ESSAYS IN INTERNATIONAL TRADE

By

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INTRODUCTION

Trade reform is an important policy tool as it: governs access to foreign markets and the organization of global supply chains; influences international trade flows; and has implications for consumer welfare in a given country. With the advent of more disaggregated data, trade economists have taken particular interest in evaluating firm behavior in response to trade liberalization. This dissertation adds to the discussion by evaluating firm-level patterns and outcomes in three distinct settings. In the first chapter, I theoretically explain and empirically support a linkage between a firms import sources and its export partners via cost complementarities. The study uses variation from Chinas accession to the WTO to identify this pattern across firms. In the second chapter, I present a theoretical model in which both output tariffs and input tariffs affect the firms relative demand for skilled labor. I show that input (output) tariff reductions from the Chile-China Free Trade Agreement induced firms to increase their skill intensity (reduce their labor force). In the third chapter, I show that the estimated impact of free trade agreements on firm-level intra-bloc flows is sensitive to the selected empirical specification and measure of trade reform. I construct a product level measure of trade reform and show that a panel data approach provides the most plausible estimates. I find that firm-level trade flows were not particularly responsive to preferential rates from the ASEAN-China Free Trade Agreement in the short-run. This dissertation showcases some of the ways trade policy can interact with industrial organization, labor markets, and the evolution of productive activities over time.

More specifically, the first chapter examines how a firms import behavior is linked to its export patterns. Previous studies have focused on the link between aggregate imports and exports; a relationship compatible with quality upgrading. This argument, while intuitive, implicitly assumes that all imported inputs facilitate quality upgrading and treats import sources homogenously. Moreover, this argument is incongruent with recent empirical which suggest firms tailor products to match market features. I present two stylized facts that: 1. show a strong, positive correlation between where firms import from and where they export to; and 2. impugn the veracity of the standard quality upgrading mechanism. To explain the observed trends, I propose an alternate theoretical mechanism which connects import sources to export patterns via cost complementarities. In the empirical analysis, I find evidence of a causal relationship between imported intermediate shares and product export revenue shares from the corresponding destination. The relationship is stronger for lower productivity firms than for higher productivity ones, for private firms than for state owned enterprises, and for goods with a greater scope for product differentiation.

The second chapter explores how bilateral trade liberalization affects labor markets. The last decade has seen a sharp increase in commodities-for-manufactures trade between China and other developing countries. These type of trade configurations can trigger major resource reallocations for China's trade partners, and induce within firm changes in skill intensity. I present a three-factor, one-good, two-country trade model in which firms endogenously choose to upgrade their relative demand for skill in accordance with firm size and with participation in import and/or export markets. Exploiting variation from a Chile-China free trade agreement, I examine how reductions in input and output tariffs affect skill intensity, the size of their labor force, and the composition of workers in Chilean manufacturing firms. I find that output tariff reductions were associated with contractions in the labor force across firms. This contraction was skill-biased insofar as unskilled labor accounted for the majority of the observed reduction. Input tariff reductions were associated with expansions in labor force and skill intensity. These effects exhibit heterogeneous impacts and were concentrated within firms towards the upper end of the productivity distribution.

In the third chapter, I examine the impact of the ASEAN-China Free Trade Agreement (ACFTA) in goods on firm-level intensive margin trade flows in the short-run. To obtain unbiased estimates, I use panel data methods to correct for the endogeneity of bilateral trade policy. I allow for asymmetric effects from import and export trade liberalization by taking advantage of heterogeneity in implementation across signatory countries, and by constructing a continuous, product-country specific measure of trade reform. This is a marked departure from the literature which has primarily relied on a "comprehensive dummy variable to measure the impact of trade reform. Using customs data on Chinese firms from 2002-2006, I show that preferential tariff rates on Chinese output had no significant effect on firm-level intra-bloc export flows. However, I provide evidence that preferential import tariff reductions increased intra-bloc imports. This result is strongest for goods with some scope for differentiation and for collective enterprises. I also provide evidence of cost complementarities in international markets. That is, firms tend to import from (export to) countries that they export to (import from) more intensively over time.

This dissertation highlights some of the channels through which trade reform can influence and shape firm behavior. It also stresses a key advantage of highly disaggregated data. Trade flows at the national level may mask within-industry and within-firm responses to trade liberalization; especially if these responses are negatively correlated with macroeconomic trends. Therefore, the use of heterogeneous firm models and more disaggregated firm-level datasets can aid in the design of more efficacious policy, and may be helpful in predicting how trade reformation may affect various outcomes across and within firms.

CHAPTER 1

Are All Imports Created Equal? The Link between Imported Intermediates Sources and Export Success for Chinese Firms

1.1 Introduction

Quality upgrading has been identified as a key mechanism to explain the link between a firm's import behavior and its aggregate export growth. This mechanism asserts that the removal of a trade barrier will induce firms to upgrade product quality via improved access to imported intermediate inputs; augmenting demand in foreign markets (Fan, Li, and Yeaple, 2014; Manova and Zhang, 2012).[1] Though product quality is a somewhat nebulous concept, previous studies argue that a reasonable approximation of quality upgrading can be obtained by aggregating imports across all destinations; implicitly treating source countries homogeneously. This assumption is incongruent with theoretical insights and recent empirical findings. In this paper, I establish a link between imported input sources and export patterns. I also provide evidence that accounting for firm-heterogeneity and the inclusion of cost complementarities are sufficient to reconcile theoretical foundations with empirical findings.

The patterns of trade described by the quality upgrading mechanism are compatible with heterogeneous-firm models emphasizing firms' productivities and product *qualities*– commonly proxied by imported intermediates and/or their unit prices– as the driving factors of domestic and aggregate export market performances. While the literature has established a robust, positive relationship between improved access to imported intermediates, quality upgrading, and international performance, it has devoted limited attention to the role of imported input *sourcing* in explaining export outcomes. This is a particularly conspicuous oversight because the workhorse trade models of endogenous quality have "baked-in" assumptions that inputs from wealthier nations are of

[1] Other studies argue that imported intermediates may also have embedded technological improvements which can enhance productivity (Bas and Strauss-Kahn, 2015; Feng, Li, and Swenson, 2016; Beaulieu and Wan, 2016; Halpern, Koren, and Szeidl, 2015; Verhoogen, 2009).

a higher quality than inputs from poorer nations, and, that a representative consumer's taste for quality increases monotonically with national income. On the empirical side, studies have shown that both input and output prices within narrowly defined product categories vary across destinations, even after accounting for transport costs and trade partner characteristics (Manova and Zhang, 2012). This finding belies predictions from standard two-country models since it suggests that firms may be altering/tailoring final good quality based on destination market features.[2]

Despite these widely accepted theoretical insights and data-driven motivations, most of the 'quality and trade' research to date has treated intermediate input source countries/regions uniformly. In so doing, two important questions have been left unanswered or under-investigated:

1. **Is the increased usage of all imported inputs necessarily proof of quality upgrading?**
2. **Does a firm's source of imported intermediates explain its export performance in source countries?**[3]

The first question impugns the assertion that all imports are created equal. The lion's share of related studies implicitly assume that intermediates sourced from *every* foreign location is more expensive and of better quality than their domestic counterparts. This may not be the case. Firstly, lower tariffs and transportation costs could make it possible for imported inputs to be cheaper than domestic inputs. In this scenario, holding input quality fixed, the optimal decision of a firm may be to import larger quantities of inputs from abroad, even though there would be no discernible change in final good quality. Secondly, imported inputs may not necessarily be of a higher quality than domestic ones. Based on the standard model, importing inputs from underdeveloped regions would generate a marked reduction in product quality. Both cases undermine the link between product quality and the unweighted measure of imported intermediates; underscoring the need to

[2]GDP and GDP per capita are the most conventional determinants of "taste for quality", and are thought to influence a firm's quality and pricing decision. The gravity literature suggests that variable markups can also be generated by other factors such as: remoteness, distance, and/or sociopolitical ties. However, the prevailing school of thought is that final good quality is (weakly) monotonic in destination GDP per capita.

[3]This question also relates to whether the connection between imports and exports is causal or merely a joint byproduct of optimization based on a firm's given productivity (Feng, Li, and Swenson 2016).

consider import sources more carefully.[4]

The second question examines the link between import sourcing and export success. Since earlier studies aggregate imports across all countries, they are ill-equipped to address this issue entirely. If there is a link between import sources and exports, one may need to modify the traditional quality upgrading argument. It could be that firms establish distributional connections, learn market conditions, and pay a fixed cost of entry when they import from a particular destination. In so doing, they increase the likelihood of them exporting to the respective destination in the future.[5] This provides another motivation for firms to manipulate final good quality. That is, firms take advantage of cost complementarities to provide goods commensurate with destinations features. Therefore, lower-quality inputs (assumed to be sourced from low-income countries) would be used in the production of goods exported to poorer destinations (the converse is true for high-income countries) and in proportional volumes.

Three notable exceptions in the literature, which begin to explore the role of intermediate input sourcing, are Bas and Strauss-Kahn (2015), Feng, Li, and Swenson (2016), and Antras, Fort, and Tintelnot (2017). Bas and Strauss-Kahn (2015) argue that following input trade liberalization, Chinese firms import more varieties of inputs from the most advanced economies. Moreover, as input tariffs fall, firms pay a higher price for their imported inputs. Feng, Li, and Swenson (2016) find that sales revenue for Chinese manufacturers increase in G-7 countries when expenditure on intermediates sourced from G-7 countries increase. Both studies capture level effects on export prices and revenues associated with imported intermediates, however, they group source countries broadly. Though their results give tacit support to the standard quality upgrading mechanism, since foreign markets are presumably more challenging than domestic ones, they do not explore the relationship at the regional or individual country level; making the refutation of a cost complementarity explanation impossible.

[4]These contradictions of the prevailing quality-upgrading mechanism occur when the reduction in goods demanded is outweighed by the reductions in expenditure from sourcing inputs abroad.

[5]Another cogent conjecture is that there is home bias in goods with respect to exports having own-nation components. Throughout the paper, I focus on the cost complementarity mechanism as I am unable to isolate any potential home bias impacts.

Antras, Fort, and Tintelnot (2017), independently and concurrently, conduct the only other study which examines the relationship between intermediate input sources and firm-level decisions. They develop a quantifiable multi-country sourcing model that embeds an Eaton and Kortum (2002) marginal cost structure inside a Melitz (2003) monopolistically competitive model; accounting for firm-heterogeneity and destination specific costs. They structurally estimate the model to isolate the roles off marginal cost savings and fixed cost heterogeneity across destinations to explain sourcing strategies. My paper also leans on firm-heterogeneity and fixed costs to explain trade patterns but differs from Antras, et al. (2017) in two fundamental ways. Firstly, they assume that firms import intermediates to minimize marginal cost. In the context of my work, firms must balance two opposing effects: lowering input quality reduces costs but firms will face reduced demand as product quality falls. The analogous characterization of my study is that firms minimize *quality-adjusted* costs. Secondly, Antras, et al. (2017) does not allow for complementarities between importing and exporting activities. While Antras, et al. (2017) stresses (weakly) monotonic hierarchical structures between sourcing strategies and underlying productivities, my work stresses the link between import intensities and export patterns.

To fill the aforementioned void in the literature, I conduct the first study which explicitly models and empirically examines the impact of intermediate input *sources* on export patterns. First, I present two stylized facts regarding import sourcing trends among firms using highly disaggregated customs data on Chinese firms from 2002-2005.[6] Next, I present a multi-country North-South trade model which generalizes a Demir (2012) model to explain the stylized findings and to garner predictions for the empirical exercise. The theoretical model expands the Melitz (2003) model to incorporate multiple dimensions of heterogeneity. On the demand side, consumers in

[6]Over the past few decades, China has become a canonical reference to showcase sustained, export-led growth. The nation's dominance on the international stage has been particularly pronounced since its accession to the WTO in 2001; an event which precipitated abrupt and significant reductions in Chinese tariffs. Between 2000 and 2007, the value of Chinese exports more than quadrupled; rising from 20 percent to 35 percent of GDP (Berger and Martin, 2011). In 2002, China's first year as a full WTO member, imported intermediate inputs for manufacturing firms grew faster than export growth in the sector (Feng, Li, and Swenson (2016). With the advent of more detailed data on Chinese firms, these exogenous policy shifts have presented an excellent opportunity to analyze the microeconomic impacts of trade liberalization on export outcomes. Much of the developing world adopted similar liberalization policies over the past 20 years. Coupled with declining trade costs and massive advancements in communication technology, these liberalization episodes have made great strides towards integrating international markets.

each region differ with respect to their taste for vertically differentiated goods and their preferences across horizontally differentiated goods within product categories. The two key features occur on the supply side. First, firms differ in their productivities and choice of input quality. Second, there is a complementarity between exporting and importing. Firms must pay a separate fixed entry cost to import and export from each destination. However, the total fixed cost faced by a firm which does both activities in the same destination is lower than the sum of the individual fixed costs. This gives firms more incentive to export to destinations which they source inputs from. The underlying mechanism suggests that within-firm product differentiation in final good quality can be tracked using imported intermediate shares from various source countries.[7] Moreover, the model suggests that the import source-export partner link may vary depending on where a given firm lies on the productivity distribution.

I take the predictions from the theoretical model to the data; exploring estimable analogs which relate the share of product revenues (exports) from a particular destination with the share of imported intermediates from said destination. These expressions are simply stated and their implications are straightforward, however, they require particularly detailed data on trading activities and the production process. To this end, I match the customs data on Chinese firms with firm-level data from manufacturing surveys. The depth of the dataset is a major advantage and allows me to: track a firm's input sources and relate them to overall input intensities; control for firm-level primitives; investigate the role of firm ownership in market performance; calculate export prices which have not been contaminated by aggregation across firms, products or across markets within a firm; and examine how destination-market characteristics affect a firm's intensive and extensive margins.

A major concern is the potential endogeneity between a firm's imports and exports. I address this issue using exogenous changes in relative costs of foreign intermediates. Specifically, I use imported input tariff changes (Feng, Li, and Swenson, 2016) and exchange rate movements

[7]The model assumes that inputs imported from the North are of a higher quality than their Southern counterparts. Therefore, firms that source a greater portion of intermediates from abroad are categorized as having higher input quality, and by extension higher final good quality.

(Verhoogen, 2008) to instrument for firm changes in the use of imported inputs, thereby identifying the causal effect of increased usage and sourcing of imported intermediates on firm-level export patterns.

I find evidence of a causal relationship between source-specific imported intermediate shares and product revenue shares from these destinations. That is, I find firms that import a greater portion of inputs from a particular country or region generate greater portions of export revenues from these countries and regions. The baseline results support my proposed mechanism which relies on cost complementarities. I also find that the link between import shares and product export shares is relatively stronger for lower productivity firms. Conversely, the cost complementarity is more important for more productive firms. Finally, the impact of import shares on product revenue shares is stronger for private firms than for state-owned enterprises and for goods with greater scope for differentiation.

This study contributes to multiple strands of the trade literature. I further the research on improved access to imported intermediates and enhanced firm performance. These studies provide key insights on the nature of technological diffusion across countries. They show that access to intermediates is linked to total factor productivity (Amiti and Konings, 2007; Gopinath and Neiman, 2011; Halpern, Koren, Szeidl, 2015), demand for skilled workers (Kasahara, Liang, and Rodrigue, 2013), expanded product scope (Goldberg et al., 2010), and quality upgrading (Amiti and Khandelwal, 2013, Manova and Zhang, 2012; Kugler and Verhoogen, 2012).[8]

I also contribute to the literature on endogenous skill acquisition, technological upgrading

[8]Substantial research has also been devoted to examining the role of country-level characteristics in the demand and supply of high quality goods. Using unit values as proxies for quality and measuring national wealth by income per capita, Hummels and Skiba (2004) and Hallak (2006) find evidence that richer countries demand a larger share of high quality goods. From the supply perspective, Schott (2004) finds that unit values tend to increase with exporters' per capita income, capital-to-labor ratio, skill ratio, and capital intensity of production. Hummels and Klenow (2005) find similar results that price and quantity indices rise with origin-country income per capita. Again, these studies relied heavily on noisy proxies. Khandelwal (2010) critiques the use of unit values as proxies for quality and instead infers exporter product quality by comparing market shares conditional on price. The use of unit values is convenient but crude as it requires that prices reflect quality differences completely as opposed to differences in productivity/manufacturing costs. He derives quality from a nested logit demand system which allows for both vertical and horizontal differentiation. Estimating quality of imports for the US, Khandelwal (2010) obtains the familiar result that higher income countries export higher quality goods. Khandelwal (2010) also stresses that there is substantial heterogeneity across products with respect to the scope for quality differentiation (quality ladders) and discusses the impact quality ladder length can have on US labor markets.

and export performance. These studies focus on the nature of selection into export-import activities along the extensive and intensive margins. Bustos (2011) studies the impact of MERCOSUR on technology upgrading.[9] Using data on Argentinean firms, she finds that larger tariff reductions from Brazil induced firms to invest in technology at a faster rate.[10] Verhoogen (2008) infers higher-quality in goods from higher-quality in workers (white-collar vs blue-collar) and proposes a mechanism linking trade and wage inequality. Using data on the 1994 peso crisis for Mexican manufacturing firms, Verhoogen (2008) finds that initially more productive plants increased the export share of sales, white-collar wages, blue-collar wages, the relative wage of white-collar workers, and ISO 9000 certification more than initially less productive plants during the crisis period. His findings suggest that quality-upgrading induced by the exchange-rate shock increased within-industry wage inequality.[11] These studies show how firms may capitalize on input trade liberalization or an exchange rate devaluation in order to upgrade their productivity and the quality of their exported products. This helps guide my choice of instruments in Section 5.

I contribute to the literature on quality sorting and trade. Crozet, Head and Mayer (2011) use direct measures of quality when looking at French wine production and find that higher quality firms export to more markets, charge higher prices and sell more of their output in each market. Crozet, Head, and Mayer (2011) obtain strong results by examining a unique product-category where productivity/technology is assumed to be homogeneous across firms and quality varies. However, this result may not necessarily be as generalizable to other goods.[12]

Finally, I contribute to the literature on global supply chains. Foreign value added can account for up to 50 percent of the value of final manufacturing output in some countries and

[9] The Bustos (2011) framework yields two effects: 1. the standard Melitz (2003) result regarding aggregate productivity gains induced by selection; and 2. the new finding that the most productive firms adopt new technology.

