	Nonmetallic mineral product	1.699	-1.212	-0.934	-1.167
331	Primary metal manufacturing	1.414	-0.584	-4.338	-6.674
332	Fabricated metal product	1.337	-0.616	1.664	0.741
333	Machinery manufacturing	1.292	0.159	3.281	2.355
334	Computer and electronic product	1.439	-2.993	6.045	2.135
335	Electrical equipment, appliances	1.455	-0.682	-2.853	-2.993
336	Transportation equipment	1.324	-1.656	6.362	4.125
337	Furniture and related product	1.460	0.397	-2.052	-0.682
339	Miscellaneous manufacturing	1.436	7.062	-0.959	5.878

Table 2.3. The Region-Specific Trade Costs During 1998-2009

U.S. Regions	Average TC 1998-2009	Percentage change (%)		
		1998-2001	2002-2009	1998-2009
Mobile, AL	2.003	-9.666	15.596	-0.146
Nogales, AZ	1.401	2.582	-7.916	-5.349
Los Angeles, CA	1.463	-0.882	0.664	-0.760
San Diego, CA	1.487	3.415	0.961	7.199
San Francisco, CA	1.630	1.752	7.868	12.523
Washington D.C.	1.748	13.300	1.440	11.115
Miami, FL	1.739	-8.234	-0.579	-4.728
Tampa, FL	1.803	-0.904	-0.701	-4.655
Savannah, GA	1.682	2.384	-5.679	-4.263
Chicago, IL	1.660	-1.362	-4.566	-4.346
New Orleans, LA	1.730	-2.013	1.641	2.083
Boston, MA	1.754	-3.518	-5.319	-6.805
Baltimore, MD	1.705	7.666	27.836	31.431
Portland, ME	1.430	-2.007	2.065	2.855
Detroit, MI	1.087	-3.522	-2.275	-5.671
Duluth, MN	1.525	-0.370	-5.330	-3.237
Minneapolis, MN	2.088	4.007	-7.924	-1.112
St. Louis, MO	2.263	4.076	6.104	8.448
Great Falls, MT	1.418	-5.261	2.538	2.878
Wilmington, NC	2.352	-0.861	-3.755	3.490
Pembina, ND	1.355	6.629	17.284	19.873
Buffalo, NY	1.232	-7.135	3.124	0.713
New York City, NY	1.569	3.958	6.235	6.979
Ogdensburg, NY	1.348	-1.091	-1.251	-1.672
Cleveland, OH	1.752	-2.187	-0.349	-0.957
Columbia-Snake, OR	1.708	-2.028	5.605	1.619
Philadelphia, PA	1.880	-9.095	-2.276	-9.859
Providence, RI	1.808	-9.566	-33.531	-31.543
Charleston, SC	1.678	-3.690	-8.832	-10.339
Dallas/Fort Worth, TX	1.682	-7.475	-2.901	-10.483
El Paso, TX	1.255	-0.495	3.982	3.550
Houston, TX	1.775	-4.044	-6.322	-8.576
Laredo, TX	1.116	-0.857	3.334	3.386
Port Arthur, TX	1.896	18.001	-10.432	-8.485
Norfolk, VA	1.726	3.412	-5.823	-3.016

St. Albans, VT	1.276	-4.057	-5.456	-4.637
Seattle, WA	1.409	-0.192	11.818	9.101
Milwaukee, WI	2.378	-3.307	-6.746	-10.517

Table 2.4. The Country-Specific Trade Costs During 1998-2009

Country	Average TC 1998-2009	Percentage change (%)		
		1998-2001	2002-2009	1998-2009
Argentina	1.921	2.122	-2.425	0.457
Armenia	1.978	*	6.616	*
Australia	1.702	-2.458	4.391	-2.510
Austria	1.839	-2.739	1.661	2.551
Azerbaijan	1.956	-12.448	7.562	1.135
Belgium	1.748	-0.038	0.837	1.782
Bolivia	1.881	3.218	-7.629	-3.709
Brazil	1.687	-3.984	-3.113	-4.967
Bulgaria	2.112	-4.617	6.215	3.152
Canada	1.168	-2.693	2.863	0.369
Chile	1.911	-0.544	-3.240	-2.822
China	1.466	-2.806	0.414	-1.783
Colombia	1.861	-7.458	-5.654	-10.259
Cyprus	2.381	11.763	5.946	15.770
Czech Republic	2.010	-0.061	2.875	2.202
Denmark	1.817	-2.197	-4.301	-4.260
Ecuador	2.175	-6.860	8.043	1.204
Egypt	1.949	-1.896	4.354	-6.565
Estonia	1.947	-9.506	13.153	8.159
Germany	1.603	1.037	1.292	0.368
Fiji	1.860	*	13.428	*
Finland	2.027	-4.637	7.977	-1.006
France	1.695	-2.416	3.715	-0.150
Georgia	1.998	12.464	1.953	6.616
Ghana	2.140	19.667	1.867	27.025
Greece	1.968	7.615	-10.489	-8.007
Hungary	1.980	-2.855	3.469	1.173
India	1.808	9.394	-5.315	2.077
Indonesia	1.795	-0.188	2.459	3.865
Ireland	1.662	-3.696	7.031	4.295
Israel	1.658	19.391	4.283	19.266
Italy	1.745	-0.416	2.422	1.426
Japan	1.532	-0.686	6.401	6.760
Jordan	1.761	-11.982	-0.958	-19.833
Kazakhstan	2.085	-18.225	-4.019	-29.101

Korea, South	1.580	-0.090	9.313	7.504
Kyrgyzstan	2.409	*	11.160	*
Latvia	1.948	1.230	21.201	12.017
Lithuania	2.152	7.990	24.579	18.218
Macedonia (Skopje)	1.899	7.025	5.416	18.487
Malawi	2.083	11.904	8.254	13.603
Malaysia	1.498	-1.041	11.883	11.688
Malta	1.973	0.291	-0.425	24.532
Mexico	1.215	-1.155	0.377	-0.169
Moldova	1.925	1.584	8.467	30.921
Morocco	2.137	-4.254	-3.929	0.075
Netherlands	1.732	-0.646	-1.115	-2.929
Nigeria	1.880	9.460	-6.936	24.331
Norway	1.948	-2.072	-0.230	-1.935
Oman	1.828	1.109	21.164	25.078
Panama	1.720	-10.011	-19.481	-21.759
Peru	1.913	1.485	-5.654	0.846
Poland	2.026	3.552	-0.501	1.461
Portugal	1.979	-3.354	1.468	-0.367
Qatar	2.141	2.797	-4.507	2.775
Romania	2.036	-0.679	3.653	3.452
Russia	1.919	4.905	0.595	1.964
Senegal	2.491	8.607	6.633	21.091
Singapore	1.572	-0.532	8.205	10.265
Slovakia	2.110	1.214	-1.700	-1.654
Slovenia	2.216	-1.648	2.725	5.817
South Africa	1.935	-0.192	-2.108	-7.020
Spain	1.975	-4.293	1.229	-2.047
Sri Lanka	1.673	-2.170	0.643	-0.399
Sweden	1.746	-3.552	6.178	0.493
Thailand	1.668	0.989	2.970	5.069
Trinidad and Tobago	1.801	0.636	-1.601	0.590
Turkey	1.971	-5.116	11.985	5.260
Ukraine	2.098	11.135	2.733	4.819
United Kingdom	1.625	-2.263	2.697	1.587
Uruguay	1.970	-4.763	2.516	-0.531
Vietnam	1.849	4.100	-13.389	-19.740

CHAPTER 3

3. SOURCES OF TRADE COSTS BY U.S. REGIONS

The results on trade costs for 1998-2009, from Chapter 2, show substantial variation across industries, customs districts, trade partners, and time. In the following, the underlying sources of trade costs are examined by regressing bilateral trade costs on policy, geographic, and institutional factors.

3.1 Regression Model and Data for Trade Costs' Sources

In the following, bilateral trade costs are attributed to three major sources. The first source relates to geographic factors like distance between trading partners and contiguity, i.e. sharing a common border. Trade policy of the United States and its partners, e.g. tariffs, is an important component of trade costs. Finally, institutional factors such as common language and logistics performance (e.g. exporter's/ importer's average time for all procedures) also influence trade costs. Thus, a regression model is specified relating the dependent variable of trade costs to the following independent variables: *Distance, Tariff rate of U.S., Tariff rate of U.S. trading partners, Common Border, Common Language, Landlocked, Logistics Performance*. However, the industry-specific tariff rate of United States and foreign countries is only available for 2004. Hence, two specifications of the dependent variable are employed in the following analysis: 2005 trade costs and the weighted average of trade costs during 2005-2009.

Following Novy (2006) and Coughlin and Novy (2009) trade costs are specified as:

$$TC_{ijs} = \alpha_0 + \beta_1 * Distance_{ij} + \beta_2 * Tariff\_US_{is} + \beta_3 * Tariff\_cty_{js} + \beta_4 * Border_{ij} + \beta_5 * CommonLanguage_{ij} + \beta_6 * LandLocked_j + \beta_7 * Logistics_j + Error_{ijs} \quad (3.1)$$

where *i* denotes U.S. customs districts, *j* denotes U.S. trade partners, and *s* denotes each three-digit NAICS level industry. A dummy variable for each customs district, trade partner and industry (*DistrictDummy*, *CtyDummy*, *IndDummy*) are added to the regression model in equation (3.1).

With regard to independent variables, distance between each major U.S. district and its trade partners (countries) is obtained by calculating the arc distance between their respective capitals or port cities. Great circle distance between a U.S. district and the trade partner's capital city is available in the public domain: http://www.indo.com/distance/. Data on tariff rates of United States and foreign countries are obtained from the MAcMAPHS6 database[6]. This comprehensive database provides detailed tariff information at the six-digit level of the Harmonized System (HS6) for 169 importing countries for 2004. Each record of MAcMAPHS6 database contains bilateral ad valorem equivalent information of the reporter as the importing country and the partner as the exporting country. The variable $Tariff\_cty_{js}$ in equation (3.1) is taken from the records of MAcMAPHS6 database whose reporter is country *j* and partner is the United States. Note that the various U.S. regions adopt the uniform U.S. (national) tariff rate for each HS six-digit product. The variable $Tariff\_US_s$ in equation (3.1) is constructed via records whose reporter is the United

States and partner is country *j* (one of 72 countries in Table 2.4). Furthermore, employing the trade volume between the United States and its trade partners as weights, the weighted average U.S. tariff rate of each three-digit level of NAICS industry, $Tariff\_US_s$, is derived. Similarly, a weighted average of HS six-digit products' tariff rate of U.S. trade partners is used to obtain $Tariff\_cty_{js}$ in equation (3.1).

The dummy variables, *common language*, *common border* and *landlocked* are taken from Rose (2000), but updated to 2009.[7] If trading pairs share a common language, the $CommonLanguage_{ij}$ dummy in equation (3.1) takes value one, otherwise it takes value zero. If the state where the U.S. customs district is located shares a border with a trade partner, the $Border_{ij}$ variable takes value one and zero otherwise. For example, the Dallas (Texas) customs district shares a common border with Mexico, and so, the associated $Border_{ij}$ variable takes value one. The $Landlocked_j$ dummy variable only depends on the trade partner *j*, since the United States is not landlocked status. If the trade partner *j* is landlocked, the $Landlocked_j$ dummy takes value one; otherwise it takes value zero.

Measures of country-specific logistics performance are taken from the *Trading Across Borders*, *Doing Business* database compiled by the World Bank, which reports on 183 economies since 2006. The World Bank database provides many options to represent logistics performance: exporter's average time for all procedures, importer's average time for all procedures, number of documents for export, and number of documents for import. However, these logistics performance indicators are highly correlated with each other. In order to minimize multicollinearity problems in the regression model, only one logistics performance indicator is included in equation (3.1): time required to import goods measured in calendar days, $Logistics_j$.[8] The time required to import goods includes time required to obtain all documents, inland transport and handling, customs clearance and inspections, and port and terminal handling. Note however that the time required to import goods does not include ocean transport time. In the 2005 (2005-2009 average) trade-costs regression, the 2006 (2006-2009 average) time required to import goods is used as an explanatory variable.[9] Summary statistics on variables used to estimate equation (3.1) are shown in the second panel of table 2.1.

3.2 Estimation Results

Recall that two regression models are employed to investigate the determinants of bilateral trade costs: 2005 and 2005-2009 weighted average trade costs. Within each empirical model, three alternative specifications are considered. The first one is the base specification, which includes all observations. The second specification contains observations for which the tariff rate of foreign countries is less than 20 percent. The weighted average tariff rate of 72 U.S. trade partners (when trading with the United States) is 7.41 percent with a standard deviation of 5.78 percent. The threshold of 20 percent therefore equals two standard deviations above the mean. The majority of U.S. trade occurs with countries imposing a tariff rate of less than 20 percent. Hence, countries with closed economies (tariff rate of more than 20 percent) trade less with the United States. Sensitivity of the regression estimates to alternative tariff thresholds is discussed in the following. To the second specification, the logistics performance indicator, i.e. importer's average time for all procedures, is added for the third specification.

Table 3.1 shows the generalized method of moments (GMM) estimates of the model using 2005 trade costs as the dependent variable. The base specification includes all observations. The coefficient associated with the distance variable is significant and positive, which means that larger distance between the United States and its trade partners raises trade costs. Table 3.1 also shows that both the 2004 U.S. tariff rate and that of the trade partners are not significantly associated with trade costs. Thus the policy factor, i.e. tariff rate, appears to be less influential in determining the variation of trade costs, a result on which additional insights are provided later in this section.

Other geographical factors, such as common border and land-locked status, significantly affect U.S. trade costs at the one percent level. The coefficient on the common border dummy has the expected negative sign and statistical significance at the one percent level. Furthermore, high trade costs are observed when the U.S. trade partner is landlocked. However, the institutional factor, common language, does not have the expected negative sign in the base specification.

In specification two of table 3.1, the sample set only includes observations when U.S. trade partners' tariff rate is less than 20 percent. The size and significance of all GMM estimates do not vary much except for the coefficient associated with trade partners' tariff rate, which is now positive and statistically significant at the one percent level. Unlike in the base specification, the tariff rate of U.S. trade partners is now an underlying source of bilateral trade costs. Note that the base specification contains all foreign countries including some developing countries which do not trade much with the United States, e.g. Armenia, Kyrgyzstan, and Malawi. The inclusion of observations from high tariff and landlocked countries appears to have made it difficult to identify the tariff effects in the base specification. Nevertheless, when excluding tariffs nearly two standard deviations above the sample average (of tariffs faced by the United States) in the second specification, the trade policy effect turns out to be one of the significant determinants of U.S. trade costs. Therefore, deleting about a thousand observations on seemingly high tariffs helps in sharpening the focus on the significant impact of tariffs in trade costs. Lowering the cutoff for trade partners' tariff rate up to 15 percent does not alter the results of specification two reported in table 3.1. Significant loss in the sample size arises when the cutoff is lowered below 15 percent. Note, however, the coefficient on U.S. tariff rate is still not significant in specification two, which implies that its protection is not a determinant of trade costs between U.S. customs districts and its trade partners. The underlying reason is the average U.S. tariff rate (2.33 percent) is significantly lower relative to the sample average of 7.41 percent. In addition, zero tariff rates apply for a majority of U.S. agricultural and manufacturing industries with most partners. In specification two, having a common border is still a big advantage that spurs U.S. trade flows with neighboring countries, such as Canada and Mexico. The coefficient on the landlocked-dummy variable continues to have the expected sign and statistical significance, unlike that of the common language dummy.

Specification three in table 3.1 includes the logistics performance indicator, i.e. importer's average time for all procedures. Here, distance is still a key determinant of trade costs between the United States and its trade partners. While the U.S. tariff rate does not significantly affect trade costs, the coefficient on trade partners' tariff rate remains positive and significant at the one percent level. The coefficients on dummy variables *Commonborder, Landlocked* have the expected sign with statistical significance. As expected, the importer's average time for all procedures has a positive and significant relationship with bilateral trade costs. That is, a country with a longer time required to complete procedures related to imports faces higher trade costs with the United States (Hausman *et al*., 2005).

In the second regression model, the dependent variable is the weighted average trade costs during 2005-2009. Table 3.2 presents the regression results of the three specifications estimated by the GMM procedure. As before, the base specification contains all observations, observations for specification two is selected by the threshold (from above) of 20 percent of U.S. trade partners' tariff rate. The logistics performance is added to specification three extending specification two.