[10] She also finds evidence of input-driven quality upgrading induced by the import tariff liberalization.

[11] Regarding intermediate factors of production, there is a consensus in the literature that importing higher quality inputs, particularly from industrialized nations, can induce skill-biased technological change (Kasahara, Liang and Rodrigue (2013). Doms, Dunne, and Troske (1997) provide evidence that the adoption of new factory automation technologies lead to skill upgrading. For recent studies discussing the importing of intermediate inputs and their role in increasing plant productivity, see Muendler (2004), Kugler and Verhoogen (2009) and Kasahara and Rodrigue (2008).

[12] Wine is an age-restricted, consumable good. While plausible, is not immediately clear if the Crozet, Head, and Mayer (2011) result accurately describes real-world trade patterns for non-consumable products or developing nations once quality and productivity are heterogeneous across differentiated products.

sectors (Blanchard, Brown, and Johnson, 2016). The increasing importance of global supply chains suggests that import barriers may reduce revenues for domestic input suppliers and domestic final goods. They also suggest that linkages between importing and exporting may ossify over time. This motivates the need for more studies to explore disaggregated import measures.

The goal of this study is to foster a better understanding of the factors that generate observed outcomes in developing economies. This in turn can improve policy design and, by extension, economic growth in these nations. For example, it might be beneficial for governments to promote R&D investment and advancement in technologies that allow firms to produce and sell more sophisticated goods (Manova and Zhang, 2012). If it is difficult to obtain high quality inputs domestically, firms must rely on importing intermediates from more advanced economies. Thus, developing countries may need to liberalize imports if they want to improve export performance.

The remainder of the study is organized as follows. Section 2 discusses the data used throughout the analysis. Section 3 presents some stylized facts about Chinese firms from 2002-2005. Section 4 details the theoretical model which explains the patterns presented in previous studies and which guides the empirical analysis. Section 5 discusses the empirical strategy, methodology, and measurement of key variables. Section 6 discusses the main findings from estimation and discusses the intuition behind these results. Section 7 conducts robustness exercises. Section 8 concludes.

1.2 The Data

I investigate the link between imported intermediate sourcing and export performance in various markets. To realize this goal I require particularly detailed data regarding firm-level characteristics and the firm's respective trade flows. I draw from six sources to compile the final dataset: 1) CEPII for distance data and other non-economic influences supported by the gravity literature; 2) World Development Indicators (WDI) compiled by the World Bank for socioeconomic profiles at the national level; 3) Chinese customs data for information on firms' participation in trade, producer prices, trade volumes, partners and, frequencies; 4) National Bureau of Statistics (NBS) data for information on firm-level characteristics and performance in the domestic market; and 5) World Trade Organization (WTO) data on product-level tariffs; and 6) Penn World Tables (PWT) data on international exchange rates.[13]

I provide a cursory discussion of how the dataset is compiled but leave the details of the process to the appendix. I obtain information on firm-level bilateral trade flows that was collected and made accessible by the Chinese Customs Office. The data chronicles the activities of the universe of 150,529 Chinese firms participating in trade from 2002-2005. They report the f.o.b. value and quantities of firm exports (imports) in U.S. dollars across 234 destination (source) countries and 6168 products in the Chinese eight-digit Harmonized System (HS 8).[14,15]

The customs data is vital for observing export patterns, determining input quantities and sources, and constructing accurate unit prices. The recorded values are not sullied by aggregation across firms or across markets within firms. I focus solely on general trade in my analysis as processing firms were exempt from tariffs pre-liberalization.[16] Unit value export prices are calculated by dividing deflated export value by physical quantities of exported products, as in Fan, Li, and Yeaple (2014).[17] Chinese import tariffs are measured as the MFN (most-favored nation) applied tariff at the HS 8-digit level from 2002-2005 (Fan, Li, and Yeaple, 2014; Feng, Li, Swenson, 2016). Both the customs and tariff data are aggregated to the HS 6-digit level.

I match the customs data with annual data on medium to large Chinese manufacturing firms compiled via surveys conducted by the National Bureau of Statistics (NBS). While the trade data encompasses the international participation of retailers and wholesale traders, by matching

[13] CEPIII and WDI are relatively common sources as they are publicly available online and these data are relatively facile to combine.

[14] The first 6 digits of Harmonized System codes are consistent internationally. The number of distinct codes in the Chinese eight-digit HS classification is comparable to that in the 10-digit HS trade data for the United States (Manova and Zhang, 2012).

[15] Presumably, quantity measures vary contingent upon the type of product (e.g. kilograms, cubic meters, etc.). I ensure that all units of measure are consistent with the industry standard and include product or industry fixed effects where applicable to control for time-invariant features that may differ across goods.

[16] China has a dual regime in which non-processing firms pay tariffs and processing firms are exempt from tariffs. Processing firms necessarily convert imported inputs into exports and are prohibited from selling in domestic markets. Conversely, firms engaged in ordinary trade must decide whether to import at all or to strictly use domestic intermediates. Therefore, processing and ordinary trade producers face disparate sourcing choices (Koopman, Wang, Wei, 2012; Feng, Li, Swenson, 2016).

[17] Deflators are taken from Brandt et al. (2012)

with the manufacturing surveys, I restrict the sample to manufacturing firms. The NBS covers both state-owned and non-state-owned industrial firms with sales of about 5 million RMB. The data reports detailed information about firm revenues, costs, wages, workforce, value-added, depreciation, capital sources and intensity, inventories, ownership, taxes, and other fees. I use these plant characteristics to control for firm-size and productivity. I am also able to examine if there is asymmetry in import-export behavior based on firm characteristics.

1.2.1 Overview of Established Trends

Before I present the findings on intermediate sourcing, I verify some of the established results from the literature on Chinese firms. To this end, I examine firm export performance with respect to import status, scope for product differentiation, and prices. This analysis is based solely on summary statistics obtained from the customs data and, as is convention in the literature, abstracts away from sourcing considerations; treating imported inputs homogenously.

Table 1.1 examines the differences in export patterns between non-importers and importers over the sample horizon. I present the statistics for number of firms engaged in exporting, average number of products sold (at both the HS6 and HS6-destination pair levels), and average export revenue, for 2002 and 2005. Columns (1) and (6) report firm participation in international markets.[18] The data shows that the number of firms participating in international trade– importing intermediates goods and exporting final goods– has increased dramatically in the post-liberalization period. I also find that, on average, importing firms are far more successful in export markets than their non-importing counterparts, suggesting a positive relationship between

[18] The total number of firms exporting and/or importing goods almost doubles; increasing from 76,054 firms in 2002 to 145,488 firms in 2005. Surprisingly, the rise in trade participation is chiefly fueled by firms which export only (EO), increasing from 34,636 firms in 2002 to 77,801 firms in 2005.

Table 1.1: Export Performance of Importers vs Non-Importers: Customs Data

Year	Non-Importers					Importers				
	# Firms	# HS6	Partners	# HS6-Partners	Exp Value	# Firms	# HS6	Partners	# HS6-Partners	Exp Value
2002	34636	6.96	5.17	13.8	3465086	41418	24.43	10.73	54.18	4327622
2005	77801	10.27	6.23	20.37	4816741	67687	21.2	10.69	50.96	7500704

Notes: Table 1.1 compares the mean values of key variaiables between firms that export only and, those which engage in import and export activities. $\#HS6$ captures the number of products a firm exports at the HS6-digit level, *Partners* captures the number of countries a firm exports to, and $\#HS6 - Partners$ captures the number of countries a firm-product pair is exported to. Export value captures the mean revenue of a firm-product pair in a given destination market.

Table 1.2: Price Changes of Importers and Non-Importers: Differentiated vs Homogenous Products

Exp Price (HS6)	All Firms			Non-Importers			Importers		
	2002	**2005**	**% Change**	**2002**	**2005**	**% Change**	**2002**	**2005**	**% Change**
Per firm-hs6, mean	1.44	1.57	9.03	1.25	1.35	8.00	1.51	1.71	13.25
diff.	1.5	1.64	9.33	1.3	1.41	8.46	1.58	1.79	13.29
homo.	1.14	1.22	7.02	1.01	1.06	4.95	1.19	1.32	10.92

Panel B

Exp Price (HS6-country)	All Firms			Non-Importers			Importers		
	2002	**2005**	**% Change**	**2002**	**2005**	**% Change**	**2002**	**2005**	**% Change**
Per firm-hs6-country, mean	1.41	1.56	10.64	1.36	1.5	10.29	1.55	1.78	14.84
diff.	1.47	1.62	10.20	1.41	1.56	10.64	1.61	1.85	14.91
homo.	1.16	1.25	7.76	1.12	1.21	8.04	1.25	1.43	14.40

Notes: Table 1.2 compares the mean export prices at the firm-HS6-digit level in Panel A, and at the firm-HS6-country level in Panel B. I also show how prices differ between homogeneous goods, *homo.*, and differentiated goods, *diff.* contemporaneously and intertemporally. Prices are calculated using unit values.

imported inputs and exports.[19] Firms that import intermediate inputs export a wider range of products, have more trade partners, and earn more export revenue, on average, than firms that export only.

Table 1.2 presents summary statistics on the logarithm of export prices for importing and export only (EO) firms.[20] Panels A and B present findings at the product and product-country levels, respectively. Table 2 also introduces an added dimension into the analysis; scope for differentiation.[21] Again, I corroborate earlier studies and find that export prices have increased over time at both the product and product-destination levels. This price increase is significantly larger for products with greater scope for differentiation.[22]

I also investigate the relationship between firms and number of export partners (See appendix, Table 1.16 and Table 1.17). The right tail of the distribution has been top-coded for expositional convenience but the relationship is weakly monotonic. Firms that only import (no exports) form 21% of observations, 61% of firms sell to less than 10 countries, and 18% of firms sell to 10 or more markets . However, the 18% of firms exporting to 10 or more destinations accrued 93% of all export revenue in the sample. The number of firms in all 3 categories grew from 2002 to 2005. Figure 1.1 shows that the relationship between number of firms and number of export destinations is generally negative.[23] These results suggest that there may be substantial heterogeneity

[19]Importing firms exported four times as many (24.43) products in 2002, and two times as many (21.20) products in 2005 than export only (EO) firms. Importing firms also exported to more destinations at both the country and product-country levels. The average number of trade partners (product-partners) for importing firms was 10.73 (54.18) in 2002, and 10.69 (50.96) in 2005. The average number of trade partners (product-partners) for EO firms was substantially less at 5.17 (13.80) in 2002, and 6.23 (20.37) in 2005. This reveals an increase in export scope for importers relative to EO firms over the post-liberalization horizon. I also find a qualitatively similar result for export value. Importing firms earned significantly more revenues over the four year period than EO firms, on average. Moreover, the growth of export revenue for importers (1.73%) dwarfs the growth of export revenue for EO firms (1.39%).

[20]I obtain qualitatively similar results using the median in lieu of the mean (See appendix).

[21]I use the United Nations Conference on Trade and Development (UNCTAD) classification of goods to categorize HS6 products as differentiated or homogenous. The UNCTAD system has seven classification headings. I classify high-skill and technology-intensive products, medium-skill and technology-intensive products, and, resource-intensive manufactures as heterogeneous (differentiated) goods. I classify mineral fuels, and non-fuel primary commodities to be homogenous goods. Unclassified goods are omitted from the analysis.

[22]Table 2 presents evidence of a persistent trend in prices. Columns (3), (6), and (9) show the price change for all firms, EO firms, and importing firms, respectively. At both the HS6 and HS6-country levels, I find that prices have increased over time. The magnitude of these price changes is more pronounced for firms that import intermediates vs EO firms, and for differentiated goods vs homogenous goods. However, even within homogenous products, I find that prices increase over the post-liberalization period.

[23]I also examine export patterns along the dimensions of products exported and markets exported to. Table 19

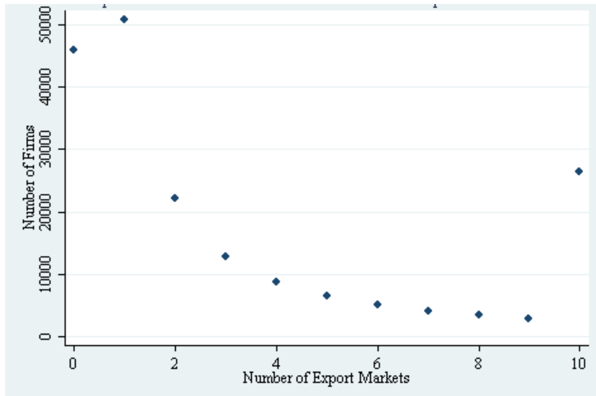

Figure 1.1: Number of Firms vs Number of Export Destinations 2002-2005

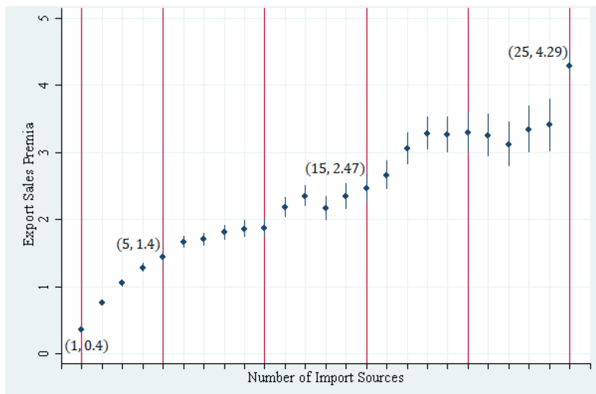

Figure 1.2: Export Sales Premia and Number of Import Source 2002-2005

in country-level fixed costs of exporting across countries.

Finally, I go beyond the broad non-importer vs importer analysis to explore how relative size in export markets vary along the intensive margin of import destinations (Figure 1.2). Figure 1.2 plots the estimated coefficients (and confidence intervals) when regressing log of export sales on dummy variables for number of import partners and industry.[24] The reference category relative to which differences are estimated is non-importers. Firms that import from one country are .4 log points larger than non-importers, firms that source from 5 countries are about 1.4 log points

indicates that the majority of firms export multiple products. For the four years examined, 21% of firms only imported, 62% of firms exported less than 10 products, and 17% of firms exported 10 or more products. However, the 17% of firms exporting 10 or more products earned 69% of all export revenue in the sample. The number of firms in all three categories grew from 2002 to 2005 but the percentage of export value captured by firms making 10 or more products actually fell over the horizon specified.

[24]This regression is of the form: $log(Export\ Sales) = \sum_{d=1} \#Sources_d + \sum_{k=1} \eta_k$.

larger, firms that source from 15 countries are 2.47 log points larger, and firms that source from 25 or more countries are 4.29 log points larger. Improved export outcomes along the gradient of importer size suggest that country-level fixed costs of importing may be significant, in some cases prohibitive, which constrains the ability of smaller firms to select into importing from a wide array of countries. Moreover, these findings suggest a role for heterogeneous effects in international markets, presumably driven by productivity differences.

1.3 Stylized Findings

1.3.1 Export Patterns and Imported Intermediates Sourcing

This section unearths two stylized facts about Chinese export firms from 2002-2005 (post liberalization period). The findings are based on preliminary OLS regressions which estimate the relationship between product export shares and imported input sources. During this time period, there were significant reductions in tariffs for most products in China. I classify both source and export destinations at four levels: 1. Stage of development ("North" or "South"); 2. Income (i.e. low, lower middle, upper middle, or high); 3. Geographical region; and 4. Country.[25] I define a product as a firm-HS6-destination combination.

I relate a firm's export share of a given product p in year t to destination d, $expratio_{fpdt}$, to the firm's imported intermediate share from destination d, $impratio_{fdt}$, and a set of controls. The main specification for the preliminary regressions is:

$$expratio_{fpdt} = \alpha + \beta \cdot impratio_{fdt} + \underbrace{\sum_t \delta_t + \sum_j type_j + \sum_p \Gamma_p + \sum_k \eta_k + \gamma Grav_{dt}}_{\text{Controls}} + \varepsilon_{fpdt} \qquad (1.1)$$

[25]There are nine regional groupings in the study: North America, Latin America and the Caribbean, Oceania, Africa, European Union (EU) Europe, non-EU Europe, Japan and the Koreas, Taiwan and Hong Kong , and Rest of Asia (See Appendix).The North-South categories are constructed in accordance with the World Bank's Analytical classifications presented in the World Development Indicators database (WDI, 2015). Nations ranked as low or lower-middle income form the South, and nations ranked as upper-middle or high income form the North.

where f denotes a firm, p denotes a product at the HS6-digit level, d denotes export (import) destination, t denotes the year, and j denotes the firm's type of business ownership.[26] My preferred measure of export performance is the firm's fraction of total export revenue of product p generated from destination d $\left(\text{i.e } expratio_{fpdt} = \frac{Rev_{fpdt}}{\sum_d Rev_{fpdt}}\right)$. Similarly, the import measure is the fraction of a firm's total expenditure on imported intermediates sourced from d $\left(\text{i.e. } impratio_{fdt} = \frac{\sum_p Imp_{fpdt}}{\sum_d \sum_p Imp_{fpdt}}\right)$. The idiosyncratic error term ε_{fpdt} is clustered at the firm-level.

I incorporate a plethora of controls to account for product characteristics that are time-invariant (captured by Γ) and year characteristics that are market-invariant (captured by δ).[27] I also include dummies for ownership configurations, *type*, to account for organizational, structural or legal guidelines across different businesses that may systematically alter a firm's participation in trade, and, industry effects at the 4-digit CIC level, η, to capture features unique to a particular sector. $Grav_{dt}$ is a set of controls that is only included in firm-product-country level estimation. It is a collection of the key determinants of aggregate trade patterns identified by the gravity literature and, partially controls for demand conditions, market toughness, and other economic factors endemic to a given location. *Grav* is comprised of four log-transformed geo-economic variables: size (GDP), wealth (GDP per capita), bilateral distance, and remoteness (a measure of multilateral resistance related to distance from all trade partners; Anderson and van Wincoop, 2003).[28]

The main focus of this analysis is on the estimated sign of β, which captures the conditional correlation between the fraction of imported intermediates from destination d and a firm's fraction of total exports of a good generated in d. The inclusion of multiple dummies in equation (1) absorbs much of the variation in the data but are needed for more accurate interpretations of β.