In the base specification, the coefficient associated with the distance variable remains positive, slightly smaller than that in table 3.1, with statistical significance at the one percent level. Other geographic factors, common border and landlocked status have the expected signs and significantly to trade costs between the United States and its trade partners. As before, both the tariff rate of the United States and U.S. trade partners do not significantly impact trade costs in the base specification. In specification two, the tariff rate of U.S. trade partners turns positive and significant at the one percent level, while distance, common border and landlocked variables have the same sign, magnitude and significance as in the base specification. Note that the coefficient on trade partners' tariff is larger in the 2005-2009 regression relative to that in the 2005 regression. In specification three, the coefficients on the determinants of trade costs and their statistical significance are strikingly similar to those in specification two (table 3.2). In addition, the coefficient on logistics performance has the expected sign, but slightly smaller than that in table 3.1. While estimates of distance and related effects have the expected sign and significance in specification three of table 3.3, the coefficient on *Commonlanguage* has now turned negative (as expected) and significant. With a larger set of observations (table 3.1 versus table 3.2) and a higher likelihood value, specification three in table 3.2 is the preferred model of this study. In the following discussion of relative contribution of alternative determinants of trade costs, emphasis is placed on elasticities from the preferred model.

Trade costs' elasticities with respect to policy, geographic and institutional factors, derived from estimates of table 3.2, are presented in table 3.3. Elasticities based on the estimates in table 3.1 are qualitatively and quantitatively similar to those reported in table 3.3, except for the common language dummy. The elasticities of the preferred model (specification three, table 3.2) suggest that a one percent increase in distance will increase the bilateral trade costs (United States and its trade partner) by 0.65 percent, all else constant. Similarly, when U.S. trade partners' tariff rate increases by one percent, average trade costs with that country increase by 0.03 percent. Finally, every one percent increase in the importer's average time for all procedures will raise bilateral trade costs by 0.56 percent. The trade-costs elasticity with respect to tariffs is consistent with the conclusion in Novy (2006, 2009) that the policy-related trade friction plays a relatively small role in the determining trade costs. Anderson and van Wincoop (2004) also find that the policy factor, including tariffs and regional trade agreements, can only explain eight percentage points of trade costs compared to forty-four points associated with common border effects. The above elasticities imply that investments in infrastructure in the form of either roads or (air or sea) ports are likely to be more effective in reducing trade costs between the United States and its trade partners. The United States may have a better road network and port infrastructure relative to its trade partners, but this study cannot identify whether investments in U.S. infrastructure or that of its trade partners will bring about a higher reduction in trade costs.[10] Nevertheless, relative to tariffs, improving physical and procedural infrastructure is important to lowering trade costs and improving conditions conducive for competition (Henderson *et al.* 2001; Limão and Venables 2001).

Table 3.1. The Determinants of Trade Costs in 2005

Regressor	GMM Results		
	Specification One (base)	Specification Two	Specification Three
Distance	0.000214*** (0.0000088)	0.000209*** (0.0000093)	0.000212*** (0.0000093)
Tariff rate of U.S.	-0.263 (0.246)	-0.239 (0.361)	-0.214 (0.368)
Tariff rate of foreign countries	0.039 (0.032)	0.559*** (0.198)	0.560*** (0.200)
Common Border	-1.163*** (0.067)	-1.130*** (0.067)	-1.130*** (0.068)
Common Language	0.456*** (0.061)	0.447*** (0.080)	1.450*** (0.125)
Land Locked	0.970*** (0.057)	0.969*** (0.079)	0.862*** (0.072)
Importer's average time for all procedures			0.059*** (0.006)
Industry fixed effects	Yes	Yes	Yes
U.S. region fixed effects	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes
Observations	18935	17974	17798
Adjusted R^2	0.587	0.589	0.588

Notes: The regression results of trade costs determinants in 2005 for three specifications are shown in the table 3.1. Specification 1 represents the base model including all the sample data. Specification 2 and specification 3 represent the models with the observations with the tariff rate of other countries less than 20%. Standard deviations are in parentheses. Industry fixed effects are for three-digit NAICS industries. Coefficients for the intercept and dummy variables are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 3.2. The Determinants of Weighted Average Trade Costs during 2005-2009

Regressor	GMM Results		
	Specification One (base)	Specification Two	Specification Three
Distance	0.000194***	0.000190***	0.000191***
	(0.000010)	(0.000010)	(0.000009)
Tariff rate of U.S.	-0.209	-0.234	-0.175
	(0.215)	(0.307)	(0.315)
Tariff rate of foreign countries	0.017	0.955***	0.960***
	(0.024)	(0.167)	(0.167)
Common Border	-1.188***	-1.147***	-1.148***
	(0.090)	(0.087)	(0.067)
Common Language	0.654***	0.552***	-0.859***
	(0.070)	(0.100)	(0.104)
Land Locked	1.036***	1.070***	0.961***
	(0.058)	(0.070)	(0.058)
Importer's average time for all procedures			0.056***
			(0.004)
Industry fixed effects	Yes	Yes	Yes
U.S. region fixed effects	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes
Observations	24801	23301	23050
Adjusted R^2	0.615	0.617	0.618

Notes: The regression results of trade costs decomposition in 2005-2009 for three specifications are shown in the table 3.2. Specification 1 represents the base model including all the sample data. Specification 2 and specification 3 represent the observations with the tariff rate of foreign countries less than 20%. Industry fixed effects are for three-digit NAICS industries. Coefficients for the intercept and dummy variables are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level

Table 3.3. Trade Costs' Elasticities with respect to Distance, Tariffs, and Logistics Indicator (2005-2009 Average)

Trade cost elasticity with respect to	Specification One (base)	Specification Two	Specification Three
Distance	0.665	0.646	0.649
Tariff Rate of U.S. (2004)	-0.003	-0.003	-0.002
Tariff Rate of Foreign Countries (2004)	0.001	0.032	0.033
Common Border	-0.014	-0.014	-0.015
Common Language	0.073	0.062	-0.094
Land Locked	0.050	0.054	0.049
Importer's average time for all procedures			0.560

Note: The trade costs' elasticities with respect to distance, tariffs, and logistics reflect the change of percent in weighted average trade costs over 2005-2009 with additional one percent change in each explanatory variable.

CHAPTER 4

4. CONCEPTUAL FRAMEWORK FOR ASSESSING THE IMPACT OF TRADE COSTS ON FIRM ENTRY, EXIT, AND INTRA-INDUSTRY RESOURCE REALLOCATION

In this chapter, a conceptual framework for the effect of trade costs on firm entry, exit, and employment patterns is developed.[11] The approach draws on Melitz's (2003) model of intra-industry competition, where trade openness yields aggregate productivity gains through:[12]

- exit of least productive firms (extensive margin), and
- resource reallocation towards more efficient firms (intensive margin).

The first objective here is to design an empirical model to test the extensive-margin hypothesis underlying the Melitz's (2003) model that a decrease in variable trade costs raises the probability of firm (establishment) exit.[13] Then, the intensive-margin hypothesis is to be tested by examining changes in the employment of surviving firms and new entrants following changes in trade costs. The following briefly outlines the Melitz (2003) framework, which provides the foundation for the proposed firm exit, entry and employment equations to be estimated.

Unlike Krugman's (1980) monopolistic competition model with homogeneous firms, Melitz's (2003) approach shows that firms with different productivities coexist in an industry. An industry characterized by heterogeneous firms arises because, before expending an irreversible cost to enter the industry, firms face uncertainty about their productivity realization. After incurring the entry cost, they do observe their productivity and choose either to exit if variable profit does not cover fixed production cost; or serve only domestic markets if variable profit covers only fixed production cost; or serve domestic and foreign markets if variable profit covers fixed production and fixed foreign market entry costs.

On account of fixed production cost, only firms with productivities yielding zero (break-even) or positive profit π remain in production, referred to as the zero cutoff profit (ZCP) condition. Melitz (2003) refers to the break-even point as the cut-off productivity φ^*, which truncates the productivity distribution of industry, g(φ), from below. On the other hand, a free entry (FE) condition ensures that long run average profit $\bar{\pi}$ equals the fixed cost of entry incurred before productivity realization. Hence industry's average productivity $\tilde{\varphi}$, long run average profit, and the cut-off productivity at which a firm breaks even are endogenous in Melitz (2003) framework. The industry's average productivity $\tilde{\varphi}$ is then a function of the cut-off φ^*:

(4.1) $$\tilde{\varphi}(\varphi^*) = \left[\frac{1}{1-G(\varphi^*)} \int_{\varphi^*}^{\infty} \varphi^{\sigma-1} g(\varphi) d\varphi \right]^{\frac{1}{\sigma-1}},$$

where $\sigma > 1$ denotes the elasticity of substitution, *G(•)* denote the cumulative productivity function.

Under a closed economy, new entrants only have two choices: exit or serve the domestic market. There is only one cutoff productivity level φ^* that determines the industry's equilibrium. Both zero cutoff profit (ZCP) condition and free entry (FE) condition depict the relationship between the average profit level $\bar{\pi}$ and cutoff productivity level φ^*, the two determinants of the industry's equilibrium. Formally, the two conditions can be expressed as:

(4.2) $$\bar{\pi} = f \cdot k(\varphi^*) = f \left[\frac{\tilde{\varphi}(\varphi^*)}{\varphi^*} \right]^{\sigma-1} - 1$$ (ZCP),

(4.3) $$\bar{\pi} = \frac{\delta f_e}{1 - G(\varphi^*)}$$ (FE),

where *f* denotes the fixed costs of production, f_e denotes the sunk cost required for entry, δ denotes a constant probability of a bad shock that forces firms to exit in each period.

The zero cutoff profit condition posits that the average profit is decreasing with the cutoff productivity level, while the opposite situation arises in the free entry condition. Note that the cutoff productivity level φ^* has a continuous cumulative distribution *G(•)* which is increasing by φ^*, and hence, the average profit level $\bar{\pi}$ has a positive relationship with the cutoff φ^* in the free entry condition. However, *k(•)* is a decreasing function of the cutoff φ^* (with $\sigma > 1$) that determines a negative relationship between the cutoff φ^* and the average profit level $\bar{\pi}$ in the zero cutoff profit condition. The equilibrium cutoff productivity level φ^* and equilibrium average profit level $\bar{\pi}$ are determined by those two conditions as in figure 4.1.

In an open economy, a firm has a third choice: produce for both the domestic and foreign market (export), in addition to the previous two choices: exit or serve the domestic market only. The original cutoff productivity level φ^* is associated with firms having zero profit. Only firms with productivities equal or greater than cutoff level φ^* can successfully survive and remain in production. A new cutoff productivity level denoted as φ_x^* incurs due the possibility of serving foreign markets. Thus, the more productive firms self-select to enter the export market with productivities equal or greater than the new cut-off level φ_x^*. The free entry condition remains the same as in the closed economy. Nevertheless, the zero cut-off profit condition is altered due to additional profits in the export markets. The new zero cutoff profit condition is written as follows:

$$\text{(4.4)} \qquad \bar{\pi} = \pi_d(\tilde{\varphi}) + p_x n \pi_x(\tilde{\varphi}_x) = f \cdot k(\varphi^*) + p_x n f_x \cdot k(\varphi_x^*) \qquad \text{(ZCP)},$$

where p_x denotes the ex-ante probability that firms survive in the export market, n denotes the number of countries that a firm export to, f_x represents the fixed cost of production in the export market.

Under the open economy, firms with relatively large productivity self-select into the export market and earn extra profit reflected in equation (4.4). Thus the ZCF curve is shifted upward relative to its position in figure 4.1. The new zero cutoff profit condition and free entry condition are shown in figure 4.2 with the new equilibrium cutoff productivity level $\varphi^{*\prime}$ and average profit level $\bar{\pi}'$. As figure 4.2 displays, the new equilibrium cutoff productivity level φ^* required to survive in the domestic market increases to higher level $\varphi^{*\prime}$. This change forces firms with productivity levels between φ^* and $\varphi^{*\prime}$ to exit the domestic market. Therefore, the probability of firm exit will increase and the average profit level will be larger under situation where an economy switches from autarky to open trade.

Melitz (2003) identified three channels through which trade liberalization occurs: (i) an increase in the number of trade partners, (ii) a decrease in the fixed trade costs f_x, and (iii) a decrease in the variable trade costs τ. This study focuses on the third mechanism only. The extra profit earned through export markets π_x in equation (4.4) can be defined as follows:

$$\pi_x(\tilde{\varphi}_x) = \frac{\tau^{1-\sigma} r_x(\tilde{\varphi})}{\sigma} - f_x, \tag{4.5}$$

where r_x denotes firms' additional revenue from exporting. When variable trade costs τ decline, $\tau^{1-\sigma}$ will increase as the elasticity of substitution is greater than one. Hence, the ZCP curve will shift further up as in figure 4.2. The new equilibrium cutoff productivity level φ^* further increases again during the trade liberalization process. All firms with productivity levels ranging from $\varphi^{*\prime}$ to $\varphi^{*\prime\prime}$are now forced to exit from the domestic market. The trade-cost induced exit of low-productivity firms is referred to as the extensive margin. The underlying hypothesis of extensive margin is that more exposure to trade increases the probability of domestic firm's exit from its home market due to the higher equilibrium cutoff productivity level relative to a closed economy or an open economy without trade liberalization.

On the other hand, the equilibrium average profit level also increases with the export participation of high-productivity. Resources such as labor released from exiting firms are now reallocated to more productive firms with higher revenue and profit, i.e., there is adjustment along the intensive margin. The net effect of trade liberalization on industry employment requires an accounting of how much employment is: (i) lost due to existing firms, (ii) gained from entering (new) firms, and (iii) gained or lost by surviving firms. Among the surviving firms, some may expand and others may shrink. Overall, the average profit level within an industry will increase due to declining variable trade costs. Hence, the underlying hypothesis of the intensive margin is that there might be more employment opportunities through resource reallocation under trade liberalization process.

Figure 4.3 and 4.4 show how market shares and profits of firms with different levels of productivity change under three scenarios. When a closed economy opens its markets, all firms lose part of domestic sales resulting from intensified foreign competition. Foreign corporations enter domestic market and seize domestic market shares in the competition with domestic firms. Recall that the cutoff level has been bid up because of intensive competition and the least-productive firms exit now due to negative profits. Firms with productivity just above the cut-off level, i.e. the low-productive firms, continue to serve only for the domestic market, but incur a profit loss due to lower market shares. The high-productive firms self-select into the export market and gain more total revenues with increased foreign market shares. Among high-productive firms, some face a tradeoff between increased total revenue and additional costs of exporting including fixed costs of foreign market entry and variable costs of production. Such firms might lose profits, as extra fixed export cost cannot be completely covered by increased total revenue. Only the most productive firms gain more profits after entering the export markets.

In an open economy with declining variable trade costs τ, the cutoff productivity keeps increasing, which forces the next set of least-productive firms to exit – the extensive margin. Nevertheless, lowered trade barriers reduce the cutoff productivity level for entering the export market, which encourage more high-productive firms to enter foreign markets. The direction of the change in firms' revenue and profit shown in figure 4.3 implies that production resources, e.g. employment, will be reallocated from less productive to more productive firms – intensive margin. Both factors will improve national welfare, but some regions may lose because of firm exits and job losses.

In addition to Melitz (2003), Melitz and Ottaviano (2008) consider the relationship between market size and the equilibrium cutoff productivity level, firm performance measures (profit, revenue, mark-up) and distribution of firms in the process of trade liberalization. Market size in terms of the number and average productivity of competing firms influences the "toughness" of competition across markets. Melitz and Ottaviano (2008) incorporate endogenous differences in mark-ups across firms that respond to the "toughness" of competition into the monopolistically competitive model with heterogeneous firms. The introduction of endogenous distribution of mark-ups will influence the selection of producers and exporters with heterogeneous productivities in that market. They conclude that the selection process is tougher in the larger market leading to higher average productivity and lower average prices relative to smaller markets. In addition, the average firm size in terms of output and sales and profits are both higher in the larger market. The increased competition in the larger market induces a downward shift in the distribution of mark-ups across firms. Only relatively more productive firms with relatively higher mark-ups can survive and the less-productive firms have to exit. As a result, the average mark-up is reduced during trade liberalization. In this model, welfare gains from trade thus include productivity gains via selection, lower mark-ups via pro-competition effect, and increased product variety. Syverson (2007) provides empirical evidence that larger markets induce larger average plant size along with higher average plant productivity. He obtains further support for the tougher competition effect in larger markets: the distribution of productivity is less disperse with a higher lower bound for the productivity distribution. This framework provided by Melitz and Ottaviano (2008) develops a new and very tractable way of analyzing how differences in market size and trade costs across trading partners affect the firm dynamics (entry, exit, and survival) and resource reallocation (e.g. employment turnover) across markets. Incorporating market size, this study will examine the impact of trade costs on regional exit and employment patterns in U.S. private industries in the spirit of Melitz and Ottaviano (2008) in the next few chapters.

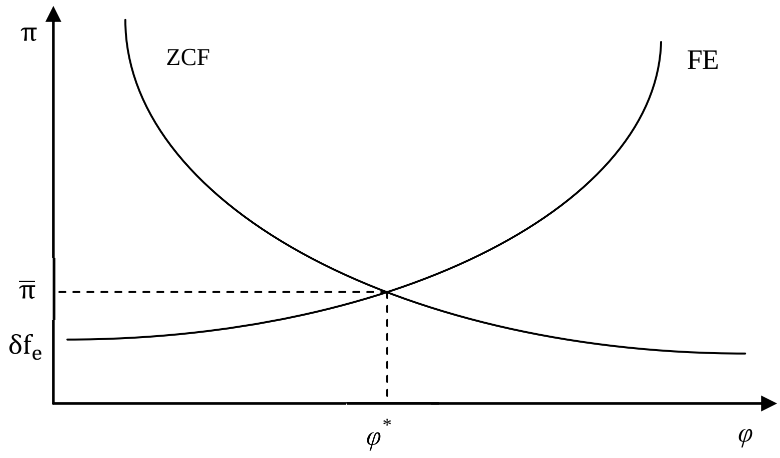

Figure 4.1. Average Profit Level $\bar{\pi}$ and Cutoff Productivity Level Φ^* under the Equilibrium in the Closed Economy

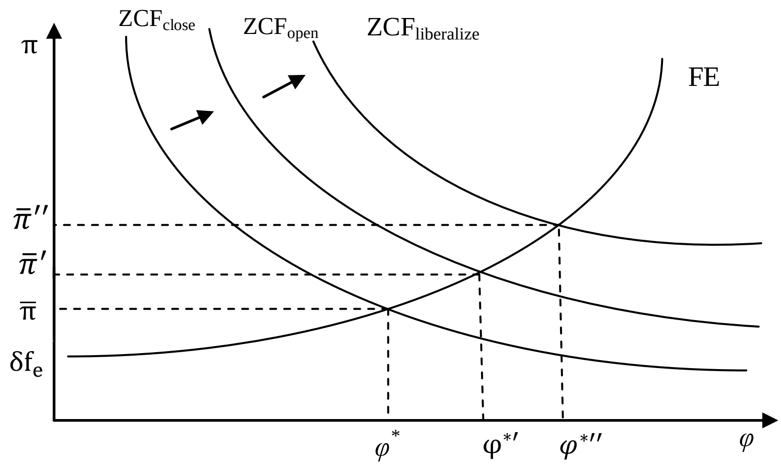

Figure 4.2. Average Profit Level $\bar{\pi}$ and Cutoff Productivity Level Φ^* under the Equilibrium in the Open Economy and Trade Liberalization

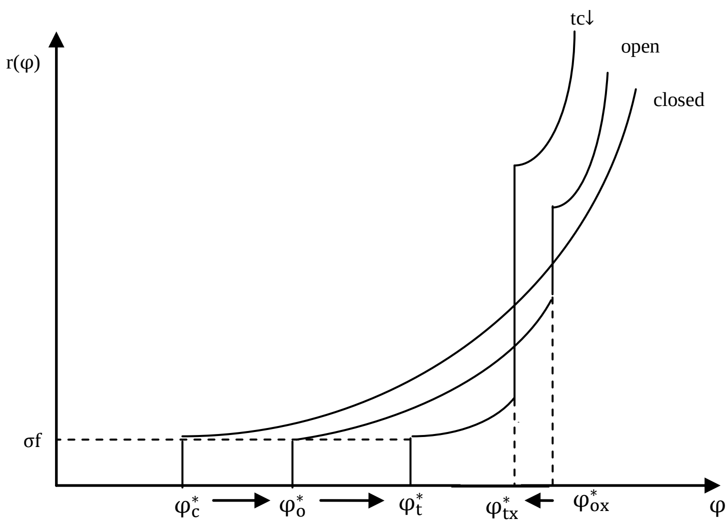

Figure 4.3. Firms' Revenue and Cutoff Productivity Level under Three Scenarios

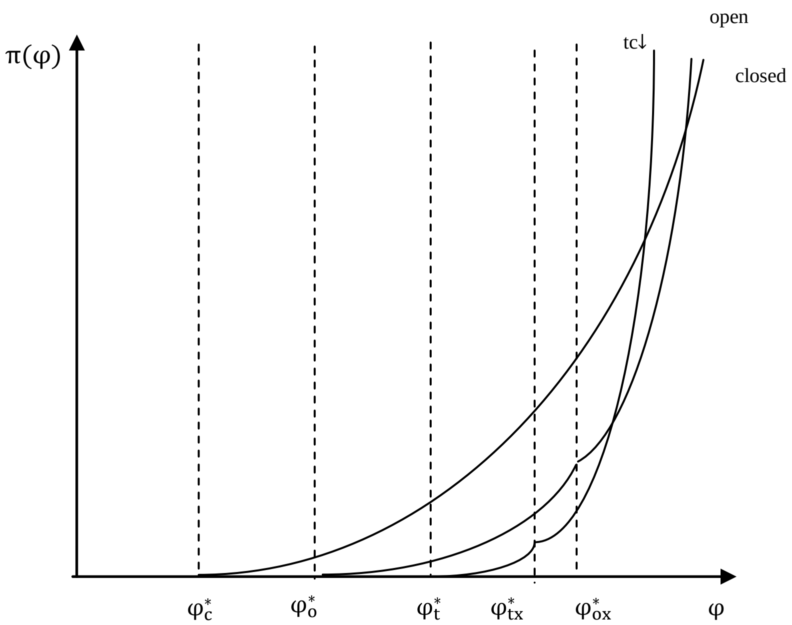

Figure 4.4. Firms' Profit and Cutoff Productivity Level under Three Scenarios

CHAPTER 5

5. AVAILABLE DATA ON U.S. BUSINESS DYNAMICS: EXIT, ENTRY, AND EMPLOYMENT

The primary sources of data for examining issues described in Chapter 4 are Business Dynamics Statistics (BDS) and Statistics of U.S. Businesses (SUSB), both from U.S. Census Bureau, trade costs from Chapter 2, and finally the Bureau of Economic Analysis, U.S. Department Commerce. Much of these data are at the firm- or establishment-level, but static in the sense that firms are not tracked over time. For the purposes of this study, these firm- or establishment-level data are aggregated to regional- or state-level to be consistent with the measures of trade costs. Thus, data are two dimensional: state or region, s, and time t. The following describes in detail the available data and their definitions.

5.1 Business Dynamics Statistics (BDS)

To examine the extensive and intensive margin changes at the U.S. region level, the BDS database from U.S. Census Bureau is accessed. The BDS database contains annual data series describing establishment-level business dynamics, entry, exit and job creation. A unique BDS feature is its longitudinal source data that permit tracking establishments and firms by size and age groups over time.[14] That is, key economic data including number of establishments, establishment openings and closings, number of employment, job creation and destruction are recorded in BDS data along dimensions of firm size and firm age. BDS series provides annual statistics from 1976 through 2009 by U.S. states. This study focuses on BDS data during 1998-2009, which consists of over six million establishments in the entire U.S. private industry (all sectors: food, manufacturing, construction, mining and services) that are located in 56 regions or customs districts.

The annual statistics of BDS database accessed for examining extensive margin and intensive margin contain *Firm_Size, Firm_Age, Firms, Estabs, Estabs_Exit, Estabs _ Entry, Emp, Job_Creation, Job_Destruction*.

- *Firm_Size* classifies firms by size, which is measured by the average employment over a consecutive two-year period (*t-1* and *t*),
- *Firm_Age* is defined by the difference between the initial operation year and the current year,
- *Firms* measures the number of firms that have positive employment and consist of one or more domestic establishments that were specified under common ownership or control in the current year *t*,
- *Estabs* measures the number of establishments that have positive employment and conduct business or perform services or industrial operations in the current year *t*,
- *Estabs_Entry* measures the total number of establishments which report zero employment in the last year *t-1* and positive employment in the current year *t*,
- *Estabs_Exit* measures the total number of establishments with zero employment in the current year *t* and positive employment in the prior year *t-1*.

Note that data on *Estabs_Exit* will be used to construct the response variable in the empirical model of extensive margin hypothesis,

- *Emp* measures the total number of paid employment consisting of full and part-time employees, who are on the payroll in the pay period including March 12,
- *Job_Creation* measures the number of employment gains from expanding establishments from *t-1* to *t*. The new employment opportunities created by new entrants (*Firm_Age*=0) is also included in the *Job_Creation*, and
- *Job_Destruction* measures the number of employment loss from contracting establishments from *t-1* to *t*.

5.2 Statistics of U.S. Businesses (SUSB)

The SUSB from the U.S. Census Bureau provides data comparable to BDS, but for each major U.S. three-digit NAICS industry.[15] Annual data include number of firms, number of establishments, employment, and annual payroll for most U.S. business establishments within each industry. In addition, data include number of establishment deaths and births. Both data are tabulated by geographic area, industry, and enterprise employment size. Industry classification is based on 2007 North American Industry Classification System (NAICS) codes. Here:

- *Establishment* is defined as a single physical location where business is conducted or where services or industrial operations are performed,

- *Employment* accounts for the number of paid employment who are on the payroll in the pay period including March 12 every year. It consists of full and part-time employees,
- *Annual Payroll* is defined as total annual payroll including all forms of compensation paid during the year to all employees, and
- *Firm* is defined as a business organization consisting of one or more domestic establishments in the same state and industry that were specified under common ownership or control.

For single-establishments, the firm is equivalent to the establishment. However, if the firms are multi-establishments, the employment and annual payroll of firms are for all establishments under common ownership. Additionally,

- *Establishment Births* corresponds to the number of the establishments that have zero employment in the first quarter of the initial year and positive employment in the first quarter of the subsequent year, and
- *Establishment Deaths* corresponds to the number of the establishments that have positive employment in the first quarter of the initial year and zero employment in the first quarter of the subsequent year.

5. 3 Trade Costs and Other Regressors

Recall from Chapter 2 that trade costs here refer to all factors limiting the movement of goods and services across countries, including handling and transportation costs, tariffs and other barriers. Equation (2.21) in Chapter 2 is used to measure U.S. region-level relative bilateral trade costs, broadly defined to include policy, geographic, and institutional factors limiting trade. We have computed two alternative trade costs series: one that is based on *U.S. Exports of Merchandise* and *U.S. Imports of Merchandise* from the Foreign Trade Statistics of U.S. Census Bureau, and another that is based on *WISERTrade* database, U.S. Census Bureau.[16] Both databases characterize the current value of commodities identified by the ten-digit Harmonized System (HS) Schedule B Classification from a U.S. customs district (*i*) to each final destination (*j*). The *Merchandise Imports* and *Exports* databases report where cargo entered or exited the United States, which may not correspond to where the goods were produced or consumed (that is, state of origin of movement and state of ultimate destination are unknown). In the *WISERTrade* database, the state of origin of movement and state of ultimate destination are recorded, but data availability is limited, i.e. 2008-2009.

Several additional factors that may impact extensive and intensive margin are considered:

- *Startup* is defined as the ratio of establishments with equal or less than three years' operation to the total establishments within the U.S. private industry or each major U.S. three-digit NAICS industry per year,

- *Wage*, the U.S. state real per capital personal income (in 2005 dollars) that comes from the table of Personal Income, Per Capita Personal Income, Disposable Personal Income and Population under Regional Data section from Bureau of Economic Analysis, U.S. Department of Commerce. To examine business dynamics for each U.S. three-digit NAICS industry, the variable *Wage* is measured directly using the annual payroll divided by the number of employment. Payroll is converted to 2005 dollars by deflating it with the annual price indexes for personal consumption and expenditure (Bureau of Economic Analysis, U.S. Department of Commerce).
- *Multi-establishment Status* is defined as the ratio of number of establishments to the number of firms within U.S. private industries or each major U.S. three-digit NAICS industry per year, and
- *Market Size* in this study employs annual population estimate on July 1 for each U.S. state extracted from U.S. Census Bureau.

CHAPTER 6

6. EMPIRICAL FRAMEWORK

6.1 Empirical Framework for Extensive Margin

In order to examine the extensive margin changes arising from variable trade costs' changes, a logistic regression model is specified for the probability of exit. Based on the trade-cost measure from the previous chapter, and using insights from Bernard, Jensen and Schott (2006), the following logistic regression model is proposed for estimation:

$$(6.1) \qquad Logit(P^d_{s,t}) = \log(\frac{P^d_{s,t}}{1-P^d_{s,t}}) = \beta^d_0 + \beta^d_1 \tau_{s,t-1} + \beta^d_x X_{s,t-1} + \delta_s + \delta_t \ ,$$

where *s* denotes each U.S. state, and *t* indexes time. In this regression model, the dependent variable $P^d_{s,t}$ is the probability of death for establishments located in the U.S. state *s* during year *t-1* and *t*. The term $\tau_{s,t-1}$ represents variable trade costs in the U.S. state *s* at year *t-1*. Recall two measures of trade costs, which are referred to using their respective samples: 1998-2009 and 2008-2009.

The term $X_{s,t-1}$ represents a list of explanatory variables including size, age, wage, and ownership, which are characteristics of a representative establishment of U.S. industries (either private industries or major three-digit NAICS industries). All of those characteristics have been found to potentially affect establishment survival in numerous studies (Dunne *et al.*, 1989; Bernard *et al.*, 2006, etc.). Specific variables included in $X_{s,t-1}$ are:

- Total employment to represent the size of the establishment. The sign associated with variable $log(emp_{s,t-1})$ is expected to be negative, which implies that an establishment with a larger size tends to have a lower probability of exit.

- *Startup*$_{s,t-1}$ represents the proportion of startup establishments having three years or less length of operation. The expected sign associated with variable *Startup*$_{s,t-1}$ should be positive, as younger establishments are more likely to exit than are firms that have a long track record (Bernard *et al.*, 2006).

In addition, controls for the wage level and multi-establishment status are included as recent studies find that these attributes also influence the dynamics of establishments (Bernard and Jensen, 2007). The real per capita income in the log form, denoted as $log(wage_{s,t-1})$, is included to control for the wage level differences across states. High wages are likely to proxy for high labor productivity. Recall that establishments with productivity larger than the cut off level in a market tend to survive (Melitz, 2003). Thus, the sign associated with $log(wage_{s,t-1})$ is expected to be negative. Furthermore, Bernard *et al.* (2006) add control for multi-establishment status to examine the reallocative effects of changing trade costs on establishment survival. In order to measure the multi-establishment status of a representative establishment in some industry, the ratio of total number of establishments to total number of firms is employed. The expected sign associated with multi-establishment status is negative since firms that have multiple units of establishments or plants are usually more productive due to large amount of skilled labor and efficient capital (Bernard and Jensen, 2007). Local market size, measured by population, is included to control for the influence of competition. The coefficient on *log(pop)* is expected to be negative, since establishments in large markets are more productive and tend to have a higher chance of survival. Finally, δ_s and δ_t denote sets of state and time dummies.[17]

In order to fully explore the establishment dynamics in response to changing variable trade costs, an establishment birth equation is specified:

$$(6.2) \qquad Logit(P^b_{s,t}) = \log(\frac{P^b_{s,t}}{1-P^b_{s,t}}) = \beta^b_0 + \beta^b_1 \tau_{s,t-1} + \beta^b_x X_{s,t-1} + \delta_s + \delta_t \ ,$$

where the dependent variable in the establishment birth equation is the ratio of the number of births to the total number of surviving establishments. The term $\tau_{s,t-1}$ is the measure of variable trade costs of state *s* at time *t-1* and $X_{s,t-1}$ is a set of control variables: size, age, wage level and multi-establishment status. The size of the local market measured by population in log form is also included in the establishment birth equations. As in the establishment death equation, year and state fixed effects are employed.

6.2 Empirical Framework for Intensive Margin

This section focuses on investigating the association between trade costs' changes and resource reallocation, specifically, employment. Particularly, three trade-induced effects on employment are explored: (i) the effects of changing trade costs on jobs in contracting establishments, (ii) the effects of changing trade costs on jobs in expanding establishments, and (iii) the effects of changing trade costs on net job creation in all continuing establishments. Again, all the investigations focus on the entire U.S. private industry during 1998-2009.

For the response of jobs in contracting establishments to changing trade costs, an establishment employment equation is specified as follows:

$$\pi_{s,t}^{cnt} = \beta_0^{cnt} + \beta_1^{cnt}\tau_{s,t-1} + \beta_2^{cnt}X_{s,t-1} + \delta_t + \varepsilon_{s,t} \ , \quad (6.3)$$

where *s* denotes each U.S. state, and *t* indexes time. In this regression model, the dependent variable $\pi_{s,t}^{c}$ is the ratio of job losses (destruction) in contracting establishments to total employment of state *s* at year *t*. The term $\tau_{s,t-1}$ represents variable trade costs in the U.S. state *s* at year *t*. The underlying hypothesis is that as trade costs fall, job losses or destruction in contracting establishments will increase because of loss of both market sales and profits, i.e., there is a negative coefficient on trade costs.

As before, $X_{s,t-1}$ represents a list of control variables: size, age, wage, ownership, and market size. All of these factors likely influence the change in the employment situation of establishments under intensified intra-industry competition due to trade liberalization. The establishment size is represented by the number of employees in the log form. A positive association between job destruction and establishment size is expected since large firms are likely to have more flexibility in rearranging labor resources. *Startup*, the ratio of establishments with equal to or less than three years' operation in total, may also be positively related to job destruction. Younger establishments are more likely to diminish their scale and employment when facing intense competition in a market. In addition, controls for the wage level and multi-establishment status are included in the intensive margin equation. Since wages proxy for productivity, a negative coefficient is expected for the log (wage) in equation (6.3). With respect to the multi-establishment status, the establishment that belongs to a multi-unit firm is quite flexible to adjust its scale based on the competitive environment and its market sales and profit level. Hence, a positive relationship is anticipated between multi-establishment status and job destruction. Again, local market size, *log(pop)*, and δ_t, the set of time dummies, are included.