Table 1.3: North vs South: OLS Regressions of Export Ratio on Import Ratio

	Dependent Variable: Export Ratio				
	(1) All	(2) North	(3) South	(4) N-S Trade	(5) S-N Trade
Imp-Ratio (by North/South)	0.174*** (0.00466)	0.0139*** (0.00253)	0.0298*** (0.00899)		
Poor Ratio				-0.0141*** (0.00253)	
Rich Ratio					-0.0303*** (0.00898)
Product and Year FEs	Yes	Yes	Yes	Yes	Yes
Firm-Type FEs	Yes	Yes	Yes	Yes	Yes
R^2	0.0957	0.0551	0.148	0.0551	0.148
N	2755688	2308102	447586	2308102	447586

Notes: Column (1) examines the relationship between a firm's export share from a HS6-digit product and its import share from the North/South for the full panel of firms in the customs data. Columns (2)- (3) examine the relationship for the North and South subgroups respectively. Columns (4) and (5) regress the export share from the North (South) on the import share from the South (North). Results include firm-clustered standard errors, a constant term (suppressed for convenience), year,product and firm ownership fixed effects. Standard errors in parentheses. ** $p < 0.05$, *** $p < 0.01$.

Results from this specification are presented in Tables 1.3 to 1.6.

The results from estimating equation (1) when d denotes **stage of development** (North/-South) are presented in Table 1.3. Observations are at the firm-product-stage of development level. Column (1) shows the estimate for the full panel, while columns (2) and (3) show the results for the "North" and the "South" subgroups, respectively. All three estimates suggest that there is a positive and statistically significant relationship between the fraction of intermediates sourced from wealthy (poor) destinations and the fraction of export revenue of a product generated from wealthy (poor) destinations. I discourage making meaningful interpretations of estimated coefficients beyond identifying signs since estimation likely suffers from endogeneity issues. However,

[26]The types of business ownerships are: private, foreign-owned, state-owned enterprises, collectives, joint ventures, and partnerships that are Hong Kong/ Macao or Taiwan (HMT) owned.

[27]Time dummies control for macroeconomic events, demand-side fluctuations, and time-varying factors which impact all firms equally at t. Product fixed effects, measured at the HS6-digit or HS4-digit levels, control for commodity characteristics such as durability, size, price elasticity, complexity, technology-intensity, etc.

[28]I also include other prominent factors from the gravity literature– such as colonial history, common language, and contiguity– in supplementary regressions. The estimated coefficients for these variables had very little explanatory power.

the preliminary results suggest that a percentage point increase in the fraction of imports from destination d is correlated with a 0.17 percentage point increase in the fraction of product-revenue generated from d. The subgroup results suggest that import sourcing may be more relevant for the South than for the North. A percentage point increase in *impratio* from the South is associated with a 0.03 percentage point increase in the fraction of product-revenue from the South while a unit increase in *impratio* from the North is associated with a 0.014 percentage point increase in the fraction of product-revenue from the North. These results suggest that imported intermediates should not be treated homogeneously.

Columns (4) and (5) show the results when *expratio* from d is regressed on *impratio* from d', where d' denotes the complement destination (poor ratio and rich ratio). Column (4) shows that an increase in poor ratio (*impratio* from the South) is associated with a decrease in the fraction of product-revenue from North. Conversely, Column (5) shows that an increase in rich ratio (*impratio* from the North) is associated with a decrease in the fraction of product-revenue from South. Overall, Table 3 presents strong evidence that firms using a greater portion of “Northern” (“Southern”) inputs also earn a greater portion of product revenue from the North (South).

Table 1.4: Income Quartiles: OLS Regressions of Export Ratio on Import Ratio

	Dependent Variable: Export Ratio				
	(1) All	(2) High	(3) UM	(4) LM	(5) Low
Imp-Ratio (by Income)	0.265*** (0.00560)	0.0204*** (0.00317)	0.0723*** (0.0148)	0.0520*** (0.0113)	0.0886*** (0.0191)
Product and Year FEs	Yes	Yes	Yes	Yes	Yes
Firm-Type FEs	Yes	Yes	Yes	Yes	Yes
R^2	0.162	0.0542	0.0735	0.111	0.165
N	2745782	2116394	222528	250816	155904

Notes: This table examines the relationship between a firm’s export share from a HS6-digit product and its import share from income quartiles. Income groups follow the World Bank Atlas method to classify countries as high, upper middle (UM), lower middle (LM), and low income countries. Results include firm-clustered standard errors, year, product, and firm ownership fixed effects.
Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Next, I estimate equation (1) when d denotes a particular **income** level and present the results in Table 1.4. Observations are at the firm-product-income level. Column (1) examines the full panel while Columns (2)-(5) present the results for each income quartile in isolation. By and large, the estimates in Table 1.4 are larger than those presented in Table 1.3. For the full sample, I find that a percentage point increase in *impratio* from destination d is associated with a 0.27 increase in $expratio_p$ from source d. This relationship holds for each income quartile, with a unit increase in *impratio* from destination d being associated with 0.02, 0.07, 0.05, and 0.09 percentage point increases in $expratio_p$ for high, upper-middle, lower-middle, and low-income levels, respectively. Again, these results suugest that imports should not be treated homogeneously. However, the evidence to this point still supports the standard quality upgrading story.

Table 1.5: Regional Outcomes: OLS Regressions of Export Ratio on Import Ratio

Panel A:					
	Dependent Variable: Export Ratio				
	(1) All Countries	(2) North America	(3) Japan and the Koreas	(4) Taiwan and Hong Kong	(5) European Union
Imp-Ratio (by Region)	0.148^{***} (0.00419)	0.0850^{***} (0.00740)	0.186^{***} (0.00744)	0.101^{***} (0.00821)	0.0770^{***} (0.00608)
Product and Year FEs	Yes	Yes	Yes	Yes	Yes
Firm-Type FEs	Yes	Yes	Yes	Yes	Yes
R^2	0.0863	0.0655	0.138	0.148	0.0507
N	2831071	442882	552295	427287	608522
Panel B:					
	Dependent Variable: Export Ratio				
	(6) Rest of Asia	(7) Non-European Union Countries	(8) African Countries	(9) Oceania	(10) Latin America and the Caribbean
Imp-Ratio (by Region)	0.0414^{***} (0.00824)	0.205^{***} (0.0359)	0.0762^{***} (0.0219)	0.145^{***} (0.0194)	0.104^{***} (0.0250)
Product and Year FEs	Yes	Yes	Yes	Yes	Yes
Firm-Type FEs	Yes	Yes	Yes	Yes	Yes
R^2	0.131	0.126	0.136	0.104	0.106
N	499174	75881	68979	91802	64183

Notes: This table examines the relationship between a firm's export share from a HS6-digit product and its import share for various regional groups. The countries which comprise each region is shown in the appendix Results include firm-clustered standard errors, year, product, and firm ownership fixed effects.
Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 1.5 presents the results when equation (1) is estimated at the **regional** level, a first attempt at matching export destinations with import sources without aggregating across wide geographical divides. Observations are at the firm-product-region level. Column (1) examines the full panel while Columns (2)-(10) present the results for each regional subgroup. For the full sample, I find that a percentage point increase in *impratio* from destination d is associated with a 0.15 percentage point increase in $expratio_p$ from source region d. The relationship holds for each regional subgroup. The estimated coefficients were largest for Non-EU European countries (column 7), Japan and the Koreas (column 3), Oceania (column 9), and Taiwan and Hong Kong (Column 4), with a percentage point increase in *impratio* from these regions being correlated with a 0.1-0.2 percentage point increase in $expratio_p$. That is, not only does the classification of import partners matter for exporting (e.g. high income partners), but the geographical location itself may also possess some explanatory power.

The final batch of estimates for equation (1) are based on observations at the **country** level and are presented in Table 1.6. Observations are at the firm-product-country level. Here I include gravity-based controls and evaluate various aggregation levels of *impratio* at the country, region, and income status levels. The dependent variable in Columns (1)-(8) is *expratio* at the country level.

Before delving into the intermediate input sourcing analysis, I discuss the gravity-related factors. I find that bilateral distance is inversely related with $expratio_p$. This result is expected as firms tend to trade more with countries that are closer than with countries that are farther away. A percentage point increase in log(distance) is associated with a 0.1 percentage point decrease in $expratio_p$. Remoteness, a measure of a countries multilateral distance from all trade partners, is also found to negatively impact $expratio_p$ in most specifications. This suggests that export markets that are more difficult to access are correlated with smaller export shares for a given product. Country size, measured by log(GDP), is generally found to be positively related to *expratio*. Larger countries tend to have a greater demand for goods, making these export markets particularly attractive.

Table 1.6: Country-Level Outcomes: OLS Regressions of Export Ratio on Import Ratio

	Dependent Variable: Export Ratio							
	(1) Full Sample	(2) Full Sample	(3) North Only	(4) South Only	(5) N-S Trade	(6) S-N Trade	(7) Full Sample	(8) Full Sample
Imp-Ratio (by Country)	0.191***							
	(0.00602)							
Imp-Ratio (by North/South)		0.0793***	0.0872***	0.0385**				
		(0.0109)	(0.0134)	(0.0169)				
Poor Ratio					-0.0877***			
					(0.0134)			
Rich Ratio						-0.0389**		
						(0.0169)		
Imp-Ratio (by Region)							0.117***	
							(0.00588)	
Imp-Ratio (by Income)								0.0831***
								(0.0107)
log(GDP)	0.0538***	0.0611***	0.0654***	-0.0793***	0.0654***	-0.0793***	0.0571***	0.0584***
	(0.00218)	(0.00232)	(0.00174)	(0.00555)	(0.00174)	(0.00555)	(0.00229)	(0.00223)
log(GDP) per capita	-0.0117***	-0.0239***	-0.00774**	0.00937	-0.00774**	0.00937	-0.0106***	-0.0267***
	(0.00200)	(0.00246)	(0.00323)	(0.00674)	(0.00323)	(0.00674)	(0.00209)	(0.00264)
log(Distance)	-0.0902***	-0.102***	-0.105***	-0.0801***	-0.105***	-0.0801***	-0.0987***	-0.101***
	(0.00230)	(0.00258)	(0.00217)	(0.00984)	(0.00217)	(0.00984)	(0.00250)	(0.00251)
log(Remoteness)	-0.0187***	-0.0155***	-0.0199***	0.149***	-0.0199***	0.149***	-0.0148***	-0.0134***
	(0.00240)	(0.00260)	(0.00185)	(0.0124)	(0.00185)	(0.0124)	(0.00255)	(0.00253)
Product and Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Type FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.183	0.169	0.175	0.172	0.175	0.172	0.174	0.170
N	2036718	2036718	1892463	144255	1892463	144255	2036718	2036718

Notes: This table examines the relationship between a firm's export share from a HS6-digit product at the country level and its import share at various aggregation levels. In addition to our main import share measures, I also include gravity literature variables to capture country size, bilateral distance, and multilateral resistance. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The results from Table 1.6 are in keeping with the theme presented in Tables 1.3 to 1.5. The parameter estimates for the sourcing variables are all significant at the 1% level and possess the expected signs. Column (1) shows that a percentage point increase in *impratio* at the country level is associated with a 0.19 percentage point increase in $expratio_p$. Column (2) shows that a percentage point increase in *impratio* at the North/South level is associated with a 0.08 percentage point increase in $expratio_p$. These results yield the strongest evidence yet of a link between import source partners and product export patterns. Columns (7) and (8) show similar estimates for *impratio* at the regional and income levels, respectively. This preponderance of evidence generates the first stylized fact.

Stylized Fact 1.3.1. *Firms that source a greater portion of intermediates from a particular destination tend to earn a greater portion of their export revenue from said destination, where a destination is defined at the North/South, income quartile, region, or country level disaggregation.*

The Nature of Input Sources: Quality vs Cost Complementarities

The first stylized fact suggests that import sources should not be treated homogenously since the origins of intermediate goods may have an impact on trade flows. This result is novel, however, it does not help to isolate the mechanism by which import sources may affect export choices since it is compatible with both the standard quality-upgrading mechanism and my proposed cost complementarity argument. In this section, I further investigate the role of imported intermediates by identifying the channel through which they influence trading partners and patterns. To this end, I explore the following specification at the firm-product-country level:

$$expratio_{fpdt} = \alpha + \beta \cdot impratiosans_{fdt} + \underbrace{\sum_t \delta_t + \sum_j type_j + \sum_p \Gamma_p + \sum_k \eta_k + \gamma \cdot Grav_{dt}}_{\text{Controls}} + \varepsilon_{fpdt} \tag{1.2}$$

The dependent variable and vector of controls are identical to equation (1). However, the new independent variable of interest is $impratiosans_{fdt}$, which captures the fraction of total imports sourced from a particular region or income level net of the relevant country's contribution $\Big($i.e.

$\frac{\sum_{p} Imp_{fpht} - Imp_{fpdt}}{\left(\sum_{h}\sum_{p} Imp_{fpht}\right) - Imp_{fpdt}}$ where $h \in \{income, region, north/south\}$ $\Big)$. Simply put, $impratiosans_{fdt}$ measures the import ratio from countries "like me but not me".

The typical quality-upgrading story posits that access to higher quality intermediate goods will increase firm-product demand in wealthier nations. In this framework, if a firm imports higher quality inputs from the United States, one would expect said firm to augment its exports to all OECD countries. However, the literature fails to adequately address the role of destination-specific costs and import complementarities in explaining export performance.[29] This cost complementarity mechanism is supply-driven. An example of this argument relates to firms which pay a high destination-specific fixed cost when importing intermediates which allow them to access a particular destination market, learn about preferences, standards, and conditions, and to establish distributional ties. As a result, firms importing from a particular destination are more likely to export to that destination. If the quality-upgrading story is more relevant, one would expect positive parameter estimates of β in equation (2) while negative estimates support the cost complementarity mechanism.

The findings are presented in Table 1.7. The analysis unambiguously supports the cost complementarity explanation of trade flows. Removing a particular country's import contribution to the share of imported intermediates at the regional, income and stage of development levels are all correlated with decreases in product export shares from the corresponding country. Again, I am wary of conducting meaningful inference here but qualitatively, these results yield second stylized fact.

Stylized Fact 1.3.2. *When we remove the share of imports from a particular country, the share of product exports to that destination tend to fall.*

Quality upgrading may not adequately explain these observed trade patterns. However, stylized fact 1.3.2 is compatible with cost complementarities.

[29] In my analysis, I am unable to disentangle to impact of home bias from fixed costs to entry. For simplicity, I focus on the fixed costs argument but from a home bias perspective, consumers abroad have a greater demand for final goods which are comprised of their home nation's inputs; compelling firms to import from destinations they export to.

Table 1.7: Quality vs Cost Complementarities: OLS Regressions of Export Ratio on Import Ratio

Panel A:	Dependent Variable: Export Ratio							
	(1) Exp-Ratio (North/South)	(2) Exp-Ratio (North/South)	(3) Exp-Ratio (North/South)	(4) Exp-Ratio3 (North/South)	(5) Exp-Ratio (Income)	(6) Exp-Ratio (Income)	(7) Exp-Ratio (Income)	(8) Exp-Ratio (Income)
Imp-Ratio	-0.215***			-0.198***	-0.291***			-0.262***
(by North/South san d)	(0.00432)			(0.00503)	(0.00569)			(0.00934)
Imp-Ratio		-0.193***		-0.0857***		-0.322***		-0.158***
(by Region san d)		(0.00774)		(0.00705)		(0.0122)		(0.0111)
Imp-Ratio			-0.161***	-0.000561			-0.272***	-0.0486***
(by Income san d)			(0.00325)	(0.00364)			(0.00453)	(0.00794)
Product and Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Type FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.205	0.0872	0.147	0.204	0.162	0.115	0.204	0.260
N	5549105	4313835	4963287	4180276	5549105	4313835	4963287	4180276

Panel B:	Dependent Variable: Export Ratio							
	(1) Exp-Ratio Region	(2) Exp-Ratio Region	(3) Exp-Ratio Region	(4) Exp-Ratio Region	(5) Exp-Ratio Country	(6) Exp-Ratio Country	(7) Exp-Ratio Country	(8) Exp-Ratio Country
Imp-Ratio	-0.446***			-0.303***	-0.523***			-0.347***
(by North/South san d)	(0.00517)			(0.00918)	(0.00593)			(0.0105)
Imp-Ratio		-0.713***		-0.349***		-0.911***		-0.520***
(by Region san d)		(0.0178)		(0.0158)		(0.0190)		(0.0160)
Imp-Ratio			-0.475***	-0.293***			-0.567***	-0.335***
(by Income san d)			(0.00474)	(0.00653)			(0.00537)	(0.00686)
Product and Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Type FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.183	0.223	0.216	0.399	0.225	0.236	0.259	0.433
N	5549105	4313835	4963287	4180276	5549105	4313835	4963287	4180276

Notes: This table examines the relationship between a firm's export share from a HS6-digit product and the "like me but not me" import measure at various aggregation levels. Here, the import share is calculated without using the contribution from the relevant country of interest. Results include firm-clustered standard errors, year, product, and firm ownership fixed effects. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Remark: The cost complementarity mechanism does not negate the role of quality-upgrading. There are likely network effects, embedded technological advantages, and final product improvements due to improved access to higher-quality materials. Rather than refuting the hypothesis altogether, the cost complementarity mechanism narrows the focus and scale of the quality-upgrading story. For example, one can expect to see firms selling higher-quality goods to the US, England, and Germany, but one can also expect that the corresponding export revenues will be proportional to the firm's import intensities from these respective countries. Both effects occur concurrently.

1.4 Theoretical Model

In this section, I detail a partial equilibrium model which explains the aforementioned stylized facts and guides my econometric analysis. This requires a framework that allows not only for endogenously determined product quality, but also for a clear delineation between the quality-upgrading and cost complementarity mechanisms motivating trade. The model detailed in this section generalizes a heterogeneous-firm model of product quality akin to Demir (2012). I discuss the germane predictions in this section and relegate less essential topics to the appendix.

1.4.1 Setup

Consider the case of $n+1$ countries engaging in bilateral trade, one Southern (S) country, and n Northern (N) countries denoted by $j \in \{S_1, N_1, ..., N_n\}$. All countries are endowed with workers who supply their labor inelastically to produce goods in a homogeneous sector and differentiated products in a single industry.[30] I present the discussion from the point of view of the Southern (less-developed) country.

[30]These laborers form the perfectly competitive intermediate good sector which firms employ in the production of final goods. Labor is immobile internationally.

1.4.1.1 Demand

The representative consumer in each country has a two-tier utility function.[31] The upper tier is a Cobb-Douglas function which determines the allocation of a consumer's budget between the untraded, homogeneous good x_{d0} and a continuum of horizontally (and vertically) differentiated varieties initially indexed by ω.[32] The lower-tier is a CES aggregate of differentiated goods with elasticity of substitution denoted $\sigma = 1/(1-\rho) > 1$.[33] For simplicity, the price of the homogeneous good is normalized to 1. Consumers choose quantity, $q(\omega)$, to maximize utility:

$$U_{ij} = x_{j0}^{1-\mu}\left(\int_{\omega\in\Omega_j}[a_{ij}(\omega)s(\omega)^{\gamma_j}q_{ij}(\omega)]^{\frac{\sigma-1}{\sigma}}d\omega\right)^{\frac{\mu\sigma}{\sigma-1}} \quad s.t.\ R_j \geq x_{j0} + \int_{\omega} p_{ij}(\omega)q_{ij}(\omega)d\omega \quad (1.3)$$

Here, μ denotes the budget share devoted to differentiated goods, γ_j denotes the intensity of consumer preferences for vertical quality differentiation in region j (assumed to be monotonically increasing in consumer income), Ω is the set of available varieties of the differentiated good, $q_{ij}(\omega)$ denotes quantity of variety ω consumed, $s(\omega)$ is a quantity-augmenting measure of final good quality of the variety ω, and $a_{ij}(\cdot)$ are destination j-specific demand parameters which capture country-level deviations in utility relative to the firm-level $s(\omega)$.[34] Firm-destination demand shocks allow the model to accommodate the fact that two firms with the same observed quality, s, may differ in the amounts exported to the same country.[35]

[31]The specification of the utility function is similar to the one proposed by Crozet, Head, and Mayer (2011).

[32]The homogeneous sector acts as the numeraire, allowing me to abstract away from wage equalization concerns across regions.

[33]The specification of the utility function follows Hallak (2006), Crozet, Head, and Mayer (2011) and Demir (2012).

[34]Naturally, γ_N is assumed to be perceptibly larger than γ_S. This is consistent with Hallak (2006) and Linder (1961) who find evidence that regions with higher per capita income demand relatively higher-quality goods.

[35]In this sense, $a_{ij}(\cdot)$ accounts for horizontal product differentiation across similar products with identical quality measures and would be thought of as a component of the structural error term for a firm-level regression. There are multiple potential interpretations for $a_{ij}(\cdot)$. In addition to cross-country variation in the tastes for the good made by the firm, it could also represent a firm's network of connections with purchasers in each market (Crozet, Head and Mayer, 2011). Foster, Haltiwanger and Syverson (2008) argue that firm-level demand shocks are important even for suppliers of the nearly homogenous goods they study.

1.4.1.2 Intermediate Sector

Laborers in each country supply "jobs" to produce the final good for firms in the differentiated good sector.[36] Production of the firm's final good consists of a continuum of jobs indexed by t, where $t \in [0,1]$. Jobs lie on the unit interval with increasing skill requirements. Let $a(t)$ denote the skill requirement of job t, then $a'(t) > 0$. Northern skill and Southern skill are equally productive in the physical production of jobs but the Northern countries are more productive than the South in the quality production: one unit of N_i for $i \in \{N_1,...,N_n\}$ skill yields one unit of quality, and one unit of S skill yields λ units of quality, $\lambda < 1$.

Intermediate sectors are perfectly competitive so suppliers of job j charge price:

$$p_t^j = a(t)r_j \quad \text{where } j = \{S, N_1, ..., N_n\}$$

r_j denotes the price of skill in region j. I assume $r_{N_1} = r_{N_2} = ... = r_{N_n} > r_S$

1.4.2 Firm Behavior

Producers in the differentiated good sector are monopolistically competitive. These firms are heterogeneous along two dimensions:

1. Productivity: Marginal labor costs vary across firms using the same technology. This idiosyncratic component of labor productivity is indexed by ϕ.

2. Quality in goods produced: Higher-quality here is assumed to be some observable characteristic or feature that is uniformly desired by each consumer.

To enter the industry in a given country, firms pay a fixed entry cost consisting of f_e units of labor. Entrants then draw their productivity and create a brand from a known cumulative distribution; combining an equal amount of each intermediate job to produce a variety of the final good. Production of physical units is represented by $F(n) = n\phi^{\alpha}$ where n denotes number of each job,

[36] The approach leans on insights from Kremer's O-Ring Model and Feenstra and Hanson (1996). Note, advancements in information and communication technologies has made the coordination of activities internationally a much easier prospect. Thus, trading inputs that were once non-tradable can now be traded (Demir, 2012).

$\phi > 0$ is firm productivity, and $0 < \alpha < 1$ is sensitivity of unit cost to firm productivity. A firm with productivity ϕ requires $\phi^{-\alpha}$ units of each task to produce one unit of the final good. Note, marginal cost is decreasing in α.[37] From the perspective of a Southern firm, selling domestically or exporting requires a fixed cost of operation denoted by f_{ii} and f_{ij}, respectively.

Job quality– analogous to the total quality of intermediate inputs– and firm productivity are assumed to complement each other in the production process. Both determine the quality of the *final good*, $s(\cdot)$, in the following way:

$$s(\phi, I) = \left[\phi^{-b} + \Psi(I)^{-b}\right]^{\frac{-1}{b}} \tag{1.4}$$

where $\Psi(I) = \lambda \int_0^I a(t)dt + \int_I^1 a(t)dt$ denotes overall job quality, and $b > 0$ is the degree of complementarity between overall job quality and firm productivity.[38] Overall quality of jobs/intermediates is a weighted average of their quality, where the weights are the corresponding skill requirements. Note that $\forall\ N_j$ such that $j \in \{N_1, ..., N_2\}$, job quality of tasks are identical. Therefore, intermediates sourced from the Northern countries are indistinguishable from the perspective of a Southern firm. If a firm sources jobs in $[0, I]$ from the South and the rest from the North, its overall quality *in jobs* is $\Psi(I)$ and its marginal cost of production is:

$$C(\phi, I) = \phi^{-\alpha}\left[r_s \int_0^I a(t)dt + \tau^{imp} r_N \int_I^1 a(t)dt\right] \tag{1.5}$$

where the term in brackets captures the variable cost of intermediates per unit of production, and $\tau^{imp} \geq 1$ is a trade cost on intermediates. Firms must pay a fixed import cost, f_{ij}^{imp} whenever tasks are sourced from destination $j\ \forall\ j \in \{N_1, ..., N_n\}$. I assume that there is some complementarity, ζ_{ij}, between import and export fixed costs when $i \neq j$. Therefore, if a firm in i exports to j without importing from j, its total fixed costs in that market will be f_{ij}. If a firm in i exports to j and also

[37] The production consists of two parts: physical units and quality. I use similar specifications to Kugler and Verhoogen (2001) and Demir (2012) for both.

[38] The predictions of the model are unchanged when using a generalized specification of Ψ so long as the following conditions are satisfied: $\frac{\partial s}{\partial \Psi} > 0$ and $\frac{\partial^2 s}{\partial \Psi^2} < 0$.

imports from j, its total fixed costs in that market will be $f_{ij} + f_{ij}^{m} - \zeta_{ij}$

Lastly, I assume that firms pay an ad valorem trade cost $\tau_{ij} \geq 1$ and a specific trade cost t_{ij} when it sells its product to market j. Here, when $j = i$, $\tau_{ii} = 1$ and t_{ii}=0. So if firm i in the South prices a good as p, the price faced by a consumer from destination j is $p_{ij}^{con}(\phi) = \tau_{ij} p_{ij}(\phi) + t_{ij}$.

1.4.3 Partial Equilibrium

The preferences described in equation (1.3) yield the demand functions:

$$q_{ij}(\phi) = \frac{(R_j - x_{j0}) \cdot \left(a_{ij}(\phi, I) s(\phi, I)^{\gamma_j} \right)^{\sigma - 1}}{\mathbb{P}_j^{1-\sigma}} [p_{ij}^{con}(\phi)]^{-\sigma}$$

where $\mathbb{P}_j = \left[\int_{\phi} p_{ij}^{con}(\phi)^{1-\sigma} \left(a_d(\phi) s(\phi)^{\gamma_j} \right)^{\sigma - 1} d\omega \right]^{\frac{1}{\sigma - 1}}$ is the quality-adjusted price index.

Given the fixed costs to supply each destination, the fixed costs of sources tasked from abroad, and the demand for its product in destination j, the firm chooses the price (p_{ij}) and the fraction of tasks to be sourced from Southern suppliers (I) separately to maximize its profits derived from supplying that destination. Its choice of I determines the marginal cost of production- as shown by equation (1.5)– and the quality of the final good– as shown by equation (1.4). The firm solves:

$$\max_{p_{ij}(\phi, I), I \in [0,1]} \pi_{ij}(\phi, I) = \{ q_{ij}(\phi)[p(\phi, I) - \tau_{ij} C(\phi, I)] - f_{ij} - f_{ij}^{m} \varepsilon_{ij} + \zeta_{ij} \varepsilon_{ij}, 0 \} \quad subject\, to$$

$$q_{ij}(\phi) = \frac{(R_j - x_{j0}) \cdot \left(a_{ij}(\phi, I) s(\phi, I)^{\gamma_j} \right)^{\sigma - 1}}{\mathbb{P}_d^{1-\sigma}} [p_{ij}^{con}(\phi, I)]^{-\sigma} \tag{1.6}$$

where ε_{ij} is a dummy variable set to 1 when firm i imports intermediates from destination j. Under CES preferences, the profit maximizing price in each market is a constant markup over marginal costs plus a fraction of the transport cost. The firm's profit maximizing price is:

$$p_{ij}(\phi, I) = \left(\frac{\sigma}{\sigma - 1} \right) C(\phi, I) + \left(\frac{1}{\sigma - 1} \right) \frac{t_{ij}}{\tau_{ij}} \tag{1.7}$$

and

$$p_{ij}^{con}(\phi,I) = \left(\frac{\sigma}{\sigma-1}\right)\tau_{ij}C(\phi,I) + t_{ij}$$

Note that as I decreases, the final good quality $s(\phi)$ rises, and by extension, the prices charged by the firm in every market increases.

The firm also chooses the fraction of its domestically-sourced jobs, and this fraction solves the expression: Substituting equation (1.6) into the expression above yields:

$$\gamma_j\left(C(\phi,I) + \frac{t_{ij}}{\tau_{ij}}\right)\frac{\partial s(\phi,I)}{\partial I} - s(\phi,I)\frac{\partial C(\phi,I)}{\partial I} = 0 \tag{1.8}$$

Without the inclusion of the quality dimension, minimizing costs would be the sole motive determining firm-level jobs selected. However, when selecting the fraction of domestically-sourced jobs, a firm in this model must strike a balance between two opposite effects: 1. a higher I reduces the firm's marginal cost (equation 1.9); and 2. a higher I lowers the quality of the product (equation 1.10) which lowers its demand.[39] These two points are shown below:

$$\begin{aligned} C(\phi,I) &= \phi^{-\alpha}\left[r_s\int_0^I a(t)dt + \tau^{imp}r_N\int_I^1 a(t)dt\right] \\ \Rightarrow \frac{\partial C(\phi,I)}{\partial I} &= \phi^{-\alpha}r_S[a(I)] - \tau^{imp}r_N[a(I)] \\ \Rightarrow \frac{\partial C(\phi,I)}{\partial I} &= \phi^{-\alpha}[r_S - \tau^{imp}r_N]\cdot a(I) < 0 \end{aligned} \tag{1.9}$$

$$s(\phi,I) = [\phi^{-b} + \Psi(I)^{-b}]^{\frac{-1}{b}} \Rightarrow \frac{\partial s(\phi,I)}{\partial I} = \frac{\partial s(\phi,I)}{\partial \Psi}\frac{\partial \Psi}{\partial I} \tag{1.10}$$

Since $\Psi(I) = \lambda\int_0^I a(t)dt + \int_I^1 a(t)dt \Rightarrow \frac{\partial \Psi}{\partial I} = \lambda a(I) - a(I) = (\lambda-1)a(I) < 0$

To summarize:

1. A higher I reduces the firm's marginal cost

[39] Using the result from equation 1.8 shows that the partial derivative of $q(\phi,I)$ with respect to I is negative.

- From equation (1.9): $\frac{\partial C(\phi,I)}{\partial I} < 0$

2. A higher *I* lowers the quality of the product which lowers the demand for the product

   - See reduced quality from equation (1.8): $\frac{\partial s(\phi,I)}{\partial I} = \frac{\partial s(\phi,I)}{\partial \Psi}\frac{\partial \Psi(I)}{\partial I} < 0$
   - See reduced demand from equation (1.4): $\frac{\partial q(\phi,I)}{\partial s} > 0$

1.4.4 Theoretical Insights

The higher the share of jobs sourced from Northern suppliers, the higher the overall quality of intermediate inputs. This specification suggests that one can examine within-firm product differentiation in final good quality by tracking input sources. The model also suggests that firms which import intermediates from a particular region should earn greater export revenues in said region than non-importers. Comparative statics on equation (8) with respect to ϕ, γ, and τ^{imp}, respectively, yield the three major insights that guide the empirical analysis. I relegate all comparative statics to the appendix.

Insight 1. *Higher-productivity Southern firms use a higher fraction of imported jobs from the North and thus produce a higher-quality variety.*

Insight 1 states that there is a positive correlation between input quality and firm-productivity. Better product quality is universally desired– to varying degrees based on national wealth– and augments consumer demand. Therefore, the well-noted intra-industry productivity gains induced by trade liberalization occur in conjunction with increased levels of importing intermediates. This suggests that there should be heterogeneous effects based on where firms lie on the productivity distribution.

Insight 2. *Southern firms face different demands for quality in different regions, and will differentiate their product quality in each market. They will sell a higher-quality variety in the higher-demand market and will use relatively higher quality of jobs by importing more jobs from the North to produce the higher-quality variety.*

Consider two export destinations j and j' such that $\gamma_j > \gamma_{j'}$; the firm faces more intense preferences for quality in j than in j'. The derivations show that the greater the destination's taste for quality, the smaller the fraction of intermediates sourced from the South, the greater the price charged, and the greater the quantity demanded. The effect is qualitatively similar to firms in the South becoming multiproduct firms. They produce multiple varieties of a product in a single product line, and sell them in different markets. They vary the quality of the good by changing the fraction of high-quality imported intermediates across varieties and therefore charge different prices across markets.

The first half of Insight 2 has been theoretically generated by Demir (2012) and empirically supported by a handful of studies. In particular, Manova and Zhang (2012), using only the customs data for Chinese firms in 2005, observe that firms have substantial price dispersion within imported products and across multiple source countries. They cite this finding as evidence of firms adjusting markups and product quality in each destination market. The second half of Insight 2 has not been rigorously tested. It states that the quality of a product should reflect the taste for quality of the export destination.

Insight 3. *A drop in the per unit cost of importing intermediates induces firms to increase their usage of Northern inputs, increasing final good quality. This effect is amplified by greater consumer taste for quality.*

A Southern firm might begin importing or choose to upgrade the quality of all varieties it produces when the cost of importing Northern intermediates fall. The incentive to upgrade quality increases with the intensity of consumer preference for quality in the destination market. This suggests that tariff cost changes are a candidate for exogenous cost shifters for a firm's input bundle.

1.4.5 Profits and Productivity Cutoffs

Given a Southern firm's rule for endogenously choosing I in a particular market (equation 1.8), I can now discuss profits and cutoff productivities. Given the pricing rule and assuming that $t_j = 0$ and $\gamma_S = 0$, equilibrium firm revenue from destination j for the Southern firm i are:

$$r_{ij}(\phi,I) = \left(\frac{\sigma}{\sigma-1}\right)\frac{(R_j - x_{j0})\cdot\left(a_{ij}(\phi,I)s(\phi,I)^{\gamma_j}\right)^{\sigma-1}}{\mathbb{P}_j^{1-\sigma}}[C(\phi,I)]^{1-\sigma}[\tau_{ij}]^{1-\sigma}$$

where $\tau_{ii} = 1$. Equilibrium profits from market j for a Southern firm are:

$$\pi_{ij}(\phi,I) = \frac{r_{ij}}{\sigma} - f_{ij} - f_{ij}^{imp}\varepsilon_{ij} + \zeta_{ij}\varepsilon_{ij} \tag{1.11}$$

The case when Southern firms do not import any tasks from the North for goods sold in market j where $j \in \{N_1, ..., N_n\}$ is straightforward. The analysis of interest relates to Southern firms that source a non-zero number of inputs (i.e. imported intermediates) from the North. Note, a Southern firm that imports intermediates to produce a variety for market j will source inputs from j to take advantage of the reduction in total fixed costs. Since all Northern firms produce identical varieties, sourcing intermediates from a Northern destination other than export partner j does not minimize cost and therefore is not profit-maximizing. For the domestic Southern market, $\gamma_S = 0$ implies that consumers have no strong preference for higher quality goods. As a result, $I = 1$ for the lowest productivity firms in the domestic market and profits depend solely on firm productivity as no firm will source intermediates from the North.

Recall, $C(\phi,I) = \phi^{-\alpha}\left[r_s \int_0^I a(t)dt + \tau^{imp} r_N \int_I^1 a(t)dt\right]$. We can rewrite this expression more succinctly as $C(\phi,I) = \frac{A(t)}{\phi^{\alpha}}$ where $A(t) = r_s \int_0^I a(t)dt + \tau^{imp} r_N \int_I^1 a(t)dt$. For the case of $I = 1, A(T) = r_s \int_0^1 a(t)dt$.