A similar specification as in equation (6.4) is employed to examine the effects of changing trade costs on the job creation in expanding establishments. The regression model is as follows:

$$(6.4) \qquad \pi_{s,t}^{\exp} = \beta_0^{\exp} + \beta_1^{\exp}\tau_{s,t-1} + \beta_2^{\exp}X_{s,t-1} + \delta_t + \varepsilon_{s,t} \ ,$$

where *s* denotes each U.S. state, and *t* indexes time. In this regression model, the dependent variable $\pi_{s,t}$ is the ratio of job creation by expanding establishments to total employment for state *s* at year *t*. The term $\tau_{s,t-1}$ represents variable trade costs in the U.S. state *s* at year *t*, $X_{s,t-1}$ represents explanatory variables: size, age, wage, ownership, and market size, and δ_t denotes the set of time dummies.

With more exposure to competition under trade liberalization, only most efficient establishments thrive and grow – they export and increase both their market share profits. The jobs released by less efficient establishments are likely reallocated toward the expanding establishments. As trade costs fall, such expanding establishments are more likely to create more job openings. Thus, we anticipate a negative association between job creation by expanding establishments and trade costs. With respect to establishment and market characteristic, note that larger, younger and more efficient establishments have high potential to create employment. More specifically, the younger establishments are on the expansion track, which would add jobs to a market. In addition, establishments that can afford high wages are usually more efficient. As variable trade costs fall resulting from more exposure to trade and foreign market sales and profits rise, the most efficient establishments attract abundant employment reallocated from less efficient ones. The establishments that belong to multi-unit firms are more likely to create more jobs due to their flexibility. Market size, measured by population, is expected to be positively related to job creation by expanding establishments in a market.

Finally, whether or not changing trade costs will affect net job creation by continuing establishments is examined using the following model:

$$\pi_{s,t}^{net} = \beta_0^{net} + \beta_1^{net}\tau_{s,t-1} + \beta_2^{net} X_{s,t-1} + \delta_t + \varepsilon_{s,t} \quad , \qquad (6.5)$$

where *s* denotes each U.S. state, and *t* indexes time. In this regression model, the dependent variable $\pi_{s,t}$ is the ratio of net job creation by continuing establishments to total employment of state *s* at year *t*. The term $\tau_{s,t-1}$ represents variable trade costs in the U.S. state *s* at year *t*. The association between net job creation and trade costs measure is likely an empirical issue. On one hand, when trade costs fall, the more efficient establishments gain both market shares and profits, and then offer more employment. On the other hand, in order to survive in the market, the less efficient establishments are likely to diminish their scale and employment to reduce costs. Thus, the net of these two effects, arising from more exposure to trade, depends on their relative strength. As before, the net job creation equations includes controls and time fixed effects.

CHAPTER 7

7. RESULTS AND DISCUSSION

7.1 Establishment Exit Equations for the U.S. Private Industry

Recall that the logistic regression model of equation (6.1) is employed to investigate the potential competitive effects of changing variable trade costs. The results of estimating establishment death equations for 1998-2009 are described in this chapter focusing initially on the extensive margin hypothesis. Results are reported across nine columns in table 7.1, with the first two specifications focusing on the trade costs measure and subsequent columns including various sets of additional establishment and market characteristics. Except for the second column, results are reported with year and state fixed effects. The 1998-2009 trade costs covers 28 U.S. states that have customs districts and hence, the total number of observations in this regression model is 308. In order to alleviate concerns of endogeneity issues, we use one-year lagged explanatory variables on the right hand side of the logistic regression models.

The second column of Table 7.1 focuses only on the variable trade costs of interest without year and state fixed effects. It indicates that establishment death and variable trade costs have the expected negative association: as trade costs fall, establishment death is more likely. The coefficient on trade costs is statistically significant at the 1% level. When adding sets of state and year dummies into the regression model, the trade cost measure is still negative and statistically significant at the 1% level, as shown in the second column of table 7.1. Columns four to ten report regressions that add in establishment characteristics as well as market size.

In all nine specifications, trade costs coefficient remains negative and statistically significant between the 1% and 5% level. Note that the magnitude of the trade costs coefficient, or level of significance does not vary much with additional controls.

On the basis of likelihood ratio tests[18], the ninth specification is the preferred model, i.e. the last column of table 7.1. In this logistic regression model, the dependent variable is the odds of establishment death in the log form. The coefficient associated with variable trade costs implies that the chances of establishment death will increase as trade costs decline, which is consistent with the underlying hypothesis of heterogeneous firms theory (Melitz, 2003; Bernard *et al.*, 2003; Bernard *et al.*, 2006). Lower trade costs intensify competition within the domestic market, and force low-productivity establishments to lose market share and exit the market. Recall that the trade costs measure is relative, i.e., a ratio of international trade to domestic trade costs. Hence, the interpretation here is that when international trade costs relative to domestic trade costs decrease by one hundred percent (one unit, absolute value), the estimated odds of establishment death will raise by 8.33% holding all else constant.

The variable *Startup* (proportion of startups in total establishments) is also statistically significant and positive as expected. The odds of establishment death will increase by 1.27% with additional one percent increase in the proportion of startup establishments. This result suggests that older establishments are more likely to survive. As implied by theory, the variable *log(wage)* has a negative association with establishment death with 1% level of significance. The wage level is one indicator of an establishment's productivity. The establishment that can afford a higher wage level likely has a relatively higher marginal value of product. As mentioned in the Melitz's model (2003), the least productive establishments are always forced to exit from the market with more exposure to free trade. The less productive establishments can survive at least, but lose domestic market shares. Thus the establishments with lowest productivity are most likely to fail and exit the market. A ten percent increase in the wage level is associated with a 8.52% reduction in the odds of establishment death. The coefficient associated with multi-establishment status is negative and significant at the 1% level. As the ratio of establishments to firms increases by one percent, the estimated mean odds of establishment death will decrease by 1.16%. The latter is consistent with the claim that multi-unit firms are more likely to be productive and help their subsidiaries avoid closure risk. Market size is also a relevant factor that impacts the death probability at the 10% significance level. The establishments located in large markets are more likely survive due to agglomeration economies. Burger *et al.* (2010) find that agglomeration economies have a positive effect on new establishments' survival, especially the larger ones.

The association between establishment deaths and changing trade costs using 2008-2009 trade costs' measures is examined as a robustness check. Due to the availability of trade data on the import side, trade costs' measures are available for 48 contiguous U.S. states and one customs district for 2008-2009. Hence, in this specification of the establishment death equation, there are 49 observations in total. Regression results are displayed across eight columns in table 7.2 with the first specification focusing on the trade cost measure of interest and subsequent columns including establishment characteristics and market size. Given the cross-sectional data structure, year or state dummy variables are not included. Across all variants, trade costs negatively affect establishment death, which is consistent with the results of establishment death equation using the alternative trade cost measure. The magnitude of the trade cost coefficient is slightly greater than that of the alternative trade cost measure. On the basis of a likelihood ratio test, the fifth variant is the preferred model. In this specification, the trade cost coefficient is negative and statistically significant at the 5% level. With a 100% additional increase in international trade costs relative to domestic trade costs, the associated odds of establishment death decrease by 15.63%. As implied by theory, wage level, as an index of relative productivity, is also negatively associated with establishment death, a statistically significant result. With respect to other establishment characteristics, it appears that larger, older establishments are more likely to survive. Furthermore, for establishments that are part of a large, multi-unit firm, the probability of death conditional on other establishment characteristic is lower.

7.2 Establishment Exit Equation by Major U.S. Three-Digit NAICS Industries

Recall that the extensive margin hypothesis is that a decrease in variable trade costs raises the probability of firm (establishment) exit. This is now tested for each major U.S. three-digit NAICS industry using the SUSB database.[19] The SUSB contains information on the number of establishments, number of deaths and births, firms, employment and annual payroll for most U.S. business establishments by each three-digit NAICS industry. Nine specifications as in Table 7.1 are employed to examine establishment death in each U.S. three-digit NAICS industry. The focus is on 24 out of 33 three-digit NAICS industries during the period 1999-2006 due to data constraints. Among the 24 industries, two relate to forestry products, fish and other marine products from agricultural industries, while the other 22 are from manufacturing industries (one is an information industry). The coefficients associated with the trade cost measure in different specifications are reported across nine columns in table 7.3 with each row representing a three-digit NAICS industry. The first two columns in table 7.3 focus on the trade cost measure and subsequent columns include various sets of additional establishment and market characteristics. All the coefficients associated with other regressors have been suppressed due to space limitations. Except for the first column, results are reported with year and state fixed effects. In order to eliminate the endogeneity problem, one-year lagged explanatory variables are used on the right hand side of the logistic regression models.

In table 7.3, the coefficient and its standard error in bold font denote the associated specification as the preferred model among all various specifications. Again, the preferred model is selected on the basis of likelihood ratio test. As shown in table 7.3, in the two sub-sectors (113, 114) from U.S. agricultural industries the coefficient associated with trade costs measure is consistently negative across all specifications, however, it is not statistically significant. Increased trade exposure does not appear to play an essential role in determining the establishment exit in agricultural industries.

Approximately 50 percent of the manufacturing industries show the extensive margin effects: establishment death and variable trade costs have the expected negative association with statistical significance. Among the manufacturing industries, the trade costs measure has a relatively larger effect on establishment death in the textile related industries, including textiles and fabrics, textile mill products, and apparel products. In those three industries, the coefficient on trade costs is consistently negative and statistically significant at the 5% level after controlling for the set of establishment and market characteristics. It implies that the chances of establishment death will increase when trade costs decline. In addition, the extensive margin hypothesis is also verified in metal production related industries, including primary metal manufacturing, fabricated metal products, machinery, expect electrical, food products, printed matter products, plastic and rubber products and transportation equipment subsectors. For the remaining subsectors, such as computer and electronic products, electrical equipment, appliances and component, and so forth, the association between trade and business dynamics is not statistically significant.

Overall, the estimation results of establishment death by industry shows substantial variation. In high-end manufacturing, survival of establishments is likely dependent on innovation, management and other factors, especially in the United States which is often the technological leader. Hence, the effects of trade costs on establishment appear less relevant. On the contrary, in the relatively more competitive and low-tech industries, for example, apparel and accessories, primary metal manufacturing, trade costs play a critical role in business dynamics. For those industries under more exposure to trade, establishments have to seize market sales and gain profits in the competition with foreign establishments. Foreign companies might have the advantage of lower costs of labor or intermediate materials, and hence, gain shares in U.S. markets.

In sum, for the majority of U.S. manufacturing industries, the extensive margin effects can be verified, that as trade costs fall, establishments are more likely to fail. This is consistent with the model prediction that aggregate productivity within an industry increases due to exit of the least productive establishments, and resource reallocation toward more efficient establishments.

7.3 Establishment Entry Equations for the U.S. Private Industry

In order to comprehensively explore the association between business dynamics and variable trade costs, the effects of changing trade costs on establishment birth are also considered. Estimation results of the U.S. private industry using the 1998-2009 trade costs are reported across nine columns in table 7.4, with the second and third columns focusing on trade costs measure and subsequent columns including additional establishment and market characteristics. A set of year and state dummy variables are included in specification 2-9. On the basis of likelihood ratio tests, the ninth specification is the preferred model, i.e. the last column of table 7.4. Note that in this logistic regression model, the dependent variable is the odds of establishment birth in the log form. From table 7.4 it is apparent that there does not exist a consistent and statistically significant association between variable trade costs and establishment birth. Among controls, the wage level and market size appear most relevant than others. The variable *log(wage)*, proxying for productivity, has a positive and significant association with establishment birth at the

1% level of significance. Market size negatively influences the establishment birth, keeping all else constant, likely due to competitive pressures in a large market.

Table 7.5 reports the regression results of establishment birth equation using the 2008-2009 trade costs measure across eight columns as a robustness check. The conclusion with respect to the effects of changing trade costs on establishment birth is unchanged. Results on controls are qualitatively similar to those in table 7.4

7.4 Establishment Entry Equations by Major U.S. Three-Digit NAICS Industries

We also examine the potential effects of trade costs on establishment birth by each U.S. three-digit NAICS industry. The SUSB database from U.S. Census Bureau is accessed. The same as in the private industries, we employ the establishment birth equation to explore how trade costs affect firm entry. The coefficients associated with the trade costs measure in different specifications are reported across nine columns in table 7.6 with each row representing a three-digit NAICS industry. All the coefficients associated with other regressors have been suppressed.

Different from the estimation results in the establishment death equation, the coefficient associated with trade costs measure does not show statistical significance in the majority of all 24 three-digit NAICS industries. It indicates that the variable trade costs are not significantly related to establishment birth. However, there are a few exceptions. In the industry of chemicals, the coefficient associated with the trade costs measure is positive and statistically significant at the 10% level in the preferred model. As bilateral or multilateral trade barriers have been reduced, foreign chemical companies will enter the U.S. market or increase the foreign direct investment in the U.S. market. The domestic new establishments should have strong competitiveness and relatively higher productivity level to seize market shares from foreign companies and gain non-negative profits in order to survive in the markets. On the other hand, we find a negative association between establishment birth and variable trade costs consistently across all variants in some industries, like textile mill products, apparel and accessories. The potential reason to explain this phenomenon is that as increasing trade costs lead to higher total costs of production and operation, new establishments will be more cautious to decide to enter the market. Overall, the variable trade costs do not play an important role on the establishment birth in the majorities of subsectors from both U.S. agricultural and manufacturing industries.

7.5 Estimation Results of Job Destruction in Contracting Establishments

The intensive margin hypothesis testing begins with examining job destruction in surviving or continuing firms, which have contracted during the sample periods. Recall that the dependent variable is expressed as the ratio of job losses to total employment in the subset of surviving, but shrinking, firms. As before, alternative specifications controlling for establishment and market characteristics are estimated. The results using the 1998-2009 trade costs measure are reported across nine columns in table 7.7, with the second and third columns reporting results focusing on our trade costs measure only and subsequent columns including various sets of additional establishment and market characteristics. Except for the second column, results are reported with year fixed effects. Again, for the period 1998-2009, the sample size covering 28 U.S. states that have customs districts is 308. In order to alleviate endogeneity concerns, one-year lagged explanatory variables are used on the right hand side of these specifications.

The second column of table 7.7 focuses only on the variable trade costs of interest without year and state fixed effects. It indicates that job destruction and variable trade costs have the expected negative association: as trade costs fall, the ratio of job destruction to total employment increases. After adding a set of year dummy variables into model, the trade costs' coefficient remains negative and statistically significant at the 5% level (column 3, table 7.7). Columns three to nine adds in establishment characteristics as well as market size. Except for the first specification, the coefficient on trade costs remains negative and statistically significant in the case of job destruction by continuing, but contracting establishments. The magnitude of the trade costs' coefficient does not vary much with additional controls of establishment and market characteristics as is the level of significance.

Based on the likelihood ratio test, the ninth specification is the preferred model, which is displayed in the last column of table 7.7. Here, as noted above, the coefficient associated with trade costs measure is negative and statistically significant. It implies that contracting continuers in the market will lose jobs when trade costs decline, which is consistent with underlying hypothesis of intensive margin effects (Melitz, 2003). The intensified intra-industry competition causes the less efficient establishments to lose market sales and profits. In order to survive, they would cut operation cost, such as labor or employment. When the international trade costs relative to domestic trade costs decrease by 100%, the estimated ratio of job destruction will raise by 6.14%, holding all else constant.

The coefficient on *Startup* (proportion of young establishments in total) is positive and statistically significant, is expected. Having more start-ups then implies an increased likelihood of job losses, ceteris paribus. Such firms are known to have large turnovers in employment (Haltiwanger *et al.,* 2010). Also, the coefficient on *log(wage)* is not statistically significant in this and other specifications. The coefficient on multi-establishment status is positive and significant at the 1% level. The latter result is anticipated since multi-plant firms have the flexibility to adjust employment due to external shocks. Market size is also a relevant factor in job destruction, with its coefficient is statistically significant at the 10% level. This result arises because establishments located in the relatively larger market may endure more competitive pressures from both local and importing firms.

For a robustness check, a second set of specifications are estimated using the 2008-2009 trade costs, where the sample size is 49. Results are displayed across columns 2-9 in table 7.8 with the second column focusing on the trade cost measure of interest and subsequent columns including establishment characteristics and market size. Given the cross-sectional data structure, year fixed effects are not included. Across all variants, the coefficient on trade costs remains negatively related to job destruction, but the magnitude of this effect is much larger than that when using the 1998-2009 trade costs measure. It suggests that the potential effect of changing trade costs on resource reallocation is intense in the later period of the sample. The preferred specification, five, shows that when international trade costs relative to domestic trade costs decrease by 100%, the estimated ratio of job destruction rises 38.94%, all else constant. With respect to controls, the coefficient on *Startup* and multi-establishment firms takes the same sign as in table 7.7, with statistical significance at the 1% level.