Exit Cutoff– For the least productive Southern firms still in operation, profits are highest when they do not import tasks from the North and they only serve the domestic market. The exit cutoff ϕ_{ii}^* is defined by:

$$\pi_{ii}(\phi_{ii}^*, I=1) = \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \frac{(R_i - x_{i0}) \cdot \left(a_{ii}(\phi_{ii}^*, I) s(\phi_{ii}^*, I)^{\gamma_i}\right)^{\sigma-1}}{\mathbb{P}_i^{1-\sigma}} \left(\frac{1}{\sigma}\right) \left[\frac{A(T)}{(\phi_{ii}^*)^{\alpha}}\right]^{1-\sigma} - f_{ii} = 0$$

$$\Rightarrow \quad (\phi_{ii}^*)^{\alpha} = \left[\frac{\sigma(f_{ii})}{R_i - x_{i0}}\right]^{\frac{1}{\sigma-1}} A(T) \frac{1}{\rho \mathbb{P}_i a_{ii}} \tag{1.12}$$

Export Cutoff– The marginal exporter does not import tasks from the North and serves market j. The export cutoff is defined by:

$$\pi_{ij}(\phi_{ij}^*, I=1) = \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \frac{(R_j - x_{j0}) \cdot \left(a_{ij}(\phi_{ij}^*, I) s(\phi_{ij}^*, I)^{\gamma_j}\right)^{\sigma-1}}{\mathbb{P}_j^{1-\sigma}} \left(\frac{1}{\sigma}\right) \tau_{ij}^{1-\sigma} \left[\frac{A(T)}{(\phi_{ij}^*)^{\alpha}}\right]^{1-\sigma} - f_{ij} = 0$$

$$\Rightarrow \quad (\phi_{ij}^*)^{\alpha} = \left[\frac{\sigma(f_{ij})}{R_j - x_{j0}}\right]^{\frac{1}{\sigma-1}} A(T) \frac{\tau_{ij}}{\rho \mathbb{P}_j a_{ij}} \tag{1.13}$$

Using equation (1.12), I can express equation (1.13) in terms of the exit cutoff:

$$(\phi_{ij}^*)^{\alpha} = (\phi_{ii}^*)^{\alpha} \left[\frac{f_{ij}}{f_{ii}} \frac{(R_i - x_{i0})}{(R_j - x_{j0})}\right]^{\frac{1}{\sigma-1}} \tau_{ij} \frac{\mathbb{P}_i a_{ii}}{\mathbb{P}_j a_{ij} s_j^{\gamma_j}} \tag{1.14}$$

Import Cutoff– The marginal firm importing intermediates is an exporter. The cutoff for sourcing job tasks from the North (ϕ_h^*) is defined by:

$\pi_{ij}(\phi_h^*, I \in (0,1) - \pi_{ij}(\phi_h^*, I=1) = 0$

$$\Rightarrow \left(A(t)^{1-\sigma} - A(T)^{1-\sigma}\right) \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \frac{(R_j - x_{j0}) \cdot \left(a_{ij}(\phi_h^*, I) s(\phi_h^*, I)^{\gamma_j}\right)^{\sigma-1}}{\sigma \mathbb{P}_j^{1-\sigma}} \tau_{ij}^{1-\sigma} \left[\frac{1}{(\phi_h^*)\alpha}\right]^{1-\sigma} = f_{ij}^{imp} - \zeta_{ij}$$

Rearranging and solving in terms of ϕ_{ii}^*:

$$(\phi_h^*)^{\alpha} = (\phi_{ii}^*)^{\alpha} \tau_{ij} \left[\frac{(f_{ij}^{imp} - \zeta_{ij})}{f_{ii}} \frac{(R_i - x_{i0})}{(R_j - x_{j0})}\right]^{\frac{1}{\sigma-1}} \frac{\mathbb{P}_i a_{ii}}{\mathbb{P}_j a_{ij} s_j^{\gamma_j}} \left[\frac{A(T)^{1-\sigma}}{A(t)^{1-\sigma} - A(T)^{1-\sigma}}\right] \tag{1.15}$$

Comparing the export cutoff with the importing cutoff:

$$\left(\frac{\phi_h^*}{\phi_x^*}\right)^{\alpha} = \left[\frac{(f_{ij}^{imp} - \zeta_{ij})}{f_{ij}}\right]^{\frac{1}{\sigma-1}} \left[\frac{A(T)^{1-\sigma}}{A(t) - A(T)^{1-\sigma}}\right]^{1-\sigma} > 1 \tag{1.16}$$

I therefore obtain a similar sorting outcome to Bustos (2011). Also, the share of active firms importing from the North is higher when the complementarity term ζ_{ij} increases and when trade costs decrease. This is because these parameters affect the total revenues of exporters relative to those of the marginal firm which only serves the domestic market.

1.4.6 Discussion:

The model features multiple avenues through which I can investigate asymmetries across countries. However, a more useful way to highlight the model's implications is to investigate extreme cases while preserving the symmetry across Northern countries. First, I consider the case where the fixed cost complementarity is zero. In this scenario, quality upgrading is the only thing that matters. Firms will import all intermediates from one Northern country, and export to all Northern countries. Therefore, the relationship between import sources and export patterns, while positive, will be *very* small.

Now, consider the case where there is no quality upgrading and fixed cost complementarities are sufficiently large. In this framework, firms will import from every nation they export to. This suggests that, for some subset of firms, eliminating the complementarity in a destination may eliminate exports to that destination altogether. In this scenario, the relationship between intermediate input sources and export patterns will be positive and large.

The pervasive factor connecting all the insights and productivity thresholds is the endogenous choice for input quality, I. Higher productivity firms will use higher quality inputs (sourced from richer destinations) and generate greater revenues in the high-demand destination.

Note, I present a theoretical model which relies on fixed cost complementarities. This formulation was selected for expositional convenience. However, this setup suggests that cost complementarities are generated along the extensive margin dimension; based solely on entry into international markets. The model can easily be extended to also include intensive margin differences by including a cost complementarity on destination-specific variable trade costs (τ^{imp}). This addition allows the model to predict how trade patterns may vary in accordance with import intensity. That is, the model suggests a causal link between the portion of imported inputs from a particular source (destination) and a greater portion of total export revenue (export ratio) earned in the related market. I explore this link rigorously throughout the empirical section.

1.5 Measurement and Empirical Methodology

In this section, I discuss my econometric specification, variable measurement, and address endogeneity concerns. The empirical analysis is conducted on the merged dataset with observations at the firm-HS6-country level.

1.5.1 Baseline: Estimating Equation for Imported Input Sourcing

I begin with an empirical equation to explore whether or not export patterns are related to the sourcing and usage of imported intermediates inputs. The basic regression is similar to the specification presented in equation (1.1):

$$expratio_{fpdt} = \alpha + \beta \cdot impratio_{fdt} + Controls + Characteristics_f + \varepsilon_{fpdt} \tag{1.17}$$

again, f denotes a firm, p denotes a product at the HS6-digit level, d denotes flows for the destination (at the stage of development, income, region, or country level), t denotes the year, and j denotes the firm's type of business ownership. Export performance is measured as the firm's fraction of total export revenue of product p generated from destination d $\left(\text{i.e } expratio_{fpdt} = \frac{Rev_{fpdt}}{\sum_d Rev_{fpdt}}\right)$, and the import measure is the fraction of a firm's total expenditure on imported intermediates sourced from d $\left(\text{i.e. } impratio_{fdt} = \frac{\sum_p Imp_{fpdt}}{\sum_d \sum_p Imp_{fpdt}}\right)$. The idiosyncratic error term ε_{fpdt} is clustered at the firm-level to address the potential correlation of errors within each firm across different products.[40]

Controls is a set of dummies to control for product characteristics that are time-invariant, year characteristics that are market-invariant, ownership configurations, industry fixed effects to control for factors specific to a given sector; and $Grav_{dt}$–a collection of the key determinants of

[40]Therefore, the specification in equation (1.17) is based on the $expratio_p$ within a firm for each product due to tariffs reductions and real exchange rate changes rather than across all goods a firm may produce.

aggregate trade patterns identified by the gravity literature– to control for geo-economic determinants.

$Characteristics_f$ is a set of variables which capture firm-level factors. This includes the logarithm of wages, logarithm of firm size, logarithm of capital, and TFP. I use a Olley-Pakes/Levinsohn-Petrin approach to estimating TFP based on manufacturing survey data (See appendix).

1.5.2 Endogeneity Concerns and Instruments

This study strives to disentangle the link between a firm's intermediate input sourcing and its export patterns. However, there may be two major sources of endogeneity obstructing causal interpretation if unaddressed. First, as suggested by the theory, the well-established correlation between firm imported intermediate use and export shares could be a byproduct of unobserved firm-productivity; with import and export decisions jointly determined during optimization. This introduces endogeneity due to simultaneity bias. To address this issue, I estimate and control for firm-productivity using the Olley-Pakes/Levinsohn-Petrin approach.

Second, I argue that firms which import from a particular country learn about standards, regulations, and/or establish distributional ties which make them more likely to export to said country. While this order of operations is intuitive, it could be the case that firms first export to a destination, obtain destination-specific information, then choose to import from said country. The latter case introduces endogeneity due to reverse causality. To isolate the impact of imported input sourcing on export behavior directly, I take advantage of exogenous changes in import costs. Namely, I use tariff reductions and real exchange rate changes to instrument for my imported input measures.

During maximization, input cost is a major determinant of the optimal input bundle. This is magnified for imported intermediates since purchasing from *each* source country may be associated with large fixed costs.[41] If the access to imported intermediates changes due to changes in

[41] Firms may also face limitations in working capital available due to credit constraints which effectively increases

import tariffs and real exchange rates, firms may respond by changing the set of imported intermediate inputs used in production, or by altering intensities of imported intermediates from the pre-liberalization bundle.

The standard argument in the literature is that these policy changes directly affect a firm's ability to use more and/or higher quality imported intermediates, increasing final good quality and consumer demand in export markets.[42,43] However, the proposed mechanism is at odds with the prevailing conjecture that Chinese firms flood foreign markets with cheap, low-priced, and low-quality products. It is also contradicted by the empirical fact that firms import inputs within the same narrowly defined product class from multiple sources and at varied prices (Manova and Zhang, 2012). If firms exported the same quality of a given product to all markets, they should have a limited range of source partners for each imported variety (as they seek to avoid large fixed costs associated with dealing with multiple countries), and should pay an identical price net of transport costs (a rational firm should only pay higher prices for a higher quality input). The variation in source countries, import prices, and export prices suggest that firms alter product quality based on destination market characteristics.

Before discussing how each instrument is measured, I discuss their validity. Exchange rates are clearly exogenous to a given firm's decisions. Though a firm's performance may be correlated with exchange rate movements, no single firm or coalition of firms can influence exchange rates. To address issues of endogeneity between changes in exports and trade policy, I verify that tariff reductions occurred independently from expected profits and lobbying activities. Establishing causality could become very difficult if policy makers reduce tariffs based on sectoral performance. In this scenario, greater reductions would be granted for industries that perform well in export markets and/or require a large quantity of imported intermediates. However, there are

costs associated with importing inputs (Feng, Li, Swenson, 2016)

[42] Koopman, Wang, and Wei (2012) noted that China's processing firms operating in more sophisticated sectors relied heavily on imported intermediates. This suggests that foreign intermediates were superior in quality to domestic alternatives in the production of sophisticated products

[43] Other studies have also noted that imported intermediates may influence productivity and output. Technology may become more efficient due to increased division of labor or due to embedded technological improvements in imported intermediates (Feng, Li, Swenson, 2016; Kasahara and Rodrigue, 2013; Amiti and Konings, 2007; Gopinath and Neiman, 2013)

several arguments against the endogeneity of trade policy in this context.

Firstly, the impetus for Chinese policymakers to join the WTO was the domestic reform agenda and a willingness to become a market economy (Branstetter and Lardy, 2006). Thus, subsequent tariff reductions are unlikely to be related to lobbying from less-efficient industries striving for lasting protections or to a firm's export projections, a priori. Moreover, Brandt et al. (2012) suggest that the observed convergence in tariffs over time is indicative of a desire to reach low tariffs in all sectors rather than in selective ones in response to industry performance or lobbying activities.

Secondly, Bas and Strauss-Kahn (2015)– in a study which explores the differential impact of tariff reductions on prices for ordinary vs processing Chinese manufacturers from 2000-2006– test for the exogeneity of input tariffs by examining the correlation of tariff reductions with initial industry performance.[44] They use data for 2000 in order to capture initial industrial performance and then regress changes in input tariffs on a number of industry characteristics.[45] They find that there is no statistical correlation between input tariffs and industry characteristics pre-WTO accession. Therefore, there does not appear to be a perceptible connection between tariff reductions and industrial performance. This evidence is consistent with exogenously determined input tariff reductions.

1.5.2.1 Measurement

It is vital that trade liberalization impacts and real exchange rate changes are properly measured to capture the effective tariff reductions and currency appreciations/depreciations, respectively, actually faced by firms. Both instruments are created using 2002 weights.[46]

The two main tariff measures for the baseline specification are calculated at the firm- and

[44] This method is identical to the exogeneity test conducted in Topalova and Khandelwal (2011).

[45] Industry characteristics include value added, use of intermediate inputs, investment, a value-added based Herfindahl index measuring industry concentration, exports and imports.

[46] Altering the year weights generates qualitatively similar results.

industry-levels:

$$FirmDuty_{fdt} = \sum_{p=1}^{P_f^M} \left(\underbrace{\left(\frac{Import_{pfd}^{2002}}{\sum_{p=1}^{P_f^M} \sum_{d=1}^{D} Import_{pfd}^{2002}} \right)}_{W_{fd}} \tau_{pt} \right) \tag{1.18}$$

$$IndusDuty_{jdt} = \sum_{p=1}^{P_j^M} \left(\underbrace{\left(\frac{Import_{pjd}^{2002}}{\sum_{p=1}^{P_j^M} \sum_{d=1}^{D} Import_{pjd}^{2002}} \right)}_{W_{jd}} \tau_{pt} \right) \tag{1.19}$$

where f denotes a firm and j denotes a 4-digit CIC industry a firm operates within. τ_{pt} is the time-varying HS6-digit (average) product tariff levied by China on each imported variety p in year t. These variables capture the weighted tariff reduction across imported intermediates by source destination d. Here, the weight, W_{fd} (or W_{jd}), is the import share of a product from d in the total import value by the firm (or industry) in the base year, 2002.[47] The firm-level measure is suggested by the theoretical model and captures intensive margin effects of tariff reductions on the initial import bundle.[48] However, these measures may introduce issues stemming from selection bias. The industry-level measure is better suited to capture the potential to import more intermediates. However, they miss some of the intensive margin effects experienced at the firm-level. Previous studies have placed greater importance on the industry-level tariff cuts. I utilize both industry- and firm-level tariff cuts to support robustness of the findings.

[47] I only use import share weights due to a lack of data on domestic intermediate usage. I am unable to track firms' input usages to specific outputs. Note, it is likely that input quality and intermediate intensity fluctuate by product within a firm. Moreover, firms likely produce asymmetric quantities of various goods with varying success in domestic and foreign markets. As I cannot observe input and product intensities within a given firm in a detailed manner with respect to domestic sales, it is best to think of the estimated coefficients presented in Table 1.8 as firm-wide averages.

[48] This measure is free of composition and reverse causality problems related to the change of weights.

The imported input real exchange rate measure is constructed at the industry-level:

$$ImRER_{jdt} = \sum_{d=1}^{D} \left(\underbrace{\left(\frac{Import_{jd}^{2002}}{\sum_{d=1}^{D} Import_{jd}^{2002}} \right)}_{\omega_{jd}} rer_{ct} \right) \tag{1.20}$$

where the notation is the same as in equations (18) and (19). The theoretical model suggests that a decrease in the associated costs of obtaining imported inputs– due to falling import tariffs or an appreciation in real exchange rates– should induce firms to increase their usage of imported intermediates at the intensive and/or extensive margins. Therefore, I expect to see a negative association between the two imported input cost measures and the use of imported intermediates.

1.6 Main Findings

In this section, I present the main results using a sample of non-processing Chinese manufacturing exporters.[49] The aim of the study is to examine the connection between a firm's intermediate input sourcing and its export behavior. To address the endogeneity of firm input choices, I employ an instrumental variables approach which takes advantage of how tariff reductions and changes in real exchange rates impact the firm's cost of obtaining imported intermediate inputs. Presumably, firm investments in importing intermediates, conditional on source, should enhance the firm's ability to serve markets domestic and abroad. First, I focus on the impact of source-specific import ratio intensities on product-destination export ratios for all firms. Next, I examine how heterogeneous productivities affect estimation. Then, I examine how import shares vary by product characteristics and ownership structure. The empirical analysis concludes with various ro-

[49]Throughout the paper I focus on ratios rather than revenues or quantities sold. I conduct import-export revenue comparisons but exclude them from this study since these measures ignore the relative scale considerations of firm's export-import activity in a particular destination. I ignore quantity sold from my analysis altogether for two reasons. Firstly, quantities sold is absent from the derivations and final expressions of interest in the theoretical discussion. Secondly, the dataset includes firms which produce multiple goods of varying input intensities. As a result, inference using quantities sold alone is likely misleading.

bustness checks. The proceeding results are based on the matched data at the firm-product-country level.

1.6.1 Baseline Results

Table 1.8 presents the IV estimates when the dependent variable is the firm-product export share at the country level. I use firm- and industry-level tariff reductions, and real exchange rate changes to instrument for "Imp-Ratio" at the corresponding level of aggregation in all regressions. Columns (1)-(4) show the results when the import share at each of the four levels of aggregation is the main explanatory variable. Columns (5)-(7) show the results for the "like me but not me" analysis; where a specific country's contribution to imported intermediates is excluded from the constructed import share calculation. All regressions include ownership, year, industry, and product fixed effects in addition to controls for firm characteristics and gravity. Errors are clustered at the firm level.

The IV estimates are in keeping with the stylized facts discussed in Section 3, qualitatively. The corresponding OLS estimates are also presented in Table 8 in the bottom panel. The IV estimates suggest that a one percentage point increase in import share at the country level stimulated a .34 percentage point increase in product-export share from a particular country as shown in Column 1. I obtain qualitatively similar results for the estimated coefficients of import share at the North/South, regional, and income levels where a percentage point increase causes a 0.35, 0.27, and 0.29 percentage point increase, respectively, in product-export share from a particular country (Columns 2, 3, and 4).

These IV estimated coefficients are significantly larger than the corresponding OLS estimates. Though the OLS estimates show a positive correlation between import shares and product export shares from a particular country, I report these coefficients for informational purposes only due to inherent endogeneity of firm sourcing decisions, which I confirm statistically.[50] More im-

[50] It is likely that attenuation bias due to measurement error contributes to the downward bias in the OLS estimates. Since aggregate demand for intermediate inputs increase due to cost, demand or other shocks, the observed increase in the share of imported intermediates may be tied to increases in price as well as increases in quantity. As a result, if

portantly, the IV estimates show that firms importing from a particular country will export more to that particular country. This relationship holds both at the country-level and at higher levels of aggregation. These findings stress the importance of global supply chains in the modern context; especially via bilateral relations. Note that the dependent variable is a fractional response. Therefore, changes in import shares generate economically significant changes in product export shares, particularly at the country level.

The results from the "like me, but not me" analysis is also in keeping with the stylized facts in Section 1.3. The IV estimates for import share net of the relevant country's contribution to intermediates is negative and statistically significant. These estimates are generally more negative than the corresponding OLS estimates. The results are particularly stark at the North/South and income levels (Columns 5, and 7). Conversely, the estimated coefficient at the regional level (Column 6) is of a much smaller magnitude. This suggests that the cost complementarity mechanism has a perceptible role in explaining product-export revenue in conjunction with the quality-upgrading mechanism. Moreover, this evidence supports the idea that distributional connections and network effects at the regional level may mitigate the importance of dealing with countries directly. That is, importing from any given country may give firms greater access to the adjacent nations in the region, thereby yielding relatively small estimates for import share at the regional level.

Each of the presented estimates include first stage tests to evaluate the relationship between import share and the selected instruments. These first stage results are not the focus of the study but they do perform in accordance with ex ante predictions. I generally find that import share at a given level of aggregation is positively associated with firm-level and industry-level import tariff reductions at the corresponding aggregation level, and negatively associated with domestic input real depreciation in China.

The Durbin-Wu-Hausman (DWH) F-tests of endogeneity suggest joint significance of the first stage instruments; confirming the presence of a potentially endogenous variable, import share. The values of the Kleibergen-Paap (KP) Wald statistics reject the null of weak instruments using

import values increase overstate the actual increase in the use of imported inputs, the resulting OLS coefficients will be biased downward.

Table 1.8: Country: IV Regressions of Export Ratio on Import Ratio

	Dependent Variable: Export Ratio (by Country)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Imp-Ratio	0.337^{***}						
(by Country)	(0.0196)						
Imp-Ratio		0.352^{***}					
(by North/South)		(0.136)					
Imp-Ratio			0.271^{***}				
(by Region)			(0.0229)				
Imp-Ratio				0.291^{**}			
(by Income)				(0.117)			
Imp-Ratio					-0.539^{***}		
(by North/South sans d)					(0.0536)		
Imp-Ratio						-0.170^{***}	
(by Region sans d)						(0.0542)	
Imp-Ratio							-0.488^{***}
(by Income sans d)							(0.0382)
Product-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	109.3	214.3	147.0	533.2	117.3	38644.5	260.0
R^2	0.280	0.249	0.277	0.252	0.334	0.286	0.357
N	174374	174374	174374	174374	174177	173844	174133
First Stage:							
	(1) Country	(2) N/S	(3) Region	(4) Income	(5) N/S Sans d	(6) Region Sans d	(7) Income Sans d
Δ Real Exchange	$-.003^{**}$	.0005	-.0002	.0005	$.002^{***}$	$-.0012^{***}$	$.0017^{***}$
Δ Industry Tariff	$.0169^{***}$	$.0029^{***}$	$.015^{***}$	$.0034^{***}$	$.0015^{***}$	$.0042^{***}$	$.002^{***}$
Δ Firm Tariff	$.0043^{***}$	$.0007^{***}$	$.0039^{***}$	$.0008^{***}$	.0011	$.0219^{***}$	$.0063^{**}$
DWH F-Stat	199.83	65.19	215.20	67.22	31.36	89.46	49.72
DWH p-value	0.0000	0.000	0.000	0.000	0.000	0.000	0.000
AR F-stat	96.45	7.53	53.09	8.22	20.99	14.80	27.09
AR χ^2	291.01	22.73	160.19	24.81	63.34	44.67	81.73
AR p-value	0.0000	0.000	0.000	0.000	0.000	0.000	0.000
KP- UnID LM	356.801	345.733	485.605	356.502	340.593	315.810	497.279
KP-UnID p-val	0.0000	0.000	0.000	0.000	0.000	0.000	0.000
KP wald F-stat	204.251	120.801	254.278	128.335	83.817	114.775	109.291
SY weak ID CV	13.91	13.91	13.91	13.91	13.91	13.91	13.91
OLS Estimates:							
Imp-Ratio	0.201^{***}	0.0213	0.168^{***}	0.0257^{**}	-0.425^{***}	-0.696^{***}	-0.461^{***}
(Corresponding)	(0.00631)	(0.0147)	(0.00634)	(0.0128)	(0.00542)	(0.0136)	(0.00546)

Notes: This table examines the relationship between a firm's product export share and import share from a particular destination. The dependent variable is the product export share at the country level. All regressions include firm-clustered standard errors, a constant term (suppressed for convenience), year, industry, ownership, and product fixed effects. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

the Stock and Yogo critical values; confirming that the selected instruments are appropriate.[51] The KP Lagrange Multiplier (LM) tests reject the null of under-identification, and the Anderson-Rubin tests suggest the model is not misspecified.[52]

Overall, the baseline results support the three major arguments of this study: 1. Imports should not be treated homogeneously; 2. Imported intermediate sources can explain export patterns; and 3. Cost complementarities form a key part of the mechanism to explain firm behavior in international markets.

1.6.2 Intermediate Input Sources and Heterogeneous Productivities

I now focus on the role of firm heterogeneity in explaining trade patterns. The summary statistics from the overview of established trends confirmed that there is a positive relationship between number of import destinations, number of export markets serviced, and firm size. The theoretical model suggests that higher productivity firms are better at converting higher quality intermediates into higher quality final goods and more likely to access multiple markets. The confluence of evidence suggests that there may be differential impacts of import share on export share in accordance with firm size.

This section empirically examines the relationship between heterogeneous productivity levels and intensities to a given country. I construct an interaction variable using firm productivity quartiles and the corresponding import shares. These measures are positive for observations relating to the given quartile and zero otherwise. A priori, I expect the standard relationship between import share and export share to hold. The estimated coefficients should be larger for lower productivity firms since they have a smaller range of trade partners in their portfolio. However, for the "like me but not me" exercise, it is not obvious what relative magnitudes– or signs– to expect for estimated coefficients. The lowest productivity firms, assumed to produce lower quality

[51] Weak identification occurs when the excluded instruments are correlated with endogenous regressors but only weakly.

[52] The under-identification test examines whether or not excluded instruments are relevant. That is, correlated with the endogenous regressor.

goods, may be more likely to use large portions of domestic inputs in exported products; particularly for less developed nations. Therefore, for the bottom quartile of productivities, it seems likely that these estimated coefficients would be positive or relatively small if negative. The theoretical model predicts that as productivity increases, cost complementarities will play a more significant role, yielding more negative estimated coefficients. However, the framework in Section 1.4 relied on symmetric trade partners and identical fixed costs. If partner characteristics vary and fixed costs are asymmetric across destinations (but not firms), this monotonicity is unlikely to hold for the highest productivity firms. The highest productivity firms are more capable of taking advantage of scale effects that make the cost complementarities less relevant to their import-export strategies (Antras, Fort, and Tintelnot, 2017).

Table 1.9: Heterogeneous Effects: Regressions of Export Ratio on Import Ratio

	Dependent Variable: Export Ratio (by Country)						
Aggregation Level of d	(1) Country	(2) Stage	(3) Region	(4) Income	(5) Stage sans d	(6) Region sans d	(7) Income sans d
Imp-Ratio$_d$ x							
1^{st} Quartile of Firms	0.421***	1.310***	0.348***	0.281***	-0.108	0.649***	-0.106
	(0.0244)	(0.0899)	(0.0257)	(0.108)	(0.0805)	(0.118)	(0.0711)
2^{nd} Quartile of Firms	0.378***	1.254***	0.305***	0.240**	-0.487***	-0.120	-0.423***
	(0.0237)	(0.0896)	(0.0249)	(0.107)	(0.0724)	(0.0809)	(0.0633)
3^{rd} Quartile of Firms	0.339***	1.222***	0.265***	0.204*	-0.651***	-0.450***	-0.572***
	(0.0229)	(0.0896)	(0.0241)	(0.107)	(0.0665)	(0.0776)	(0.0571)
4^{th} Quartile of Firms	0.276***	1.205***	0.212***	0.176*	-0.576***	-0.228***	-0.495***
	(0.0200)	(0.0898)	(0.0219)	(0.105)	(0.0629)	(0.0770)	(0.0529)
R^2	0.267	0.274	0.265	0.262	0.264	0.260	0.263
N	174393	1373525	174393	174393	174393	174393	174393

Notes: This table examines the relationship between a firm-product's export share and import share at various levels of aggregation. Import shares have been interacted with dummies for productivity quartiles. All regressions include firm-clustered standard errors, a constant term (suppressed for convenience), year, product, industry, and ownership fixed effects. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results for this analysis are presented in Table 1.9. Overall, I obtain the same positive relationship between export ratio and import ratio for all four quartiles of firm productivity (columns 1 to 4). However, the strength of the relationship appears to be decreasing in productivity level. A percentage point increase in import share resulted in a .42%, .38%, .34%, and .28% increase in export share for low, lower middle, upper middle, and high productivity firms, respectively (Column 1). This pattern is congruent with expectations. Since productivity levels generally correspond with number of import and export destinations, the import intensity for lower productivity firms is a particularly strong predictor for export intensity in a given destination. The estimates using import shares at the North/South, region, and income levels yield qualitatively similar results.

For the "like me but not me" exercise, I again obtain evidence of heterogeneous impacts. The results when import shares are aggregated at the North/South and income levels (Columns 5 and 7) suggest that ignoring a countries contribution to imports has an insignificant impact on product export shares. Support for the cost complementarity story is restored for the 2nd, 3rd, and 4th quartiles, however, it appears to be more of a motivating factor for firms in the 3rd quartile of the productivity distribution. Note that based on the presented standard errors, it is not clear that the estimates for firms in the 3rd and 4th quartiles are statistically different from each other. When the import share is aggregated at the regional level (Column 6) the ordering is preserved but the implications are slightly different. For the lowest productivity firms, a percentage point increase in import share causes a .65 percentage point increase in product export share. For the 2nd quartile, the estimated coefficients are insignificant. The standard estimates in support of the cost complementarity story are restored for the 3rd and 4th quartiles, with the estimates being more negative for the 3rd quartile of productivities.

Overall, the results suggest that import sources are intimately linked with export shares. However, the average effect may not necessary hold for the extremes. I find that the link has a heterogeneous effect; stronger for smaller firms relative to larger ones. Crucially, the lowest productivity firms appear to operate in accordance with the standard quality upgrading mechanism. On the other hand, larger firms appear to take advantage of fixed costs complementarities en masse. This relationship is not monotonic, however, as the largest firms are able to take advantage of scale effects, reducing the role of complementarities in their input-export strategies.

1.6.3 Intermediate Input Sources and Scope for Differentiation

Next, I examine the impact of imported intermediate sourcing on various subgroups of products. I use the United Nations Conference on Trade and Development (UNCTAD) classification system which classifies goods by skill and technology composition. The six product classifications are: 1. high skill and technology-intensive, 2. medium skill and technology-intensive, 3. low skill and technology-intensive, 4. mineral fuels, 5. non-fuel primary commodities, and 6. resource-intensive manufactures. A priori, I expect to obtain larger, statistically significant estimates for the high, medium, and low skill subgroups since technology-intensive products tend to encompass a wide array of vertically differentiated goods. Mineral fuels and non-fuel commodities exhibit a much narrower scope for product differentiation, and should yield smaller and/or statistically insignificant estimates.

Table 1.10 presents the results when the dependent variable is export share at the firm-product-country. Import share is calculated at the country level and is instrumented using real exchange rates, firm-level and industry-level tariff reductions. Again, the estimated coefficients are in line with expectations. A percentage point increase in the share of imported intermediates sourced from a particular country causes a 0.21 to 0.39 percentage point increase in product-export share for the range of product classes. Moreover, these country-specific export shares for (technology-intensive) goods with greater scope for differentiation yield the largest, statistically significant estimates (See Columns 1, 2, and 3). Surprisingly, mineral fuels- which tend to be associated with primary commodities and presumably thin quality ladders- yielded a large estimated coefficient. Resource-intensive commodities also yielded surprising estimates, with an unexpectedly low magnitude relative to other product categories. Both results are likely shortcomings of the constructed import share measure since the dataset includes multi-product firms and I am unable to directly match import purchases to exported products. I address this issue by examining single-product exporters as a robustness check.

Overall, the results suggest a complementarity between higher skill levels of labor, technology intensity, and import shares. This suggests that import sourcing is particularly relevant for

Table 1.10: Scope for Differentiation: IV Regressions of Export Ratio on Import Ratio

	Dependent Variable: Export Ratio (by Country)					
	(1) High Skill	(2) Low Skill	(3) Medium Skill	(4) Mineral Fuels	(5) Non-Fuel Comms	(6) Resource- Intensive
Imp-Ratio (by Country)	0.382*** (0.0351)	0.318*** (0.0383)	0.391*** (0.0273)	0.383*** (0.0843)	0.286*** (0.0757)	0.213*** (0.0374)
Clusters	4318	4023	7159	927	1811	6810
Product-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	64.16	44.21	345.5	79.56	190.9	42.54
R^2	0.219	0.207	0.228	0.252	0.308	0.286
N	22468	18262	44510	3633	7248	66910
First Stage:	(1) (Country)	(2) (Country)	(3) (Country)	(4) (Country)	(5) Country	(6) Country
Δ Real Exchange	-.0018***	-.0022	-.0015	.0014	-.0009	-.0007
Δ Firm Tariff	.0045***	.0043***	.004***	.0045***	.0045***	.0047***
Δ Industry Tariff	.0000135***	.0158***	.0175***	.015	.0129	.0064
DWH F-stat	51.75	119.93	133.64	14.64	50.39	65.82
DWH p-value	0.000	0.000	0.000	0.000	0.000	0.000
AR F-stat	43.81	19.51	52.55	9.15	9.04	15.83
AR χ^2	132.95	58.96	158.22	27.95	27.79	47.69
AR p-value	0.000	0.000	0.000	0.000	0.000	0.000
KP-UnID LM	179.178	190.780	214.136	24.771	95.889	161.818
KP-UnID p-value	0.000	0.000	0.000	0.000	0.000	0.000
KP Wald F-stat	52.425	120.286	138.378	15.043	49.788	67.266
SY weak ID CV	13.91	13.91	13.91	13.91	13.91	13.91
OLS Estimates:						
Imp-Ratio (Corresponding)	0.235*** (0.0175)	0.189*** (0.0220)	0.289*** (0.0151)	0.195*** (0.0390)	0.138*** (0.0261)	0.137*** (0.0150)

Notes: This table examines the relationship between a firm-product's export ratio and import ratio at the country level for products classified by UNCTAD skill and technology composition. All regressions include firm-clustered standard errors, a constant term, year, product, industry, and ownership fixed effects. Standard errors in parentheses. ** $p < 0.05$, *** $p < 0.01$

goods with greater scope for product differentiation. The results also support both the quality ladder story suggested by Khandelwal (2010) and the contention that firms vary product quality based on destination characteristics suggested by Manova and Zhang (2012).

1.6.4 Imported Intermediates and Firm Ownership

The results presented thus far reveal a strong connection between intermediate input sources and product export shares. However, these results may gloss over the role of organizational structures in shaping a firm's sensitivity of exports to firm imports. In this section I address this issue by investigating the impact of intermediate input sourcing on product-export shares, distinguished by firm ownership characteristics. I continue to use the base specification (equation 1.17) to investigate six ownership structures: 1. collectives, 2. private firms, 3. state-owned enterprises, 4. Hong Kong, Taiwan, or Macau (HMT), 5. foreign-owned firms and 6. joint ventures. The results are presented in Table 1.11, where the dependent variables is firm-product-country export share. The main variables of interest in this analysis are dummy variables for each type of ownership structure interacted with instrumented estimates of firm import share aggregated at the country, North/South, region, and income levels in Columns 1, 2, 3, and 4, respectively. Columns 5, 6, and 7 conduct the "like me but not me" analysis at the North/South, regional, and income levels.

I find substantial heterogeneity in the impacts of increased import shares by type of ownership. Overall, the results indicate that the link between import sources and export intensities is much stronger for private and foreign owned firms than it is for SOEs (Column 1). This suggests that increases in export shares to various destinations is tightly tethered to improved access to intermediates from the corresponding countries. While the cost complementarity mechanism applies to all ownership groups (Columns 5 to 7), it appears to be far more of a driving factor for privately owned firms than for any other ownership types. This is likely due to access to credit, financial security, and distributional considerations. Private firms, relative to SOEs and foreign owned enterprises, have more limited access to credit and less "know-how" on the international stage. They

Table 1.11: Ownership Characteristics: Regressions of Export Ratio on Import Ratio

	Dependent Variable: Export Ratio (by Country)						
Aggregation Level of *d*	(1) Country	(2) Stage	(3) Region	(4) Income	(5) Stage sans *d*	(6) Region sans *d*	(7) Income sans *d*
Imp-Ratio$_d$ x							
Collective	0.193***	2.577***	2.577***	0.181*	-0.822***	-0.849***	-0.754***
	(0.0292)	(0.135)	(0.135)	(0.110)	(0.115)	(0.186)	(0.117)
Private	0.212***	2.518***	2.518***	0.186*	-1.091***	-1.216***	-0.970***
	(0.0226)	(0.132)	(0.132)	(0.107)	(0.105)	(0.196)	(0.0918)
SOE	0.187***	2.660***	2.660***	0.188*	-0.662***	-0.617***	-0.623***
	(0.0355)	(0.137)	(0.137)	(0.113)	(0.0737)	(0.126)	(0.0659)
HMT	0.333***	2.641***	2.641***	0.266**	-0.648***	-0.421**	-0.573***
	(0.0254)	(0.137)	(0.137)	(0.113)	(0.0991)	(0.164)	(0.0918)
Foreign	0.353***	2.622***	2.622***	0.286***	-0.496***	-0.0202	-0.418***
	(0.0203)	(0.135)	(0.135)	(0.110)	(0.0720)	(0.0697)	(0.0596)
Joint-Venture	0.309***	2.591***	2.591***	0.261**	-0.565***	-0.171**	-0.490***
	(0.0195)	(0.135)	(0.135)	(0.110)	(0.0767)	(0.0815)	(0.0645)
R^2	0.271	0.278	0.278	0.266	0.265	0.263	0.266
N	174374	1373181	1373181	174374	174374	174374	174374

Notes: This table examines the relationship between a firm's export ratio and import ratio. The dependent variable is the across all products and destinations. All regressions include firm-clustered standard errors,) a constant term, year and firm ownership fixed effects. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

also are less likely to continue operations after experiencing negative shocks or inefficiencies in production. Therefore, these firms likely rely more heavily on knowledge ascertained about foreign markets via importing. This suggests that cost complementarities are more integral to their trade flows.