7.6 Estimation Results of Job Creation by Expanding Establishments

The estimation results of job creation by expanding establishments are reported across nine columns in table 7.9, with the second and third columns focusing on our trade costs measure, and subsequent columns having additional establishment and market characteristics. The response variable of this regression model is the ratio of job creation by expanding establishments to total employment within U.S. private industry by each state during 1998-2009. Except for the second column, results are reported with year fixed effects. A one-year lag of explanatory variables is used in the right hand side of these specifications to alleviate possible endogeneity.

Based on the likelihood ratio test, the ninth specification is the preferred model, i.e. the last column of table 7.9. However, results across all specifications do not show a negative and statistically significant association between ratio of job creation by expanding establishments and trade costs. All establishment and market characteristics, by contrast, do significantly relate to the response variable. The coefficient on *Startup* is positive and statistically significant. Recall that a positive coefficient was obtained in job destruction models as well. The relatively young establishments have more potential, but also face risks. A recent study by the Center for Economic Studies showed that relatively young and small firms created and lost a large share of jobs in the United States (Haltiwanger *et al.* 2010)[20]. In contrast to the job destruction equation, the variable *log(wage)* has a positive and statistically significant association with job creation at the 1% level. As noted earlier, the wage level could be proxy for the establishment's productivity. During trade liberalization, only most efficient establishments that can gain both market sales and profits could expand the scale of employment. The coefficient on multi-establishment status is positive and significant at the 1% level in the job creation and destruction models. This signals firm flexibility in adjusting scale based on the competitive environment. Finally, the coefficient on market size is also positive and significant at the 1% level. This indicates again that large markets face substantial churning of resources (job destruction and creation).

Similar to the hypotheses above, specifications using the 2008-2009 trade costs allow for a robustness check. Results are displayed in columns 2-9 in Table 7.10 with the second column focusing on the trade cost measure of interest, and subsequent columns having establishment characteristics and market size. Different from the results in Table 7.9, the coefficient on trade costs is negative with statistical significance in several specifications (Table 7.10). The negative sign is consistent with the intensive margin based on intra-industry resource reallocation, which is common in heterogeneous firms models. The fifth specification, column 6 of Table 7.10, is the most preferred model based on likelihood ratio tests. Here, when the international trade costs relative to domestic trade costs decrease by 100%, the estimated ratio of job creation by expanding establishments relative to total employment rises by 35.67%, ceteris paribus. *Startup*, *log(wage)* and multi-establishment status remain key factors related to job creation by expanding establishments.

7.7 Estimation Results of Net Job Creation by Continuers

In order to fully explore the potential effects of changing trade costs on the labor market of U.S. private industries, a net job creation equation is employed. The estimation results using the 2008-2009 trade costs measure are reported in the last nine columns of Table 7.11, with the second and third columns focusing on our trade costs measure, and subsequent columns including various sets of additional establishment and market characteristics. As before, the right hand side of this equation employs one-period lagged explanatory variables. The second column of Table 7.11 focuses only on the variable trade costs of interest without year and state fixed effects. The association between net job creation and trade costs measure is not statistically significant. After adding set of year dummy variables into model, trade costs measure is still not significant. The column three to nine adds in establishment characteristics as well as market size. Across all nine specifications, a significant association between net job creation and trade costs is not found. Nevertheless, establishment characteristics, age and wage level, are significantly related to net job creation. Furthermore, market size is also a relevant factor that influences net job creation; the significance level is 1%. The negative sign on market size suggests that in recent years, large regions have not contributed to job creation. In the robustness check in Table 7.20, the coefficient on trade costs remains positive and statistically significant in some specifications. It would appear that job destruction arising from shrinking establishments is a stronger feature than job creation by expanding establishments. The dominant job destruction effect coincides with the severe recession encountered during 2008-2009. Other control variables are largely in line with expectations and have an effect similar to that in Table 7.11.

Table 7.1. Probability Of Death in the U.S. Private Industry, 1998-2009

Regressors	Logit: Deaths of Establishments, 1998-2009								
	Specification One	Specification Two	Specification Three	Specification Four	Specification Five	Specification Six	Specification Seven	Specification Eight	Specification Nine
Trade Cost	-0.092***	-0.146***	-0.119***	-0.095**	-0.122***	-0.085**	-0.136***	-0.094**	-0.080**
	(0.022)	(0.045)	(0.044)	(0.042)	(0.043)	(0.042)	(0.044)	(0.042)	(0.042)
Startup			1.938***		0.931*	1.010**	1.235***		1.256**
			(0.437)		(0.542)	(0.491)	（0.395）		(0.511)
Log (employment)			-0.423***		-0.424***				
			(0.114)		(0.113)				
Log(wage)				-0.787***		-0.879***		-0.779***	-0.887***
				(0.134)		(0.140)		(0.134)	(0.140)
Ratio of multi plant				-2.033***	-1.816***	-1.217**		-2.123***	-1.171**
firm				(0.422)	(0.595)	(0.578)		(0.431)	(0.576)
Market Size							-0.160	-0.100	-0.171*
							(0.109)	(0.098)	(0.101)
State fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	308	308	308	308	308	308	308	308	308
Log likelihood	-36304.59	-6322.50	-5974.75	-5554.68	-5830.57	-5494.61	-6156.88	-5539.54	-5454.14
C Statistic	0.508	0.530	0.531	0.532	0.531	0.533	0.530	0.532	0.533

Notes: Standard deviations are in parentheses. Coefficients for the intercept and dummies are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 7.2. Probability Of Death in the U.S. Private Industry, 2008-2009

Regressors	Logit: Deaths of Establishments, 2008-2009							
	Specification One	Specification Two	Specification Three	Specification Four	Specification Five	Specification Six	Specification Seven	Specification Eight
Trade Cost	-0.114	-0.147*	-0.367***	-0.148*	-0.169**	-0.140	-0.100	-0.159*
	(0.137)	(0.091)	(0.135)	(0.093)	(0.074)	(0.091)	(0.144)	(0.086)
Startup		3.574***		3.557***	3.159***	3.567***		3.119***
		(0.289)		(0.322)	(0.284)	（0.291）		(0.338)
Log (employment)		-0.026*		-0.025*				
		(0.015)		(0.015)				
Log(wage)			-0.387***		-0.236***		-0.603***	-0.247***
			(0.130)		(0.069)		(0.131)	(0.085)
Ratio of multi plant firm			-1.667***	-0.028	-0.447*		-1.909***	-0.472*
			(0.406)	(0.228)	(0.238)		(0.370)	(0.265)
Market Size						-0.024*	0.087***	0.004
						(0.015)	(0.024)	(0.017)
Observations	49	49	49	49	49	49	49	49
Log likelihood	-6535.69	-1648.42	-4711.38	-1647.95	-1432.72	-1659.38	-3703.72	-1431.30
C statistic	0.498	0.533	0.522	0.534	0.535	0.533	0.525	0.535

Notes: Standard deviations are in parentheses. Coefficients for the intercept and dummies are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 7.3. The Coefficient of Trade Costs in the Establishment Death Equation of Each U.S. Three-Digit NAICS Industry, 1999-2006

Ind	Description	S1	S2	S3	S4	S5	S6	S7	S8	S9
113	Forestry products	-0.03	-0.05	-0.04	-0.02	-0.03	-0.02	-0.04	**-0.01**	-0.01
		(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	**(0.04)**	(0.04)
114	Fish, fresh, chilled, or frozen and other marine products	-0.06	-0.06	-0.04	-0.19*	**-0.03**	-0.20*	-0.05	-0.11	-0.18
		(0.10)	(0.10)	(0.15)	(0.11)	**(0.13)**	(0.12)	(0.10)	(0.17)	(0.19)
311	Food and kindred products	-0.16***	-0.16***	-0.04	-0.10**	-0.02	-0.003	-0.05	**-0.08***	-0.01
		(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	**(0.04)**	0.04
312	Beverages and tobacco products	0.06	0.05	0.08	0.14	**0.12**	0.15	0.06	0.07	0.09
		(0.10)	(0.10)	(0.10)	(0.10)	**(0.10)**	(0.10)	(0.11)	(0.10)	(0.10)
313	Textiles and fabrics	-0.33***	-0.32***	**-0.21****	-0.29***	-0.18*	-0.15	-0.22**	-0.25**	-0.15
		(0.09)	(0.08)	**(0.08)**	(0.10)	(0.09)	(0.10)	(0.09)	(0.10)	(0.10)
314	Textile mill products	-0.33***	-0.33***	-0.28***	-0.34***	**-0.20*****	-0.27***	-0.17**	-0.22***	-0.19***
		(0.06)	(0.06)	(0.06)	(0.06)	**(0.07)**	(0.07)	(0.07)	(0.07)	(0.07)
315	Apparel and accessories	-0.32***	-0.32***	-0.18**	-0.29***	-0.13	-0.29***	-0.19**	-0.21**	**-0.24*****
		(0.08)	(0.08)	(0.08)	(0.08)	(0.09)	(0.09)	(0.09)	(0.09)	**(0.08)**
316	Leather and allied products	-0.09	-0.09	**-0.04**	-0.08	-0.02	-0.03	-0.08	-0.14	-0.05
		(0.08)	(0.08)	**(0.10)**	(0.08)	(0.10)	(0.09)	(0.11)	(0.12)	(0.12)
321	Wood products	-0.04*	-0.05**	-0.002	-0.06**	-0.002	-0.01	**-0.002**	-0.06**	-0.01
		(0.03)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	**(0.02)**	(0.03)	(0.03)
322	Paper	-0.10***	-0.09***	-0.04	-0.08**	-0.03	-0.03	**-0.04**	-0.06	-0.03
		(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	**(0.04)**	(0.04)	(0.04)
323	Printed matter and related products	-0.18***	-0.18***	**-0.09*****	-0.19***	-0.10***	-0.11***	-0.08***	-0.12***	-0.10***

		(0.02)	(0.02)	**(0.02)**	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
324	Petroleum and coal products	-0.06	-0.02	-0.01	-0.03	**-0.06**	0.004	-0.002	-0.05	-0.02
		(0.17)	(0.18)	(0.18)	(0.18)	**(0.17)**	(0.18)	(0.18)	(0.18)	(0.19)
325	Chemicals	-0.08**	-0.07**	**-0.01**	-0.09***	-0.02	-0.01	-0.01	-0.06	-0.01
		(0.04)	(0.03)	**(0.03)**	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)
326	Plastics and rubber products	-0.23***	-0.22***	**-0.15*****	-0.16***	-0.16***	-0.13***	-0.16***	-0.17***	-0.16***
		(0.04)	(0.04)	**(0.03)**	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)
327	Nonmetallic mineral products	-0.08*	-0.07	-0.04	-0.09*	-0.04	**-0.03**	-0.05	-0.10**	-0.04
		(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	**(0.05)**	(0.05)	(0.05)	(0.05)
331	Primary metal manufacturing	-0.26***	-0.27***	**-0.14****	-0.20***	-0.13**	-0.10	-0.14**	-0.19**	-0.09
		(0.08)	(0.06)	**(0.06)**	(0.07)	(0.06)	(0.07)	(0.06)	(0.07)	(0.08)
332	Fabricated metal products	-0.30***	-0.29***	-0.14***	-0.36***	-0.09**	**-0.13*****	-0.15***	-0.30***	-0.15***
		(0.07)	(0.06)	(0.05)	(0.05)	(0.05)	**(0.05)**	(0.05)	(0.06)	(0.05)
333	Machinery, except electrical	-0.25***	-0.24***	**-0.10***	-0.28***	-0.10*	-0.08	-0.07	-0.20***	-0.08
		(0.07)	(0.06)	**(0.05)**	(0.07)	(0.05)	(0.05)	(0.05)	(0.07)	(0.06)
334	Computer and electronic products	-0.11**	-0.10**	**0.03**	-0.04	0.02	0.002	0.03	0.06	0.03
		(0.05)	(0.05)	**(0.06)**	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)
335	Electrical equipment, appliances, and component	-0.13***	-0.13***	**-0.05**	-0.11**	-0.07	-0.05	-0.01	-0.003	0.01
		(0.05)	(0.05)	**(0.05)**	(0.05)	(0.06)	(0.05)	(0.06)	(0.07)	(0.07)
336	Transportation equipment	-0.08**	-0.07*	-0.05	-0.22***	-0.04	**-0.08***	-0.04	-0.18***	-0.07
		(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	**(0.05)**	(0.04)	(0.05)	(0.05)
337	Furniture and fixtures	-0.19***	-0.19***	-0.04	-0.16***	-0.03	**-0.05**	-0.04	-0.12***	-0.04
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	**(0.03)**	(0.04)	(0.03)	(0.04)
339	Miscellaneous manufactured commodities	-0.11**	-0.11**	-0.02	-0.08*	-0.05	**-0.07***	-0.01	0.02	-0.03
		(0.05)	(0.05)	(0.04)	(0.05)	(0.05)	**(0.04)**	(0.05)	(0.06)	(0.04)

511	Newspapers, books & other published matter, nesoi	0.01 (0.02)	0.01 (0.02)	**0.01** **(0.02)**	0.01 (0.02)	0.01 (0.02)	0.01 (0.02)	0.01 (0.02)	0.01 (0.02)	0.01 (0.02)

Notes: The coefficient associated with the trade cost variable in the logistic regression of establishment death during 1999-2006 for nine specifications is shown in the table 7.3. Set of state and year dummies are included in the model. Standard deviations are in parentheses. Coefficients for the intercept, other independent variables, and dummies are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 7.4. Probability of Birth in U.S. Private Industries, 1998-2009

Regressors	Logit: Births of Establishments, 1998-2009								
	Specification One	Specification Two	Specification Three	Specification Four	Specification Five	Specification Six	Specification Seven	Specification Eight	Specification Nine
Trade Cost	-0.100***	0.051	0.054	0.026	0.053	0.029	0.060*	0.028	0.032
	(0.029)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)
Startup			0.651*		0.545	0.202	0.946***		0.405
			(0.358)		(0.453)	(0.419)	（0.315）		(0.436)
Log (employment)			0.051		0.051				
			(0.096)		(0.096)				
Log(wage)				0.442***		0.424***		0.452***	0.417***
				(0.117)		(0.123)		(0.117)	(0.123)
Ratio of multi plant				-0.644*	-0.195	-0.476		-0.753**	-0.436
firm				(0.366)	(0.511)	(0.506)		(0.372)	(0.505)
Market Size							-0.157*	-0.123	-0.146*
							(0.089)	(0.084)	(0.088)
State fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	308	308	308	308	308	308	308	308	308
Log likelihood	-67125.24	-4867.55	-4790.04	-4663.27	-4788.36	-4660.72	-4758.04	-4639.97	-4630.49
AIC	134254.47	9813.10	9662.07	9408.54	9660.72	9405.44	9598.08	9363.94	9346.99
C Statistic	0.511	0.541	0.542	0.543	0.542	0.543	0.542	0.543	0.543

Notes: Standard deviations are in parentheses. Coefficients for the intercept and dummies are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 7.5. Probability of Birth in the U.S. Private Industries, 2008-2009

Regressors	Logit: Births of Establishments, 2008-2009							
	Specification One	Specification Two	Specification Three	Specification Four	Specification Five	Specification Six	Specification Seven	Specification Eight
Trade Cost	-0.164	0.003	-0.245*	0.015	0.005	-0.004	0.074	0.017
	(0.127)	(0.059)	(0.140)	(0.059)	(0.049)	(0.060)	(0.147)	(0.057)
Startup		3.241***		3.352***	3.635***	3.248***		3.588***
		(0.189)		(0.207)	(0.190)	（0.191）		(0.223)
Log (employment)		0.022**		0.021**				
		(0.010)		(0.010)				
Log(wage)			-0.035		0.143***		-0.269**	0.131**
			(0.135)		(0.046)		(0.133)	(0.056)
Ratio of multi-			-0.956**	0.184	0.448***		-1.204***	0.420**
plant firm			(0.423)	(0.146)	(0.159)		(0.375)	(0.174)
Market Size						0.020**	0.098***	0.005
						(0.010)	(0.025)	(0.011)
Observations	49	49	49	49	49	49	49	49
Log likelihood	-4791.19	-752.39	-4269.35	-735.22	-691.89	-760.21	-3212.75	-690.20
AIC	9586.39	1512.78	8546.69	1480.44	1393.77	1528.42	6435.50	1392.41
C Statistic	0.508	0.532	0.514	0.533	0.534	0.533	0.520	0.534

Notes: Standard deviations are in parentheses. Coefficients for the intercept and dummies are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 7.6. The Coefficient of Trade Costs in the Establishment Birth Equation of Each U.S. Three-Digit NAICS Industry, 1999-2006