1.7 Robustness Checks

I now present pertinent results to demonstrate the robustness of the findings in Section 6. These results are obtained by replicating of the baseline estimations with single-sector exporters as well as with a dataset that uses a different classification system of imports to capture intermediate goods. I show that the overarching arguments of my paper still hold, or in some cases, are strengthened.

1.7.1 Single-Product Exporters

Most firms in the merged dataset export multiple goods. For these multi-product firms, I am unable to track their input usages to specific outputs with complete certainty. It is likely that imported input quality and intermediate intensities fluctuate by product within a firm. Moreover, firms likely produce asymmetric qualities and quantities of various goods with varying success in domestic and foreign markets. As I cannot observe input and product intensities within a given firm in a detailed manner with respect to domestic sales, it is best to think of the estimated coefficients presented in Table 1.8 to 1.11 as firm-wide averages.[53]

1.7.1.1 Single-Product Exporters and Country level IV regressions

To more accurately track imported intermediate usage to exports, I conduct the previous estimation exercises on the sub-sample of single-product export firms. As a result, I am able to

[53]Products will vary widely with respect to input costs and requirements. Therefore, attributing the same input shares across all products may introduce measurement error into the analysis. That is, this approach may overstate (or understate) the relationship between imported intermediates and product-export ratios for each good in larger, multiproduct firms.

Table 1.12: Single Sector Firm-Product Exporters: IV Regressions of Export Ratio on Import Ratio

	Dependent Variable: Export Ratio for Single Sector firms (by Country)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Imp-Ratio (by Country)	0.296*** (0.0597)						
Imp-Ratio (by North/South)		-0.243 (0.154)					
Imp-Ratio (by Region)			0.0703 (0.0544)				
Imp-Ratio (by Income)				-0.293* (0.153)			
Imp-Ratio (by North/South sans d)					-0.375*** (0.0821)		
Imp-Ratio (by Region sans d)						-0.204*** (0.0541)	
Imp-Ratio (by Income sans d)							-0.375*** (0.0630)
F	1741.1	1132.3	1696.4	469.8	600.6	864.4	1515.0
R^2	0.293	0.273	0.294	0.262	0.302	0.300	0.324
N	8625	8625	8625	8625	8608	8583	8599
First Stage:							
	(1) Country	(2) N/S	(3) Region	(4) Income	(5) N/S Sans d	(6) Region Sans d	(7) Income Sans d
Δ Real Exchange	.0012	.0019***	-.0005	.0011	.0012***	-.0014	.0031*
Δ Industry Tariff	.0237***	.0046***	.00001***	.0057***	.0021***	.0058***	.0029***
Δ Firm Tariff	.0057***	.0009***	.0052***	.0011***	-.0006	.00001***	-.0014
DWH F-Stat	57.05	41.20	46.12	39.32	22.62	27.89	38.93
DWH p-value	0.000	0.000	0.0000	0.000	0.000	0.000	0.000
AR F-stat	17.15	6.62	4.50	7.31	6.18	3.67	9.62
AR χ^2	51.58	19.92	13.52	21.99	18.57	11.03	28.92
AR p-value	0.000	0.000	0.004	0.0001	0.0003	0.012	0.000
KP- UnID LM	162.644	189.715	210.725	170.665	86.525	75.729	97.251
KP-UnID p-val	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KP wald F-stat	55.968	53.533	69.020	57.672	31.758	35.579	56.042
SY weak ID CV	13.91	13.91	13.91	13.91	13.91	13.91	13.91

Notes: This table examines the relationship between a firm's product export share and import share from a particular destination. The dependent variable is the product export share at the country level. All regressions include firm-clustered standard errors, a constant term (suppressed for convenience), year, industry, ownership, and product fixed effects. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

abstract away from intermediate input distribution considerations across multiple products within a firm.

I first replicate the exercise conducted in Table 1.8 with the dataset of single-product firms. The findings are reported in Table 1.12. The estimated coefficients diverge from baseline estimates but adds even more credence to the sourcing link and the cost complementarity mechanism. A percentage point increase in import share at the country level causes a 0.34 percentage point increase in product-export share. The coefficients obtained when import shares are aggregated at the North/South, income, and regional levels are statistically insignificant. This is partially a function of having a smaller sample size but the implication is clear: for single sector firms, the link between import shares and product export shares are driven by bilateral flows. Import share measures at higher levels of aggregation do not explain exports to particular destinations.

Columns 5-7 replicate the "like me but not me" exercise. As with Table 1.8, I find that import share net of the relevant country's contribution is negatively associated with the product-export ratio. The effect is much more pronounced for the import measure at the North/South and income aggregation levels than it is for the regional results.[54] However, the results are much more stable/comparable with the baseline results. Again, this supports the cost complementarity mechanism I propose.

1.7.1.2 Single-Product Exporters and Scope for Differentiation

The presence of multi-product firms was particularly germane for the analysis of product characteristics discussed in Section 1.6.2 (Table 1.9). I initially obtained perverse results with respect to mineral fuels, which yielded relatively large point estimates, and resource-intensive commodities, which yielded relatively small point estimates. The analysis using the UNCTAD classification system with the dataset for single-product firms is presented in Table 1.13.

The estimated coefficients for import share are exactly as expected. Resource-intensive

[54] The corresponding results from Table 1.8 for the "like me but not me" exercise were quantitatively similar for all specifications.

commodities as well as high, medium, and low skill products that are technologically intensive yield the largest estimates and are the only categories which are statistically significant. This reverses the perverse results in Table 1.9 and corroborates the quality ladder assertion unambiguously.[55]

Table 1.13: Scope for Differentiation: Single Sector Exporters

	Dependent Variable: Export Ratio (by Country)					
	(1)	(2)	(3)	(4)	(5)	(6)
	High Skill	Medium Skill	Low Skill	Mineral Fuels	Non-Fuel Comms	Resource Intensive
Imp-Ratio	0.221*	0.358***	0.365*	-0.208	-0.0407	0.503***
(by Country)	(0.122)	(0.0807)	(0.196)	(0.265)	(0.175)	(0.136)
clusters	1096	504	1538	126	344	1047
F-statistic	13.76	13.46	10.80	2.159	10.22	14.55
R^2	0.154	0.133	0.205	0.103	0.261	0.0848
N	2128	2740	758	189	546	1546
First Stage:						
	(1)	(2)	(3)	(4)	(5)	(6)
	(Country)	(Country)	(Country)	(Country)	Country	Country
Δ Real Exchange	-.0009	.0026	.0036**	-.0048	.0027	.0029
Δ Firm Tariff	.0099***	.0033***	.006***	.0033***	.008***	.007***
Δ Industry Tariff	.00001	.022	.023**	-.0000301	-.017	.012
DWH F-stat	26.20	8.80	35.20	4.70	7.02	23.84
DWH p-value	0.000	0.000	0.000	0.004	0.000	0.000
AR F-stat	1.58	1.11	6.95	2.19	0.29	12.31
AR χ^2	4.80	3.43	21.01	7.37	0.92	37.42
AR p-value	0.19	0.33	0.000	0.061	.82	0.000
KP-UnID LM	53.839	18.965	73.502	9.521	7.819	36.822
KP-UnID p-value	0.000	0.0003	0.000	.0231	.0499	0.000
KP Wald F-stat	25.908	7.547	34.230	4.607	7.542	24.031
SY weak ID CV	13.91	13.91	13.91	13.91	13.91	13.91

Notes: This table examines the relationship between a firm-product's export ratio and import ratio at the country level for products classified by UNCTAD skill and technology composition. All regressions include firm-clustered standard errors,) a constant term (suppressed for convenience), year and firm ownership fixed effects. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

1.7.2 BEC Classification

Finally, a potential concern is that observed imports may not necessarily be used as intermediates in production. This introduces the possibility that goods associated with day-to-day

[55] As previously mentioned, this idea is most commonly attributed to Khandelwal (2010).

operations of a firm are counted as inputs for the final goods. To address this issue, I adopt the Broad Economic Categories (BEC) method, detailed by the UN, to identify intermediate goods. Approximately 88% of observations can be classified as intermediates.

The results when import shares are constructed using the BEC group of imports (Table 1.14) are almost identitical to those presented in the baseline specification (Table 1.8). Again, I find support for both the import sourcing link (Columns 1 to 4) and the cost complementarity mechanism (Columns 5 to 7).

Table 1.14: BEC Imports: IV Regressions of Export Ratio on Import Ratio

	Dependent Variable: Export Ratio for Single Sector firms (by Country)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Imp-Ratio (by Country)	0.334*** (0.0202)						
Imp-Ratio (by North/South)		0.353** (0.139)					
Imp-Ratio (by Region)			0.266*** (0.0236)				
Imp-Ratio (by Income)				0.293** (0.118)			
Imp-Ratio (by North/South sans d)					-0.491*** (0.0498)		
Imp-Ratio (by Region sans d)						-0.173*** (0.0544)	
Imp-Ratio (by Income sans d)							-0.464*** (0.0378)
R^2	0.279	0.248	0.276	0.250	0.337	0.285	0.356
N	172523	172523	172523	172523	172335	172044	172270

Notes: This table examines the relationship between a firm's export ratio and import ratio. The dependent variable is the (total exports from d/ total exports) by firm, aggregated across all products and destinations. All regressions include firm-clustered standard errors, a constant term (suppressed for convenience), year and firm ownership fixed effects. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

1.8 Conclusion

The bulk of the trade literature argues that access to imported intermediates allows firms to upgrade their product quality, increasing demand for their goods from abroad. These studies treat imported intermediates from all source nations homogenously. I present two stylized facts which suggest that imported intermediates should be treated heterogeneously and challenges the standard quality-upgrading assertion. I present a theoretical model which relates export patterns to imported intermediate shares, and suggests a role for cost complementarities in explaining trade flows. I take these predictions to the data by looking at the relationship between export shares at the firm-product-country level and import shares. To address endogeneity concerns, I estimate the model using IVs; instrumenting import shares with real exchange rate changes, firm-level tariff cuts, and industry-level tariff cuts. I find that firms which import a larger proportion of inputs from a particular source is more likely to export a particular product to said region. This effect is stronger for smaller firms relative to larger ones. It is also more pronounced for goods with a greater scope for quality differentiation, as well as for privately-owned firms as opposed to state-owned enterprises.

1.9 Appendix

1.9.1 Constructing the dataset

Customs Data

I obtain information on firm-level bilateral trade flows that was collected and made accessible by the Chinese Customs Office. The data chronicles the activities of the universe of Chinese firms participating in trade from 2002-2005. They report the f.o.b. value and quantities of firm exports (imports) in U.S. dollars across 225 destinations (source) countries (or territories).[56] Presumably, quantity measures vary contingent upon the type of product (eg. kilograms, cubic meters, etc.). I ensure that all units of measure are consistent with the industry standard and include product or industry fixed effects where applicable to control for time-invariant features that may differ across goods.

The customs data is vital for observing export patterns, determining input quantities and sources, and constructing accurate unit prices. The values recorded are not sullied by aggregation across firms or across markets within firms; a major weakness of most studies which utilize the unit value approach. The level of detail and precision afforded by the data allows for a more accurate approach to deriving accurate unit values.

The data is collected at a monthly frequency. Due to the nature of the study, I opted to convert the observations to yearly intervals and to focus on the four year horizon from 2002 -2005. These decisions are motivated by many factors.

- Aggregating to the Annual Level

  1. To capture firm production, domestic performance, and gravity-based data on firms and trade partners, respectively, I must merge the customs data with other datasets. All supplementary data are recorded annually, so aggregating the customs data is necessary for congruence.

[56] The first 6 digits of Harmonized System codes are consistent internationally. The number of distinct codes in the Chinese eight-digit HS classification is comparable to that in the 10-digit HS trade data for the United States (Manova and Zhang, 2012).

2. Time series and real business cycle literature stress that economic data recorded at high frequencies tend to exhibit a substantial amount of seasonality. Moreover, many firms do not export/import a given product to/from a particular destination every month. Aggregating to the annual level removes these challenges and related concerns with price rigidity (Manova and Zhang, 2012).
3. Outliers and statistical anomalies in the data are of greater concern and more likely to precipitate spurious results in monthly data.

- Horizon Selection

1. China became a full member of the WTO in December, 2001. This introduces exogenous variation which is of particular interest for the subsequent years in the medium term.
2. There is high turnover in the export market leading to attrition in the customs data. This issue is exacerbated by the matching process detailed in Section 2. As a result, though a minority of firms are present for each year, the final dataset is more akin to a repeated cross-section than a longitudinal panel. From this perspective, I choose the horizon length to optimize the number of observations. I estimate most empirical models using a cross-sectional approach, and include a litany of fixed effects where applicable.

NBS Data

I match the customs data with annual data on medium to large Chinese manufacturing firms. The data was compiled via surveys conducted by the National Bureau of Statistics (NBS), and span four years (2002-2005). The NBS covers both state-owned and non-state-owned industrial firms with sales about 5 million RMB.

The data reports detailed information about firm revenues, costs, intermediate materials, wages, workforce, capital sources, inventories, ownership, industry classification, taxes, fees, and length of incumbency. With this data I capture plant characteristics and other non-quality primitives of the firm's profit maximization problem.

Matching

Combining the geographical and socioeconomic data– provided by CEPIII and the WDI, respectively– is straightforward. However, merging the NBS and customs data to create the final dataset is worthy of discussion. Matching the firm-level data with the corresponding customs data is a critical component of the empirical process. Both datasets provide firm-identifiers to track activity over time. However, the identifiers differ in each dataset which makes this metric infeasible for the matching process.

Fortunately, both datasets also report plant-specific location and contact information. I exploit these common features to match firms. Specifically, I match data along the dimensions of firm name, zip code, primary telephone number, and area code. Exported products and firms which are associated with a consistent location and telephone number are included in the final sample. While this alternative matching method yields a considerable number of observations, for the majority of firms I fail to procure a perfect match.

The less than desirable number of matched observations are due to multiple factors. First, the number and sizes of firms included in each dataset are asymmetric. Small firms engaging in trade activity do not meet the inclusion requirements for the NBS data and would necessarily be unmatched. Second, some firms have multiple firm-level identifiers but report the same company name, location and contact information. To err on the side of caution, I exclude all such firms from the matching process. Third, I am unable to safely match firms which report multiple plants and/or multiple telephone numbers. Finally, a successful match is predicated on an absence of missing slots and/or entry errors. Any inconsistencies (egs. misplaced or incongruent characters) in either dataset renders a match impossible.

Nevertheless, the NBS panel provides an estimate of exports. Of the firms that report positive exports, I match approximately 70% of them with the customs data.

Auxiliary Predictions

1.9.2 Optimal Profit

I use the first order conditions from the firm's maximization problem to derive an expression for optimal domestic profit:

$$\pi^*(\phi,I) = \frac{(R-x_0)\cdot\left(a(\phi,I)s(\phi,I)^{\gamma}\right)^{\sigma-1}}{(\sigma-1)\cdot\mathbb{P}^{1-\sigma}}\left[\frac{\sigma}{\sigma-1}\right]^{-\sigma} C(\phi,I)^{1-\sigma} \tag{1.21}$$

Result 1.9.1. *The optimal profit expression indicates that firms selling higher-quality goods earn higher profits domestically. Conversely, firms with higher marginal costs earn lower profits, ceteris paribus.*

Result 1.9.1 is intuitive. Within any product category, holding all other variables constant, the return to producing a higher-quality variety is greater profits. The second portion of the result is also unsurprising (i.e. firms with lower marginal costs tend to be more productive). A biproduct of Melitz-type models is that higher productivity translates into higher profitability. It is important to note, however, that these results may be mitigated or tempered by horizontal differentiation and brand loyalty, captured by $a(\cdot)$.