Ind	Description	S1	S2	S3	S4	S5	S6	S7	S8	S9
113	Forestry products	-0.04	-0.03	-0.01	-0.03	-0.02	-0.03	**-0.03**	-0.02	-0.02
		(0.04)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	**(0.04)**	(0.04)	(0.04)
114	Fish, fresh, chilled, or frozen and other marine products	-0.02	-0.03	-0.21*	-0.09	-0.24**	-0.09	-0.01	-0.16	**-0.25***
		(0.07)	(0.08)	(0.11)	(0.08)	(0.11)	(0.09)	(0.09)	(0.13)	**(0.14)**
311	Food and kindred products	-0.20***	-0.20***	-0.03	-0.21***	**-0.09***	-0.07	-0.05	-0.18***	-0.08
		(0.06)	(0.06)	(0.05)	(0.06)	**(0.05)**	(0.05)	(0.05)	(0.06)	0.05
312	Beverages and tobacco products	-0.10	-0.06	0.04	-0.04	0.04	0.04	**0.03**	-0.04	0.02
		(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	**(0.08)**	(0.09)	(0.09)
313	Textiles and fabrics	-0.57***	-0.58***	-0.24*	-0.37**	**-0.18**	-0.25	-0.30*	-0.36**	-0.26
		(0.15)	(0.15)	(0.12)	(0.15)	**(0.14)**	(0.16)	(0.16)	(0.16)	(0.16)
314	Textile mill products	-0.41***	-0.42***	-0.33***	-0.42***	-0.32***	**-0.32*****	-0.32***	-0.37***	-0.31***
		(0.08)	(0.08)	(0.08)	(0.08)	(0.09)	**(0.09**)	(0.09)	(0.09)	(0.10)
315	Apparel and accessories	-0.52***	-0.51***	-0.46***	-0.18*	-0.31***	**-0.18***	-0.33***	-0.18*	-0.19*
		(0.10)	(0.10)	(0.10)	(0.09)	(0.10)	**(0.09)**	(0.11)	(0.10)	(0.10)
316	Leather and allied products	-0.33***	-0.32***	-0.20*	-0.30***	-0.22*	-0.20**	**-0.06**	-0.16	-0.09
		(0.09)	(0.09)	(0.11)	(0.09)	(0.11)	(0.10)	**(0.12)**	(0.13)	(0.13)
321	Wood products	-0.08**	-0.08**	0.01	-0.08**	0.01	0.02	0.004	-0.07*	**0.02**
		(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)	**(0.03)**
322	Paper	-0.08*	-0.09*	0.002	-0.10**	**-0.03**	-0.02	-0.02	-0.09	-0.03
		(0.04)	(0.04)	(0.05)	(0.05)	**(0.05)**	(0.05)	(0.05)	(0.05)	(0.05)
323	Printed matter and related products	-0.15***	-0.15***	0.01	-0.19***	-0.01	-0.06	0.05	-0.04	**-0.01**

		(0.05)	(0.05)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)	**(0.04)**
324	Petroleum and coal products	0.08	-0.01	0.02	0.02	-0.04	**0.10**	0.03	-0.03	0.08
		(0.24)	(0.24)	(0.25)	(0.24)	(0.23)	**(0.24)**	(0.24)	(0.24)	(0.25)
325	Chemicals	-0.01	-0.02	0.05	-0.04	0.05	0.06	**0.08***	0.02	0.07
		(0.05)	(0.04)	(0.04)	(0.05)	(0.04)	(0.05)	**(0.04)**	(0.05)	(0.05)
326	Plastics and rubber products	-0.14***	-0.14***	-0.06	-0.06	**-0.09****	-0.02	-0.08	-0.11**	-0.09*
		(0.05)	(0.05)	(0.05)	(0.05)	**(0.05)**	(0.05)	(0.05)	(0.05)	(0.05)
327	Nonmetallic mineral products	-0.05	-0.06	0.01	-0.14**	-0.08	-0.04	-0.02	-0.17**	**-0.09**
		(0.08)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	**(0.07)**
331	Primary metal manufacturing	-0.29***	-0.28***	-0.06	-0.29***	-0.07	-0.11	**-0.07**	-0.33***	-0.16*
		(0.09)	(0.08)	(0.07)	(0.09)	(0.07)	(0.09)	**(0.07)**	(0.09)	(0.09)
332	Fabricated metal products	-0.20**	-0.21**	-0.05	-0.31***	0.01	-0.02	-0.08	-0.31***	**-0.10**
		(0.09)	(0.08)	(0.06)	(0.07)	(0.06)	(0.06)	(0.06)	(0.08)	**(0.06)**
333	Machinery, except electrical	-0.22**	-0.24**	-0.06	-0.43***	**-0.07**	-0.12	-0.02	-0.28***	-0.10
		(0.10)	(0.10)	(0.08)	(0.10)	**(0.08)**	(0.09)	(0.09)	(0.11)	(0.09)
334	Computer and electronic products	-0.07	-0.07	**-0.03**	-0.04	0.01	-0.01	0.01	0.04	0.01
		(0.07)	(0.06)	**(0.07)**	(0.07)	(0.08)	(0.07)	(0.08)	(0.08)	(0.08)
335	Electrical equipment, appliances, and	-0.21***	-0.22***	-0.10*	-0.16**	**-0.07**	-0.07	-0.11	-0.13	-0.11
	component	(0.06)	(0.06)	(0.06)	(0.07)	**(0.06)**	(0.06)	(0.07)	(0.08)	(0.08)
336	Transportation equipment	0.03	0.03	0.03	-0.17***	0.04	-0.03	0.04	-0.15**	**-0.04**
		(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	**(0.06)**
337	Furniture and fixtures	-0.25***	-0.25***	-0.07	-0.16***	-0.06	-0.04	-0.09	-0.17***	**-0.07**
		(0.06)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	**(0.05)**
339	Miscellaneous manufactured	-0.07	-0.07	0.01	-0.04	**-0.07**	-0.01	0.02	0.02	-0.06
	commodities	(0.06)	(0.06)	(0.05)	(0.06)	**(0.05)**	(0.05)	(0.06)	(0.07)	(0.06)

511	Newspapers, books & other published	0.02	0.03	0.02	0.03	0.02	**0.02**	0.02	0.03	0.02
	matter, nesoi	(0.03)	(0.03)	(0.02)	(0.03)	(0.02)	**(0.02)**	(0.02)	(0.03)	(0.02)

Notes: The coefficient associated with the trade cost variable in the logistic regression of establishment births during 1999-2006 for nine specifications is shown in the table 7.6. Set of state and year dummies are included in the model. Standard deviations are in parentheses. Coefficients for the intercept, other independent variables, and dummies are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 7.7. Ratio of Job Destruction by Continuers in the U.S. Private Industry, 1998-2009

Regressors	OLS: Job destruction by continuers, 1998-2009								
	Specification One	Specification Two	Specification Three	Specification Four	Specification Five	Specification Six	Specification Seven	Specification Eight	Specification Nine
Trade Cost	-0.003	-0.003**	-0.002*	-0.005***	-0.003***	-0.003***	-0.002*	-0.004***	-0.003***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Startup			0.067***		0.087***	0.102***	0.062***		0.090***
			(0.013)		(0.013)	(0.012)	(0.013)		(0.014)
Log (employment)			0.003***		0.001**				
			(0.0004)		(0.0004)				
Log(wage)				0.002		0.004**		-0.003	0.003
				(0.002)		(0.002)		(0.002)	(0.002)
Ratio of multi plant firm				0.069***	0.057***	0.069***		0.034***	0.058***
				(0.009)	(0.010)	(0.008)		(0.010)	(0.010)
Market Size							0.003***	0.003***	0.0008*
							(0.0003)	(0.0004)	(0.001)
Year fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	308	308	308	308	308	308	308	308	308
Log likelihood	939.29	1080.58	1129.52	1111.77	1145.09	1145.01	1130.87	1126.80	1146.19
AIC	-1872.58	-2135.16	-2229.04	-2193.53	-2258.19	-2258.04	-2231.75	-2221.59	-2258.39
Adjusted R^2	0.004	0.588	0.698	0.662	0.727	0.726	0.701	0.692	0.728

Notes: Standard deviations are in parentheses. Coefficients for the intercept and dummies are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 7.8. Ratio of Job Destruction by Continuers in the U.S. Private Industry, 2008-2009

Regressors	OLS: Job destruction by continuers, 2008-2009							
	Specification One	Specification Two	Specification Three	Specification Four	Specification Five	Specification Six	Specification Seven	Specification Eight
Trade Cost	-0.028**	-0.021**	-0.030**	-0.023***	-0.023***	-0.020**	-0.019	-0.023***
	(0.012)	(0.010)	(0.012)	(0.009)	(0.008)	(0.010)	(0.012)	(0.009)
Startup		0.222***		0.281***	0.265***	0.220***		0.265***
		(0.036)		(0.035)	(0.033)	（0.035）		(0.037)
Log (employment)		0.002*		-0.001				
		(0.001)		(0.002)				
Log(wage)			-0.023**		-0.010		-0.026**	-0.010
			(0.011)		(0.007)		(0.010)	(0.008)
Ratio of multi plant firm			0.004	0.107***	0.084***		-0.042	0.084***
			(0.036)	(0.028)	(0.026)		(0.040)	(0.033)
Market Size						0.003*	0.004**	0.000
						(0.001)	(0.002)	(0.002)
Observations	49	49	49	49	49	49	49	49
Log likelihood	147.48	163.35	150.07	169.61	170.31	163.81	152.45	170.31
AIC	-288.96	-316.71	-290.14	-327.23	-328.63	-317.62	-292.91	-326.63
Adjusted R^2	0.080	0.497	0.135	0.602	0.613	0.506	0.198	0.604

Notes: Standard deviations are in parentheses. Coefficients for the intercept and dummies are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 7.9. Ratio of Job Expansion by Continuers in the U.S. Private Industry, 1998-2009

Regressors	OLS: Job expansion by continuers, 1998-2009								
	Specification One	Specification Two	Specification Three	Specification Four	Specification Five	Specification Six	Specification Seven	Specification Eight	Specification Nine
Trade Cost	0.0003	0.0001	0.0001	-0.006***	-0.002	-0.001	0.0004	-0.004**	-0.001
	(0.003)	(0.003)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Startup			0.121***		0.159***	0.276***	0.107***		0.197***
			(0.017)		(0.015)	(0.015)	（0.017）		(0.016)
Log (employment)			0.011***		0.008***				
			(0.001)		(0.001)				
Log(wage)				0.024***		0.031***		0.008***	0.020***
				(0.004)		(0.003)		(0.003)	(0.003)
Ratio of multi plant				0.206***	0.109	0.205***		0.081***	0.133***
firm				(0.014)	(0.012)	(0.010)		(0.013)	(0.012)
Market Size							0.010***	0.009***	0.005***
							(0.001)	(0.001)	(0.001)
Year fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	308	308	308	308	308	308	308	308	308
Log likelihood	829.80	854.89	1052.86	957.06	1090.90	1071.63	-1045.85	1046.84	1109.83
AIC	-1653.61	-1683.78	-2075.72	-1884.11	-2149.80	-2111.26	-2061.70	-2061.68	-2185.67
Adjusted R^2	0.001	0.119	0.755	0.543	0.808	0.782	0.743	0.744	0.829

Notes: Standard deviations are in parentheses. Coefficients for the intercept and dummies are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 7.10. Ratio of Job Expansion by Continuers in the U.S. Private Industry, 2008-2009

Regressors	OLS: Job expansion by continuers, 2008-2009							
	Specification One	Specification Two	Specification Three	Specification Four	Specification Five	Specification Six	Specification Seven	Specification Eight
Trade Cost	-0.025***	-0.007	-0.017**	-0.008	-0.014**	-0.009	-0.007	-0.008
	(0.009)	(0.008)	(0.008	(0.008)	(0.007)	(0.008)	(0.008)	(0.007)
Startup		0.026		0.042	0.111***	0.026		0.085***
		(0.029)		(0.032)	(0.029)	（0.030）		(0.030)
Log (employment)		0.006***		0.005***				
		(0.001)		(0.001)				
Log(wage)			0.025***		0.031***		0.022***	0.027***
			(0.007)		(0.006)		(0.006)	(0.006)
Ratio of multi plant firm			0.091***	0.029	0.125***		0.050**	0.090***
			(0.023)	(0.026)	(0.022)		(0.024)	(0.027)
Market Size						0.005***	0.004***	0.003**
						(0.001)	(0.001)	(0.001)
Observations	49	49	49	49	49	49	49	49
Log likelihood	162.69	172.86	171.37	173.47	177.92	171.24	176.41	180.13
AIC	-319.39	-335.71	-332.74	-334.94	-343.85	-332.47	-340.82	-346.26
Adjusted R^2	0.116	0.390	0.352	0.392	0.493	0.348	0.460	0.526

Notes: Standard deviations are in parentheses. Coefficients for the intercept and dummies are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 7.11. Ratio of Net Job Creation by Continuers in the U.S. Private Industry, 1998-2009

Regressors	OLS: Net job creation by continuers, 1998-2009								
	Specification One	Specification Two	Specification Three	Specification Four	Specification Five	Specification Six	Specification Seven	Specification Eight	Specification Nine
Trade Cost	-0.0003	-0.0007	0.0003	-0.0002	0.0004	0.0005	0.0004	-0.0004	0.0006
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Startup			0.046**		0.044**	0.040**	0.050***		0.076***
			(0.018)		(0.019)	(0.017)	（0.018）		(0.020)
Log (employment)			-0.001**		-0.001				
			(0.0005)		(0.001)				
Log(wage)				0.005*		0.006**		0.007**	0.011***
				(0.003)		(0.003)		(0.003)	(0.003)
Ratio of multi plant firm				-0.020*	-0.005	-0.020*		-0.007	0.013
				(0.011)	(0.015)	(0.011)		(0.014)	(0.015)
Market Size							-0.001**	-0.001	-0.002***
							(0.001)	(0.001)	(0.001)
Year fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	308	308	308	308	308	308	308	308	308
Log likelihood	867.89	1021.14	1025.06	1023.84	1025.11	1026.45	1025.94	1024.91	1031.81
AIC	-1729.79	-2016.28	-2020.11	-2017.67	-2018.23	-2020.90	-2021.88	-2017.82	-2029.61
Adjusted R^2	0.000	0.617	0.624	0.621	0.623	0.626	0.743	0.622	0.829

Notes: Standard deviations are in parentheses. Coefficients for the intercept and dummies are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 7.12. Ratio of Net Job Creation by Continuers in the U.S. Private Industry, 2008-2009

Regressors	OLS: Net job creation by continuers, 2008-2009							
	Specification One	Specification Two	Specification Three	Specification Four	Specification Five	Specification Six	Specification Seven	Specification Eight
Trade Cost	0.041***	0.018	0.039***	0.020*	0.034***	0.017	0.017	0.020*
	(0.014)	(0.013)	(0.014)	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)
Startup		-0.154***		-0.199***	-0.230***	-0.151***		-0.169***
		(0.045)		(0.049)	(0.050)	（0.044）		(0.050)
Log (employment)		-0.007***		-0.005**				
		(0.001)		(0.002)				
Log(wage)			0.019		0.008		0.026**	0.016
			(0.013)		(0.011)		(0.011)	(0.010)
Ratio of multi plant firm			-0.053	-0.082**	-0.122***		0.040	-0.040
			(0.042)	(0.039)	(0.038)		(0.042)	(0.044)
Market Size						-0.008***	-0.009***	-0.006***
						(0.002)	(0.002)	(0.002)
Observations	49	49	49	49	49	49	49	49
Log likelihood	139.13	151.36	142.03	153.44	150.95	152.43	149.98	155.15
AIC	-272.25	-292.72	-274.05	-294.87	-289.89	-294.86	-287.97	-296.30
Adjusted R^2	0.123	0.444	0.187	0.478	0.422	0.468	0.399	0.502

Notes: Standard deviations are in parentheses. Coefficients for the intercept and dummies are suppressed. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

CHAPTER 8

8. GAINS FROM TRADE: THIS STUDY'S CONTRIBUTION

8.1 Scale Economies, Monopolistic Competition and the Gains from Trade

Ricardian and Heckscher-Ohlin models have been the primary conceptual frameworks for decades for examining causes and consequences of trade. In the Ricardian model, trade occurs on the basis of differences in technology, while the difference in factor endowments is the motivation for trade in the Heckscher-Ohlin model. Krugman (1979) was the among the few who pointed that even if two countries have the same preferences, technology, and factor endowments, trade and gains from trade can arise. In Krugman's model, trade is driven by economies of scale and product differentiation rather than differences in factor endowments in the Heckscher-Ohlin model, or in technology in the Ricardian model. The model is a specific, extended version of the monopolistic competition model developed by Dixiz and Stiglitz (1977). Consumers share the common utility function with constant elasticity of substitution preferences on the consumption side. As for the production side, each firm produces only one differentiated product that differs from those of other firms to some extent under conditions of increasing returns to scale. Labor is the only factor of production, and all firms have the same fixed and marginal cost, i.e., firms are homogeneous. As economies of scale are internal to firms, the market faces monopolistic competition.

The equilibrium of the economy is given by: (i) the price of each product relative to wages (markup); (ii) the output of each good; (iii) the quantity of goods produced. Krugman (1979) uses this model to analyze the effects of trade on the equilibrium markup, output, and the number of varieties available to consumers. Assuming that countries have the same preferences and technologies, Krugman (1979) incorporates trade openness with zero transportation cost. The trade-induced effects include an increase in real wages, in the scale of production and in the number of varieties available for consumption. Welfare in both trading partners will increase resulting from lower markup of each product and increased choices. Nonetheless, production of some varieties will be shut down in both countries. The latter should not be a concern if countries are face uniform distribution of economic activity within its borders. Overall, increasing returns to scale can bring about trade and gains from trade even when there are no international differences in preferences, technology, or factor endowments.

8.2 Heterogeneous Firms Model

The introduction of heterogeneous firms into the monopolistic competition model is a notable progress in trade theory, in which the productivity levels of firms are different even within an industry (Melitz, 2003). The heterogeneous firms model continues to employ the monopolistic competition framework with constant elasticity of substitution preferences. However, on the production side, an industry characterized by heterogeneous firms arises because, before expending an irreversible cost to enter the industry, firms face uncertainty about their productivity realization. After incurring the entry cost, they observe their productivity and choose either to exit if variable profit does not cover fixed production cost. They serve only domestic markets if variable profit covers only fixed production cost; and serve domestic and foreign markets if variable profit covers fixed production and fixed foreign market entry costs.

In an open economy with increased exposure to trade, all firms lose domestic sales under the intensified competition with foreign importing firms. Less efficient firms can still survive but only serve in the domestic market. In addition, trade encourages the domestic firms which are able to cover the fixed costs of exporting overseas to enter the export market. The more efficient firms that serve both domestic and foreign markets can achieve higher sales. Nevertheless, the direction of the profit change involves a tradeoff between the between the increase in total revenue and the increase in fixed cost due to the additional export costs. Only the most efficient firms can gain both market shares and profits. Thus, the overall distribution of market sales shifts toward the most efficient firms. To summarize, trade liberalization in the presence of heterogeneous firms within an industry has two important competition-induced effects: (i) increase in average industry productivity, and (ii) resource reallocation within an industry. The model emphasizes the intra-industry competition, where trade openness yields aggregate productivity gains through trade-induced resource reallocation towards more efficient firms.

8.3 The Gains from Trade

Referring to the model of scale economies and monopolistic competition (Krugman, 1979; 1980; 1981; Helpman, 1981; Lancaster, 1980) and the model of heterogeneous firms (Melitz, 2003; Bernard *et al.*, 2003; Helpman, 2006), there are three sources on the gains from trade: (i) price reductions due to increasing return to scale; (ii) increased product variety available to consumers; and (iii) intra-industry reallocation of resources from changes to the extensive and intensive margins.

8.3.1 Price Reductions

The first source of the gains from trade, price reductions, is closely related to economies of scale. It is one of the implications of the monopolistic competition model. As tariff rates between two trading partners decline, the least efficient firms exit the market and the more efficient firms expand their production and reduce their average costs through increasing returns of scale. In equilibrium, the decrease in average costs causes a decrease in prices. Harris (1984a, 1984b) develops simulation models to detect the change in firm scale and production costs, following the Canada-United States free trade agreement. With expanding scale and falling costs in various Canadian industries, he predicted that firm output would increase by

40-70% along with an improvement in labor productivity of 20-30%. However, Head and Ries (1999, 2001) finds no systematic evidence that Canadian firms grew more in the industries with the largest tariff rate reductions. Tybout *et al.* (1991) focus on the impacts of trade liberalization in some developing countries, e.g. Chile, Mexico and find little indication that declining tariffs cause an expansion in firm scale. With regard to the Single Market Program in Europe, Badinger (2007) uses sectoral data during 1981-1999 to find strong evidence of reductions in markups in manufacturing and construction sectors, but not in services. Friberg (2001) agrees with the conclusion that the elimination of rules and policies between European countries will lower the ability of firms to price-discriminate and promote trade.

8.3.2 Increased Product Variety

The second gains from trade based on the implications of monopolistic competition model are more varieties of products available to consumers. This area has received much attention in recent research using disaggregated data. The gains from trade on the product variety are quite sensitive to the elasticity of substitution across products. If the elasticity of substitution between one domestic product and one importing product is high, it implies that products from domestic and foreign market easily substitute for each other, and then consumers do not increase much utility for having a new variety of product. Therefore, the measure of elasticity of substitution matters in assessing this gain. Broda and Weinstein (2006) estimate elasticity of substitution for over 30,000 products available in the Harmonized System of trade data on the Tariff Schedule of the United States. By combining the data of new importing products with the estimated elasticity of substitution, the gains from trade resulting from the increase of import varieties for the United State is estimated. They find gains equivalent to 2.6% of U.S. GDP in 2001. Thus, positive evidence that gains from having more product varieties from new supplying countries does exist. Welfare of each resident will increase when more import varieties become available.

Hummels and Klenow (2005) employ cross-sectional data of countries in 1996 and compare the trade between larger and smaller countries. They investigate the question: is growth in trade is driven by the extensive margin, or by the intensive margin. Here, the extensive margin in trade means the range of products of exporting and importing. The intensive margin in trade means the trading volume of each product. They conclude that about two-thirds of growth in trade flows between countries is explained by the extensive margin, a more diverse range of goods from exporting and imports. And the other one-third of growth in trade is explained by the intensive margin, trading more of the same good. Broda *et al.* (2006) explore the association between the new input variety and productivity growth. They estimate that new import varieties can account for about 15% of growth in productivity in the United States. Furthermore, the productivity gain could be higher in developing countries, since they depend more on imported intermediate materials.

8.3.3 Intra-Industry Resource Reallocation

The third source of gains from trade in the monopolistic competition model is the intra-industry reallocation of resources, with only more productive firms surviving and expanding scale after trade liberalization. The extensive and intensive margin predictions have received a large amount of support from current empirical work using disaggregate data, e.g. firm-level or plant-level data sets. For the case of the United States, Bernard *et al.* (2003) show that only a small proportion of firms are exporters, while these exporting firms are substantially more productive than other firms in the industry. The same situation is also observed in France (Eaton *et al.*, 2004; 2011). These studies demonstrate that firms with different levels of productivity coexist within an industry, and that there are heterogeneous responses to trade liberalization.

Trefler (2004) focuses on the impact of the Canada-United States free trade agreement on the selection and productivity of firms utilizing firm-level data. Due to the elimination of tariffs, low-productivity plants shut down, and high-productivity plants in Canadian manufacturing industries expanded their scale and outputs, and entered the U.S. market. Such reallocation was most common to formerly protected industries. When tariff rate declined, labor productivity increased by 15%, half of which is accounted by the closing of inefficient plants. In addition, Trefler (2004) also provides some evidence on how tariff elimination affects employment. First of all, the employment of Canadian industries that relate to tariff was reduced by 12%. Second, job destruction was a short-term impact, and employment in Canadian manufacturing industries did not fall over a ten-year period. To summarize, Trefler (2004) finds substantial evidence of intra-industry resource reallocation in Canadian industries after the Canada-United States free trade agreement. The trade-induced 6% increase in average productivity growth of Canadian manufacturing industries led to higher wages and lower prices, which enhanced consumers' welfare.

Feenstra and Kee (2006) conduct a survey on 44 developing countries during 1980-2000 and find that gains from trade via such reallocation are also substantial. Over this period of increased globalization, the variety of goods which were produced in developing countries and exported to U.S. increased by 4.6% per year. The increased varieties of export products accounts for a 4.5% productivity growth for those exporters which are developing countries. The gains for the firms in those countries switching to exports are actually larger than the U.S. gains of 2.6% of GDP from expanding import variety.

8.3.4 This Study's Contribution

This study mainly focuses on the effects of trade liberalization on intra-industry resource reallocation, the third source of gains from trade. The extensive margin - hypothesis that a decrease in variable trade costs raises the probability of firm (establishment) exit is first tested. Using establishment death data on 1998-2009 from Business Dynamics Database and Survey of U.S. Business, and trade costs computed in Chapter 2, estimation results show that as trade costs fall, establishment death becomes more likely. This relationship appears robust to a number of controls used in the estimation. Focusing on disaggregated data, this study finds that establishment death is more likely when trade costs fall in a majority of three-digit NAICS industries. Those industries include food products, textile and fabrics, plastics and rubber products, metal manufacturing, and transportation equipment. In high-end manufacturing, however, there is not statistical support for such a relationship. This is presumably due to the role of innovation and technology in those industries. So, this study suggests that low-productivity firms are likely exiting when international competition increases in the U.S. market. This result has implications for average productivity in U.S. industries. However, changing trade costs appear to have little effects on establishment birth, i.e., new business opportunities.

The intensive-margin hypothesis is also tested, specifically, the idea that employment of expanding and surviving firms (establishments) increases in response to declining trade costs, while the employment of contracting and surviving firms (establishments) decreases in response to declining trade costs. The BDS and SUSB databases, and trade costs from Chapter 2, are used in identifying these effects. The estimation results indicate that when trade costs fall, the ratio of jobs lost or destroyed to total employment in contracting and surviving firms tends to increase. At the same time, falling trade costs create jobs in expanding and surviving establishments. However, these two effects tend to cancel each other out. This may explain why a significant effect of trade costs on net job creation is not found during 1998-2009.

In sum, strong evidence of the extensive margin changes suggests international competition disciplines domestic industry in raising the level of productivity required to survive in the market. Within surviving firms, the results suggest that trade costs' effects create and destroy some jobs, leaving net job creation unaffected. While these changes are beneficial to the whole economy, i.e. increased productivity, some regions face establishment exit and job losses. So, the assessment of gains from trade should be mindful of the distributional consequences of resource reallocation within an industry, as well as within a country.

CHAPTER 9

9. SUMMARY AND CONCLUSION

The objective of this dissertation is to examine U.S. business dynamics – firm entry, exit, and job creation – arising from changes in the costs of trading among nations. In doing so, this study recognizes that U.S. trade with its partners occurs through a large number of and diverse set of sub-regions within the U.S. Therefore, a single measure of trade costs for the entire United States, and a national level examination of business dynamics, would mask important regional differences and equity considerations. For this purpose, a gravity-based measure of trade costs is extended, based on a general equilibrium framework, to a regional setting in U.S. agricultural and manufacturing industries during 1998-2009. Following the measurement of trade costs, and an examination of their determinants (policy, geographic, and institutional factors), the consequences for firm entry, exit and job creation are estimated.

With regard to trade costs, the empirical results show significant heterogeneity among three-digit NAICS level U.S. industries, major U.S. customs districts and U.S. trade partners during 1998-2009. Among industries, the relative trade costs of U.S. agricultural industries are significantly higher than those in the manufacturing sector (over 200 versus about 145 percent of domestic trade costs). For most U.S. industries, relative trade costs fell during 1998-2001, but increased between 2002 and 2009 coinciding with the change in regulatory environment following 2001. The U.S. customs districts closer to the Canadian or Mexican border tend to have lower relative trade costs, e.g. Buffalo, New York and El Paso, Texas. In addition, inland customs districts such as St. Louis, Missouri, generally face higher trade barriers than port cities. Again, relative trade costs of major U.S. customs districts declined during 1998-2001, but showed significant increases during 2002-2009. Among U.S. trade partners, Canada and Mexico have the lowest weighted average trade costs (less than 125 percent of domestic trade costs). Both geographic (distance and common border) and policy factors (NAFTA) appear to have contributed to lower relative trade costs with Canada and Mexico. China's trade costs with the United States are about twice that of Canada or Mexico, but only two-thirds of most developed countries from Europe (e.g. Germany, France).

With substantial spatial and industrial variation in relative trade costs, an investigation of underlying sources – policy, geographic and institutional factors – is undertaken. A cross-sectional regression equation is used to relate 2005 trade costs (indexed by industry, U.S. customs district, trade partner) to geographic factors (distance, common border, landlocked status), policy (tariff rate) and institutional factors (common language, logistics performance). GMM estimation procedures are used. A similar equation is specified with the 2005-2009 weighted average of trade costs as the dependent variable. Results from the above specifications show that distance has a significant and positive impact on trade costs. Sharing a common border, on the other hand, lowers trade costs. The foreign country's or U.S. tariff rate does not significantly affect U.S. trade costs in the base specification. However, removing countries with very high tariffs (rates higher than 2 standard deviation of the global average) from the sample changes this result - foreign country tariffs have a positive and statistically significant effect on U.S. trade costs. The results on the logistics performance index show that the longer the time taken by a foreign country to process import documents, the higher is its trade costs with the United States.

The elasticity of trade costs with respect to distance, tariff rate, logistics performance and other explanatory variables are evaluated at the sample average. Results show that distance has the largest elasticity, followed by that of logistics performance. The tariff elasticity is very small relative to that of distance and logistics performance. The finding that geographic factors outweigh policy/tariff impacts on trade costs or frictions is no surprisingly, as it is consistent with previous cross-country studies. Tariff rates are generally not extremely high, due to earlier waves of trade liberalization. Distance and logistics performance at the regional level appears to be quite important. It would seem that infrastructure investments, both domestic as well as international, are likely to bring about continued reductions in trade costs and improvements in competitive market conditions.

To investigate business dynamics, an empirical framework was developed to investigate: (i) firm entry or exit arising from changes in trade costs, i.e. extensive margin, and (ii) changes in the employment of surviving firms arising from changes in trade costs, i.e., the intensive margin. Trade costs measures, developed earlier, are employed to examine business dynamics and resource reallocation. The regression models concern establishment birth, death, job destruction, job expansion, and net job creation. Firm-level and market characteristics such as size, age, wage level, multi-establishment status, and market size are also included as control variables.

A key result is that establishment death is more likely when trade costs fall. This finding is robust across specifications and under alternative measures of trade costs. With respect to other characteristics, it appears that larger, older and more productive establishments are more likely to survive. Furthermore, establishments that are part of a large, multi-unit firm face relatively lower risk of closure. Also, establishments located in a large market are more likely survive due to agglomeration economies. The test of the extensive margin hypothesis is extended to each major U.S. three-digit NAICS industry. The estimation results of establishment death by industry shows substantial variation. In relatively more competitive and low-tech industries, such as apparel and accessories, and primary metal manufacturing, trade costs play a critical role in business dynamics. On the contrary, in high-end manufacturing, it is innovation, management and other factors that appear more relevant to the success of business. Trade costs changes are muted in those industries with respect to extension margin. This study finds little evidence of effects of changing trade costs on the birth of establishments, i.e. new business opportunities.

With regard to the intensive margin hypothesis, the effects of trade costs on job creation is examined in three steps: (i) surviving but contracting firms – job destruction, and (ii) surviving but expanding firms – job expansion, and (iii) all surviving firms – net job creation. The set of establishment and market characteristics in the establishment birth/death equations are also included in the job creation models. The estimation results indicate that falling trade costs increase job destruction. This result remains robust across specifications and under alternative trade costs measures. Second, there is some evidence that falling trade costs result in job expansion by continuing firms, but the result is not robust under alternative trade costs measures. Finally, the above two offsetting effects on job destruction and expansion is likely the reason that net job creation is unaffected by changing trade costs.

Viewing the entire set of results on business dynamics, it appears that international competition disciplines domestic industry, by raising the level of productivity required to survive in the market, via the extensive margin changes. However, net job creation of surviving firms remains unaffected likely due to trade cost effects in creating some jobs and destroying other jobs. As noted in the previous chapter, the intra-industry reallocation of resources to high productivity firms is a source of gains from trade to the whole economy. Nonetheless, some regions face firm/establishment exit and job losses. In assessing the gains from trade, attention must be paid to the distributional consequences of resource reallocation within an industry as well as a country.

Future research may focus on improved measures of trade costs by regions, e.g. export and import costs, for a longer time period than considered in this study. Moreover, the availability of establishment level data on a time-series basis, especially inputs, outputs and exports, should allow for further confirmation of trade costs' effects on business dynamics: firm entry, exit and employment changes. Spatial econometric techniques can then help measure the extent of spatial reallocation of resources within an industry, which should help address the design of policies to address distributional consequences of trade reform.

ENDNOTES

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[1] The list of 25 three-digit NAICS industries, 38 major U.S. customs districts and 72 foreign countries appear in Table 2, 3 and 4, respectively.

[2] The level is derived using equation (2.21), i.e. the ratio on the right hand side of equation (2.21).

[3] *i*, *j*, and *s* denote U.S. region, foreign country, and industry, respectively.

[4] The minimum for many of the listed variables is not exactly zero but a few thousand dollars.

[5] **Common border, common language*, and *landlocked* are dummy variables.

[6] For a description of the *MAcMAPHS6* database, see http://www.ifpri.org/book-5078/ourwork/program/macmap-hs6 and Bounellassa *et al.* (2009).

[7] http://faculty.haas.berkeley.edu/arose/RecRes.htm.

[8] Port-specific data are not available to infer on the asymmetric effects of U.S. and foreign country's logistics performance on trade costs as in the case of tariffs. The *DistrictDummy* likely alleviates some of this problem.

[9] Both tariffs and importer's average time for all procedures do not vary over time. Hence, the 2006 importer's average time for all procedures is used in the regression of 2005 trade costs. As shown later, results from using 2005 trade costs as the dependent variable are qualitatively and quantitatively similar to those from the second specification employing 2005-2009 weighted average trade costs.

[10] Recall that the *DistrictDummy* includes some of these effects for the United States.

[11] The effect of trade costs on firm entry, exit, and employment pattern will then be examined via empirical regression models provided in chapter seven.

[12] The model of heterogeneous firms mainly considers trade-induced effects within a narrowly defined industry

[13] The primary sources of data, Business Dynamics Statistics and Statistics of U.S. Business, are at the establishment-level. The business here is considered at the establishment-level.

[14] http://www.census.gov/ces/dataproducts/bds/

[15] http://www.census.gov/econ/susb/

[16] Two alternative trade costs series are referred to 1998-2009 trade costs and 2008-2009 trade costs. The former trade costs primarily focus on 28 U.S. states that have customs districts. The latter trade costs include all 48 contingent U.S. states.

[17] The fixed effects for year and region are added into regression models for model accuracy, which account for difference in the response variable among regions and years after controlling for independent variables.

[18] In Logistic regression, likelihood ratio test is used to compare a full model and a reduced model. The null hypothesis is that the reduced model is an adequate fit to data, i.e. the coefficients associated with extra explanatory variables are zero.

[19] The effect of changing trade costs on business dynamics is examined individually in each major U.S. three-digit NAICS industry using the Statistics of U.S. Business database. Due to the data constrains, 24 three-digit NAICS industries are included.

[20] Haltiwanger *et al.*(2010) address that business startups and young businesses play a relatively critical role in both U.S. gross and net job creation rather than businesses with large size.

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APPENDIX

In the theoretical model, the industry-specific trade costs by regions are assumed to be symmetric. In the appendix, that assumption is relaxed to derive measures of import trade costs and export trade costs for each U.S. region.

Model Setup

The measurement of bilateral trade costs between U.S. regions and their trade partners is the extension of Novy's model[1]. Trade costs are solved through a multiple region-country general equilibrium system of the micro-founded gravity model. Assume that the home country contains multiple regions, and all the other countries are only endowed with one region. The range of all consumers and products in the world is the continuum [0, 1]. The country j ($j=1, 2 \ldots J$) has the range of differentiate varieties $[n_{j-1}, n_j]$, and each of them is produced by a single firm. Within the product range, $[n_{j-1}, n_{j-1}+s_j(n_j-n_{j-1})]$ is tradable, and the remaining part is non-tradable. s_j denotes the fraction of tradable products as exogenous. All the tradable products can be consumed by the entire world, but the non-tradable cannot be traded across countries. For each region of the home country, there are three categories: international tradable products: $[n_{r-1}, n_{r-1}+s_{r,i}(n_r-n_{r-1})]$, inter-state tradable products: $[n_{r-1}+s_{r,i}(n_r-n_{r-1}), n_{r-1}+(s_{r,i}+s_{r,s})(n_r-n_{r-1})]$, and non-tradable products: $[n_{r-1}+(s_{r,i}+s_{r,s})(n_r-n_{r-1}), n_r]$[2]. Here $s_{r,i}$ and $s_{r,s}$ represent the share of international tradable and regional tradable, respectively. The iceberg-type trade costs $\tau_{r,j}$ incurs during the transportation process from country to country, which implies that for each unit of product *i*, a certain percentage melts away as if an iceberg were shipped across the ocean[3].

Consumer

Followed by Dixit and Stiglitz' model, the CES composite consumption index for region *r* is defined as

$$\text{(A.1)} \qquad C_r \equiv [\sum_{j=1}^{J} \int_{n_{j-1}}^{n_{j-1}+s_j(n_j-n_{j-1})} (c_{ri})^{\frac{\sigma-1}{\sigma}} di + \int_{n_{r-1}+(s_{r,i}+s_{r,s})(n_r-n_{r-1})}^{n_r} (c_{ri})^{\frac{\sigma-1}{\sigma}} di + \sum_{r=1}^{R} \int_{n_{r-1}+s_{r,i}(n_r-n_{r-1})}^{n_{r-1}+(s_{r,i}+s_{r,s})(n_r-n_{r-1})} (c_{ri})^{\frac{\sigma-1}{\sigma}} di]^{\frac{\sigma}{\sigma-1}}$$

where c_{ri} denotes per capital consumption of variety *i*, and σ denotes the elasticity of substitution between varieties. Maximizing (A.1) subject to the per-capita budget constraint[4], the individual demand of product *i* is as follows,

$$\text{(A.2)} \qquad c_{ri} = (\frac{\xi_{ri}}{P_r})^{-\sigma} C_r$$

where P_r denotes the consumption-based price index defined by

$$\text{(A.3)} \quad P_r \equiv [\sum_{j=1}^{J-1} \int_{n_{j-1}}^{n_{j-1}+s_j(n_j-n_{j-1})} (\xi_{ri})^{1-\sigma} di + \int_{n_{r-1}+(s_{r,i}+s_{r,s})(n_r-n_{r-1})}^{n_r} (\xi_{ri})^{1-\sigma} di + \sum_{r=1}^{R} \int_{n_{r-1}+s_{r,i}(n_r-n_{r-1})}^{n_{r-1}+(s_{r,i}+s_{r,s})(n_r-n_{r-1})} (\xi_{ri})^{1-\sigma} di]^{\frac{1}{1-\sigma}}$$

In the price index, ξ_{ri} denotes the c.i.f. (cost, insurance, freight) price of the individual product *i*, defined as follows

(A.4) $$\xi_{ri} = \frac{1}{1-\tau_{j,r}} p^{T}_{j,i} \quad for \;\; n_{j\text{-}1} \le i \le n_{j-1} + s_j(n_j - n_{j-1}) \;\; \text{where } j = 1,2,...,\text{J}.$$

(A.5) $$\xi_{ri} = \frac{1}{1-\tau_{k,r}} p^{ST}_{k,i} = p^{ST}_{k,i} \quad for \;\; n_{k\text{-}1} + s_{ks}(n_k - n_{k-1}) \le i \le \; n_{k\text{-}1} + (s_{k,i} + s_{k,s})(n_k - n_{k-1})$$

(A.6) $$\xi_{ri} = p^{NT}_{r,i} \quad for \;\; n_{r\text{-}1} + (s_{ri} + s_{rs})(n_r - n_{r-1}) \le i \le n_{r+1}$$

$p_{j,i}{}^{T}$ denotes the f.o.b. (free on board) price produced by country j firm i. The iceberg-type trade costs incur through the above equations, since the fraction $\tau_{r,\,j}$ melts away during shipping process. In order to simplify the model, the interregional bilateral trade costs are ignored, thus $\tau_{k,r}$ is equal to zero. This assumption is a normalization which is also used by Baier and Bergstrand (2003).

Firms

Assume all the firms face a constant-returns-to-scale production function, where labor is the only input factor. Therefore, the production function is

(A.7) $$y^{T}_{r,i,j} = A_r L^{T}_{r,i,j} \qquad y^{ST}_{r,i,k} = A_r L^{ST}_{r,i,k} \qquad y^{NT}_{r,i} = A_r \; l$$

where A_r is exogenous and region-specific technology, the same across tradable and non-tradable sectors; $y_{r,i,j}{}^{T}$, $y_{r,i,k}{}^{ST}$, and $y_{r,i}{}^{NT}$ denote the total output produced by an individual firm in the international tradable sector, interregional tradable and non-tradable sector, respectively.

Market Equilibrium

By the market clearing condition, the total output should equal the total consumption. Hence the three equations for $y_{r,i,j}{}^{T}$, $y_{r,i,k}{}^{ST}$, and $y_{r,i}{}^{NT}$ are as follows,

(A.8) $$(1-\tau_{r,j})y_{r,i,j}^{T} = \left(\frac{\frac{1}{1-\tau_{r,j}}p_{r,i}^{T}}{P_j}\right)^{-\sigma}(n_j - n_{j-1})C_j$$

(A.9) $$y_{r,i,k}^{ST} = \left(\frac{p_{r,i}^{ST}}{P_k}\right)^{-\sigma}(n_k - n_{k-1})C_k$$

(A.10) $$y_{r,i}^{NT} = \left(\frac{p_{r,i}^{NT}}{P_r}\right)^{-\rho}(n_r - n_{r-1})C_r$$

In addition, the profit function is defined by total revenue minus total cost

(A.11) $$\pi_{r,i}^{T} = \sum_{j=1}^{J}(p_{r,i}^{T}y_{r,i,j}^{T} - W_r L_{r,i,j}^{T})$$

Plugging the production function and market clearing conditions into the profit function, and maximizing it with respect to the individual price, the prices in three sectors are equal,

(A.12) $$p_{r,i}^{T} = p_{r,i}^{ST} = p_{r,i}^{NT} = \frac{\rho}{\rho-1}\frac{W_r}{A_r} \equiv p_r$$

Using (A.12) to recalculate the consumption-based price index (A.3), the consumer price index at region r is rewritten as,

(A.13) $$P_r = \frac{\rho}{\rho-1}\omega_r^{\frac{1}{1-\rho}}W_r$$

where

$$\text{(A.14)} \quad \omega_r = \sum_{k=1}^{R} s_k (n_k - n_{k-1}) A_r^{\rho-1} \left(\frac{\omega_r}{\omega_k}\frac{s_r}{s_k}\right)^{\frac{\rho-1}{2\rho-1}} \left(\frac{A_k}{A_r}\right)^{\frac{-\rho(\rho-1)}{2\rho-1}} + (1-s_r)(n_r - n_{r-1}) A_r^{\rho-1}$$
$$+ \left(\sum_{j=1}^{J} s_j (n_j - n_{j-1})(A_j(1-\tau_{j,r}))^{\rho-1} \left(\frac{\omega_r}{\omega_j}\frac{s_r}{s_j}\left(\frac{A_r}{A_j}\frac{(1-\tau_{r,j})}{(1-\tau_{j,r})}\right)^{\rho-1}\right)^{\frac{\rho-1}{2\rho-1}}\right)$$

A Gravity Equation with Bilateral Trade Costs

Define the total export from region *r* to country *j* and total export from country *j* to region *r* as

$$\text{(A.15)} \qquad EXP_{r,j} = s_r (n_r - n_{r-1}) y_{r,i,j}^T \qquad EXP_{j,r} = s_j (n_j - n_{j-1}) y_{j,i,r}^T$$

The ratios of ω_r and ω_j, of ω_r and ω_k are,

$$\text{(A.16)} \qquad \left(\frac{\omega_r}{\omega_j}\right)^{\frac{\sigma-1}{2\sigma-1}} = \frac{\omega_r L_{r,i,j}^T \left(\frac{A_r}{A_j}\frac{(1-\tau_{r,j})}{(1-\tau_{j,r})}\right)^{\frac{\sigma(\sigma-1)}{2\sigma-1}}}{L_j \left(\frac{s_j}{s_r}\right)^{\frac{\sigma}{2\sigma-1}} (n_j - n_{j-1})(A_r(1-\tau_{r,j}))^{\sigma-1}}$$

$$\text{(A.17)} \qquad \left(\frac{\omega_r}{\omega_k}\right)^{\frac{\sigma-1}{2\sigma-1}} = \frac{\omega_r L_{r,i,k}^{ST} \left(\frac{A_r}{A_k}\right)^{\frac{\sigma(\sigma-1)}{2\sigma-1}}}{L_k \left(\frac{s_k}{s_r}\right)^{\frac{\sigma}{2\sigma-1}} (n_k - n_{k-1}) A_r^{\sigma-1}}$$

Plug (A.16) and (A.17) into (A.18), the expression of ω_r can be simplified as

$$\text{(A.18)} \qquad \omega_r = \omega_r s_r \sum_{j=1}^{J} L_{r,i,j}^T / L_r + (1-s_r)(n_r - n_{r-1}) A_r^{\sigma-1} + \omega_r s_r \sum_{k=1}^{R} L_{r,i,k}^{ST} / L_k$$
$$= \frac{(n_r - n_{r-1}) A_r^{\sigma-1} L_r}{L_r^{NT}}$$

Finally, the bilateral trade volumes between region *r* and country *j* are obtained by

$$\text{(A.19)} \quad EXP_{r,j} = (1-\tau_{r,j})^{\frac{(\sigma-1)^2}{2\sigma-1}} (1-\tau_{j,r})^{\frac{\sigma(\sigma-1)}{2\sigma-1}} (s_r)^{\frac{\sigma-1}{2\sigma-1}} (s_j)^{\frac{\sigma}{2\sigma-1}} ((n_r - n_{r-1}) y_{r,r}^{NT})^{\frac{\sigma}{2\sigma-1}}$$
$$((n_j - n_j) y_{j,j}^{NT})^{\frac{\sigma-1}{2\sigma-1}} \left(\frac{n_j - n_{j-1}}{n_r - n_{r-1}}\right)^{\frac{1}{2\sigma-1}}$$

$$\text{(A.20)} \quad EXP_{j,r} = (1-\tau_{j,r})^{\frac{(\sigma-1)^2}{2\sigma-1}} (1-\tau_{r,j})^{\frac{\sigma(\sigma-1)}{2\sigma-1}} (s_j)^{\frac{\sigma-1}{2\sigma-1}} (s_r)^{\frac{\sigma}{2\sigma-1}} ((n_j - n_{j-1}) y_{j,j}^{NT})^{\frac{\sigma}{2\sigma-1}}$$
$$((n_{rj} - n_r) y_{r,r}^{NT})^{\frac{\sigma-1}{2\sigma-1}} (\frac{n_r - n_{r-1}}{n_j - n_{j-1}})^{\frac{1}{2\sigma-1}}$$

Furthermore, notice that $(n_r\text{-}n_{r-1})$ and $(n_j\text{-}n_{j-1})$ can be represented by the population of region r and country j, respectively, and

$$\text{(A.21)} \quad (n_r - n_{r-1}) y_{r,r}^{NT} = GDP_r - EXP_r, \quad (n_j - n_{j-1}) y_{j,j}^{NT} = GDP_j - EXP_j$$

Recalculate the equations of export volume

$$\text{(A.22)} \quad EXP_{r,j} = (1-\tau_{r,j})^{\frac{(\sigma-1)^2}{2\sigma-1}} (1-\tau_{j,r})^{\frac{\sigma(\sigma-1)}{2\sigma-1}} (s_r)^{\frac{\sigma-1}{2\sigma-1}} (s_j)^{\frac{\sigma}{2\sigma-1}} (GDP_r - EXP_r)^{\frac{\sigma}{2\sigma-1}}$$
$$(\frac{POP_j}{POP_r})^{\frac{1}{2\sigma-1}} (GDP_j - EXP_j)^{\frac{\sigma-1}{2\sigma-1}}$$

$$\text{(A.23)} \quad EXP_{j,r} = (1-\tau_{j,r})^{\frac{(\sigma-1)^2}{2\sigma-1}} (1-\tau_{r,j})^{\frac{\sigma(\sigma-1)}{2\sigma-1}} (s_j)^{\frac{\sigma-1}{2\sigma-1}} (s_r)^{\frac{\sigma}{2\sigma-1}} (GDP_j - EXP_j)^{\frac{\sigma}{2\sigma-1}}$$
$$(\frac{POP_r}{POP_J})^{\frac{1}{2\sigma-1}} (GDP_r - EXP_r)^{\frac{\sigma-1}{2\sigma-1}}$$

And solve for the bilateral trade costs,

$$\text{(A.24)} \quad \tau_{r,j} = 1 - \frac{(EXP_{j,r})^{\frac{\sigma}{\sigma-1}} (\frac{pop_j}{pop_r})^{\frac{1}{\sigma-1}}}{(EXP_{r,j})(GDP_j - EXP_j)^{\frac{1}{\sigma-1}} (s_r)^{\frac{1}{\sigma-1}}}$$

$$\text{(A.25)} \quad \tau_{j,r} = 1 - \frac{(EXP_{r,j})^{\frac{\sigma}{\sigma-1}} (\frac{pop_r}{pop_j})^{\frac{1}{\sigma-1}}}{(EXP_{j,r})(GDP_r - EXP_r)^{\frac{1}{\sigma-1}} (s_j)^{\frac{1}{\sigma-1}}}$$

Note that in the equations of region r's export and import trade costs, the extreme large difference between the import and export volume will incur unstable trade costs measures. When using the U.S. regional trade flow data, this situation always happens.

ENDNOTES

[1] D. Novy. 2007. "Is the Iceberg Melting Less Quickly? International Trade Costs after World War II." University of Warwick: working paper.

[2] Note: n_{r-1}, n_r are actually $n_{r-1, J+1}$, $n_{r, J+1}$, here we just ignore $J+1$.

[3] $\tau_{J, r, j}$ is less than one unit.

[4] The budget constraint is $P_rC_r=W_rL_r+\pi_r$, where W_r denotes wage, and π_r denotes the profit per capita.