1.9.3 Comparative Statics (ϕ)

Rewrite equation (1.14) as:

$$D_I = \gamma(\sigma-1)(p(\phi,I)-C(\phi,I))\tfrac{\partial s(\phi,I)}{\partial I} - s(\phi,I)\tfrac{\partial C(\phi,I)}{\partial I} = 0$$

Totally differentiate equation(1.15) with respect to ϕ and I to get:

$$\gamma(\sigma-1)\left\{\left(\tfrac{\partial p}{\partial\phi}d\phi - \tfrac{\partial C}{\partial\phi}d\phi\right)\tfrac{\partial s}{\partial I} + \left(p(\phi,I)-C(\phi,I)\right)\tfrac{\partial^2 s}{\partial I\partial\phi}d\phi\right\} - \tfrac{\partial s}{\partial\phi}d\phi\tfrac{\partial C}{\partial I} - s(\phi,I)\tfrac{\partial^2 C}{\partial I\partial\phi} + D_{II}dI = 0$$

$$\Rightarrow \frac{dI}{d\phi} = -\left[\frac{\gamma(\sigma-1)\left\{\left(\frac{\partial p}{\partial\phi}-\frac{\partial C}{\partial\phi}\right)\frac{\partial s}{\partial I}+(p(\phi,I)-C(\phi,I))\frac{\partial^2 q}{\partial I\partial\phi}\right\}-\frac{\partial s}{\partial\phi}\frac{\partial C}{\partial I}-q(\phi,I)\frac{\partial^2 C}{\partial I\partial\phi}}{D_{II}}\right]$$

After an innocuous parameter restriction (See appendix), I show that $\frac{dI}{d\phi} < 0$. This precipitates the second result:

Result 1.9.2. *Higher-productivity Southern firms, relative to lower-productivity ones, use a higher fraction of imported jobs from the North and thus produce a higher-quality variety. Higher-productivity firms should also charge a lower quality-adjusted price than lower-productivity ones and therefore earn larger revenues.*

Remark: The quality-adjusted price charged by a more productive firm is lower since: $\left(\frac{d[p^{cif}(\phi,I)/s(\phi,I)^{\gamma}]}{d\phi}\right)_{I=I^*} = \left\{\frac{\partial[p^{cif}(\phi,I)/q(\phi,I)^{\gamma}]}{\partial\phi} + \frac{\partial[p^{cif}(\phi,I)/q(\phi,I)^{\gamma}]}{\partial I}\frac{dI}{d\phi}\right\}_{I=I^*}$. By the Envelope theorem, $\frac{\partial[p^{cif}(\phi,I)/q(\phi,I)^{\gamma}]}{\partial I}\frac{dI}{d\phi} = 0 \Rightarrow \left(\frac{d[p^{cif}(\phi,I)/s(\phi,I)^{\gamma}]}{d\phi}\right)_{I=I^*} = \left\{\frac{\partial[p^{cif}(\phi,I)/q(\phi,I)^{\gamma}]}{\partial\phi}\right\}_{I=I^*} < 0$

Result 1.9.2 predicts that there is a positive correlation between input quality and firm-productivity. Ostensibly, Result 1.9.2 adds credence to previous studies which conflate quality with productivity. However, measuring quality via productivity is only valid if the correlation is of a high order. I generally abstract away from this relationship in subsequent regressions as I assume productivity is time-invariant and can be captured by including firm fixed effects.

1.9.4 Comparative Statics (γ)

From equation (1.7):

$$D_I = \gamma(C(\phi,I)+t)\frac{\partial s(\phi,I)}{\partial I} - s(\phi,I)\frac{\partial C(\phi,I)}{\partial I} = 0 \tag{1.22}$$

Totally differentiate equation (1.14) with respect to γ and I to get: [57]

$$\left\{\left[(\sigma-1)(p(\phi,I)-C(\phi,I))\frac{\partial s}{\partial I}\right]d\gamma + D_I I dI\right\}_{I=I^*} = 0$$

$$\Rightarrow \left(\frac{dI}{d\gamma}\right)_{I=I^*} = -\left\{\frac{(C(\phi,I)+t)\frac{\partial s}{\partial I}}{D_{II}}_{I=I^*}\right\}$$

[57] Recall that $p(\phi,I) = \frac{\sigma}{\sigma-1}C(\phi,I) + \frac{1}{\sigma-1}t \Rightarrow t = (\sigma-1)p(\phi,I) - \sigma C(\sigma,I)$

Since $\frac{\partial s}{\partial I} < 0$ and D_{II}, then $\left(\frac{dI}{d\gamma}\right)_{I=I^*} < 0$

Note: $\left(\frac{dq(\phi,I)}{d\gamma}\right)_{I=I^*} = \left\{\frac{\partial s(\phi)}{\partial I}\frac{dI}{d\gamma}\right\}_{I=I^*} > 0$ and firms will charge a higher price for this variety since:

$\left(\frac{dp(\phi,I)}{d\gamma}\right) = \frac{\sigma}{\sigma-1}\left\{\frac{\partial C(\phi,I)}{\partial I}\frac{dI}{d\gamma}\right\} > 0$. This forms the basis for the first result:

Result 1.9.3. *Comparative statics on γ indicate that Southern firms who face different demands for quality in different regions will differentiate their product quality in each market. They will sell a higher-quality variety in the higher-demand market. They will use relatively higher quality of jobs by importing more jobs from the North to produce the higher-quality variety.*

Result 1.9.3 has been supported empirically but has not been generated theoretically outside of the Demir (2012) model. Manova and Zhang (2012), using only the customs data for Chinese firms in 2005, observe that firms have substantial price dispersion within imported products and across multiple source countries. This is evidence of firms adjusting markups and product quality in each destination market. They argue that this finding is indicative of nonhomothetic preferences. I cannot dispute the propriety of a nonhomothetic model but I have shown that this result can be generated in a model with CES preferences. In terms of the empirical analysis, this prediction falls outside the purview of my study as it requires detailed knowledge of a given firm's input mix for each product. I refer those interested in an excellent empirical treatment of Result 9.3 to Manova and Zhang (2012).

1.9.5 Comparative Statics (t)

Totally differentiate equation (1.14) with respect to t and I to get:

$$\gamma\frac{\partial s(\phi,I)}{\partial I}dt + D_{II}dI = 0$$

$$\Rightarrow \left\{\frac{dI}{dt}\right\}_{I=I^*} = -\left\{\frac{\partial s(\phi,I)}{\partial I}\frac{\gamma}{D_{II}}\right\}$$

Result 1.9.4. *A Southern firm's product quality is higher in distant markets than near ones. Imported varieties of a job are more expensive than domestic jobs, so the firm bears a higher production cost, and thus charges a higher price for the variety of final good it sells in the distant* *market.*

If I interpret t purely as a measure of distance and transport costs then Result 1.9.4 seems dubious. Heuristically, prices of Chinese goods (eg. in the USA– a major trade partner) are not perceptibly high relative to closer destinations. However, if I interpret t as a measure that also captures remoteness and difficulty in penetrating a market, then the result seems more plausible. As argued by CHM (2011), firms producing higher quality goods are more likely to access difficult markets and charge higher prices. Unfortunately, I am unable to explore this result in the empirical section due to my inclusion of country fixed effects. Any potential measures to proxy for market access are country-specific and will be absorbed by this fixed effect. Therefore, while I am able to control for market access concerns, I am unable to quantify their impact.

1.9.6 Comparative Statics (λ)

Totally differentiate equation (1.14) with respect to λ and I to get:
$\left[\gamma(C(\phi,I)+t)\frac{\partial^2 s}{\partial I \partial \lambda} - \frac{\partial s}{\partial \lambda}\frac{\partial C}{\partial I}\right]d\lambda + D_{II}dI = 0 \Rightarrow \left\{\frac{DI}{d\lambda}\right\} = -\left\{\frac{\gamma(C(\phi,I)+t)\frac{\partial^2 s}{\partial I \partial \lambda} - \frac{\partial s}{\partial \lambda}\frac{\partial C}{\partial I}}{D_{II}}\right\}$

$\frac{\partial^2 q}{\partial I \partial \lambda} > 0$, $\frac{\partial s}{\partial \lambda} > 0$, and $\frac{\partial C}{\partial I} < 0$ which implies that $\frac{\partial I}{\partial \lambda} > 0$ (See Appendix). This yields the fourth result:

Result 1.9.5. *Assume that Southern workers upgrade their skills (i.e. λ rises). At constant skill prices, this leads a Southern firm to increase the fraction of its domestically-sourced tasks. The resulting impact on its product quality is ambiguous.*

Results 1.9.5 has been established from a static perspective. Presumably, in the real world, λ monotonically increases over time. By design, Result 1.9.5 must be viewed through a dynamic lens, as I discuss in Section VI. Empirically, a substantial increase in λ could generate the result that product quality is negatively correlated with profits. If local intermediates become viable options in lieu of importing materials, one would expect that firms would strive to maintain a similar level of quality and sales while mitigating the increase in input prices due to transport costs.

Table 1.15: Country List

North America	**European Union**	**Africa**	**Oceania**
Canada (H)	Austria (H)	Algeria (LM)	Australia (H)
Mexico (UM)	Belgium (H)	Angola (L, LM)	Micronesia (LM)
USA (H)	Bulgaria (LM)	Benin (L)	French Polynesia (H)
Japan and Koreas	Croatia (UM)	Botswana (UM)	Kiribati (LM)
Japan (H)	Cyprus (H)	Burkina Faso (L)	Marshall Islands (LM)
Korea (L)	Czech Republic (UM)	Burundi (L)	New Caledonia (H)
Korea Republic (H)	Denmark (H)	Cameroon (L, LM)	New Zealand (H)
Hong Kong and Taiwan	Estonia (UM)	Cape Verde (LM)	Papua New Guinea (L)
Hong Kong (H)	Finland (H)	Central Africa (L)	Samoa (LM)
Taiwan (H)	France (H)	Chad (L)	Solomon Islands (L)
Rest of Asia	Germany (H)	Sierra Leone (L)	Tonga (LM)
Afghanistan (L)	Greece (H)	Comoros (L)	Tuvalu (H)
Armenia (LM)	Hungary (UM)	Congo (L, LM)	Vanuatu (LM)
Azaerbaijan (L, LM)	Ireland (H)	Djibouti (LM)	**Latin America and the Caribbean**
Bahrain (H)	Italy (H)	Egypt (LM)	Antigua (UM, H)
Bangladesh (L)	Latvia (UM)	Equitorial Guinea (L)	Argentina (UM)
Bhutan (L)	Lithuania (UM)	Eritrea (L)	Aruba (H)
Brunei (H)	Luxembourg (H)	Ethiopia (L)	Bahamas (H)
Cambodia (L)	Malta (H)	Gabon (UM)	Barbados (UM, H)
India (L)	Netherlands (H)	Gambia (L)	Belize (UM)
Indonesia (L, LM)	Poland (UM)	Ghana (L)	Bermuda (H)
Iran (LM)	Portugal (H)	Guinea (L)	Bolivia (LM)
Iraq (LM)	Romania (LM, UM)	Guinea-Bissau (L)	Brazil (LM)
Israel (H)	Slovakia (UM)	Ivory Coast (L)	Cayman Islands (H)
Kazakhstan (LM)	Slovenia (H)	Jordan (LM)	Chile (UM)
Kuwait (H)	Spain (H)	Kenya (L)	Colombia (LM)
Kyrzystan (L)	Sweden (H)	Lesotho (L, LM)	Costa Rica (UM)
Laos (L)	UK (H)	Liberia (L)	Cuba (LM)
Lebanon (UM)	**Non-EU**	Libya (UM)	Curacao (H)
Macao (H)	Albania (LM)	Madagascar (L)	Dominica (UM)
Malaysia (UM)	Andorra (H)	Malawi (L)	Dominican Republic (LM)
Maldives (LM)	Belarus (LM)	Mali (L)	Ecuador (LM)
Mongolia (L)	Bosnia and Herzegovina (LM)	Maurithania (L)	El Salvador (LM)
Myanmar (L)	Fiji (LM)	Mauritius (UM)	Grenada (UM)
Nepal (L)	Georgia (L, LM)	Mayotte (UM)	Guatemala (LM)
Oman (UM)	Gibraltar (H)	Morocco (LM)	Guyana (LM)
Pakistan (L)	Greenland (H)	Mozambique (L)	Haiti (L)
Philippines (LM)	Iceland (H)	Namibia (LM)	Honduras (LM)
Qatar (H)	Liechtenstein (H)	Niger (L)	Jamaica (LM)
Saudi Arabia (UM, H)	Macedonia (LM)	Nigeria (L)	Nicaragua (L, LM)
Singapore (H)	Moldova (L, LM)	Rwanda (L)	Panama (UM)
Sri Lanka (LM)	Monaco (H)	Sao Tome (L)	Paraguay (LM)
Syria (LM)	Norway (H)	Senegal (L)	Peru (LM)
Tajikstan (L)	Russia (LM, UM)	Seychelles (UM)	Puerto Rico (H)
Thailand (LM)	San Marino (H)	Somalia (L)	St. Kitts and Nevis (UM)
Turkmenistan (LM)	Switzerland (H)	South Africa (LM, UM)	St. Lucia (UM)
UAE (H)	Turkey (LM, UM)	Sudan (L)	St. Marteen (H)
Uzbekistan (L)	Ukraine (LM)	Swaziland (LM)	St. Vincent (LM, UM)
Vietnam (L)		Tanzania (L)	Suriname (LM)
Yemen (L)		Togo (L)	Trinidad and Tobago (UM)
		Tunisia (LM)	Turks and Caicos (H)
		Uganda (L)	Uruguay (UM)
		Zaire (L)	Venezuela (UM)
		Zambia (L)	
		Zimbabwe (L)	

Notes: This table lists source/partner countries used throughout my analysis. It also describes the construction of regional groupings (in bold) and income levels (in parentheses). If two or more income levels are listed, the respective nation rose or fell in their income classification over time.

Table 1.16: Number of Products Exported- Customs Data

# Export Products (HS 6-digit)	# Firms (%) All Years	% Value All Years	# Firms (%) 2002	% Value 2002	# Firms (%) 2005	% Value 2005
0	91,212 (20.8)	_	17,288 (22.7)	_	27,362 (18.8)	_
1	97,634 (22.3)	2.2	17,233 (22.7)	1.5	32,004 (22.0)	2.3
2	55,502 (12.7)	2.2	9,663 (12.7)	1.8	18,625 (12.8)	2.4
3	35,495 (8.1)	2.8	6,122 (8.1)	2.1	11,940 (8.2)	3
4	25,118 (5.7)	3	4,299 (5.7)	2.7	8,684 (6.0)	3
5	18337 (4.2)	3.5	2,997 (4.0)	2.8	6,316 (4.3)	3.5
6	13,676 (3.1)	3.7	2,200 (2.9)	3.6	4,845 (3.3)	4.1
7	10,668 (2.4)	4.1	1,716 (2.3)	3.9	3,790 (2.6)	4.1
8	8,567 (2.0)	4.2	1,402 (1.8)	4	3,083 (2.1)	4.6
9	7,053 (1.6)	4.8	1,100 (1.5)	4.3	2,566 (1.8)	4.8
10 or more	74,497 (17.0)	69.4	12,035 (15.8)	73.3	26,274 (18.1)	68.3

Notes: This table categorizes the number and percentage of firms in the customs data by the number of products they export. When number of exported products equals zero, then the corresponding statistics reflect firms that import only. The table also shows the percentage of export value earned by each group of exported products. Number of products is top-coded at 10 or more.

Table 1.17: Number of Export Partners- Customs Data

# Export Markets (Countries)	# Firms (%) All Years	% Value All Years	# Firms (%) 2002	% Value 2002	# Firms (%) 2005	% Value 2005
0	91,212 (20.8)	_	17,288 (22.7)	_	27,362 (18.8)	_
1	106,869 (24.4)	0.4	19,061 (25.1)	0.48	34,898 (24.0)	0.37
2	51,481 (11.8)	0.53	9,049 (11.9)	0.61	17,340 (11.9)	0.5
3	31,239 (7.14)	0.61	5,306 (7.0)	0.66	10,805 (7.4)	0.6
4	21,984 (5.0)	0.66	3,564 (4.7)	0.69	7,657 (5.3)	0.67
5	16,892 (3.9)	0.77	2,762 (3.6)	0.77	5,837 (4.0)	0.77
6	13,427 (3.1)	0.81	2,179 (2.9)	0.79	4,633 (3.2)	0.77
7	10,936 (2.5)	0.89	1,651 (2.2)	0.82	3,965 (2.7)	0.88
8	9,151 (2.1)	0.93	1,529 (2.0)	0.89	3,126 (2.2)	0.94
9	7,834 (1.8)	0.95	1,264 (1.7)	0.94	2,798 (1.9)	0.95
10 or more	76,734 (17.5)	93.45	12,402 (16.3)	93.35	27,068 (18.6)	93.56

Notes: This table categorizes the number and percentage of firms in the customs data by the number of countries they export to. When number of export partners equals zero, then the corresponding statistics reflect firms that import only. The table also shows the percentage of export value earned by each group of export partners. Number of partners is top-coded at 10 or more.

CHAPTER 2

Import Competition, Employment, and Skill Upgrading: Evidence from the Chilean Manufacturing Firms

2.1 Introduction

A recent proliferation of free trade agreements between China and various countries in the developing world has led to renewed concerns about the losers from import competition. This phenomenon is especially relevant to the productive structure in Latin America; the site of a growing debate on the impacts of globalization on labor markets. Most studies exploit unilateral episodes of trade reform to explain how the removal of trade barriers affects the quality and quantity of employment in the region. In contrast, I investigate the labor impacts of a free trade agreement between Chile and China on Chilean manufacturers. While free trade agreements largely characterize the contemporary approach to trade reform, relatively few studies have explored how they permeate throughout various industries. In this paper, I show that input and output tariff reductions significantly affect firm-level skill intensity and labor force composition. I also show that these impacts rely, crucially, on where a firm is initially located on the size distribution; suggesting heterogeneous effects.

Over the past 30 years, much of the developing world has reoriented policies to transform their protectionist regimes to progressively more open market economies. With the weakly monotonic procession towards free trade comes an increasingly more urgent need to understand how these reallocations affect workers and alter firm incentives in various sectors. To date, there remains some debate in the literature about the impact of trade on skill upgrading for middle to low-income countries.

This study contributes to the discussion by investigating the impact of a bilateral free trade agreement between China and Chile on within plant changes in relative demand for skilled labor in Chilean manufacturing firms. I differ from previous studies by explicitly modeling channels through which both input and output tariff reductions can affect the firm's relative skill demand. These features allow me to identify the impact of the Chile-China free trade agreement (CCFTA) on firms within different quartiles of the size distribution– suggesting that skill changes and labor force adjustments may vary within sectors– and to identify the impacts of input and output tariff reductions separately.[1]

Trade liberalization can precipitate major reallocations of productive factors and alter the distribution of resources.[2] Neoclassical trade models emphasize the concept of comparative advantage, predicting increased factor rewards in resource-abundant sectors and across countries, but offer no role for firm dynamics (Bernard et al., 2007; Harrigan and Reschef, 2011). More recent heterogeneous firm models predict that trade integration transfers market shares towards exporters and the most productive firms; increasing aggregate productivity among surviving firms (Pavcnik, 2002; Melitz, 2003; Bernard et al., 2003). However, these types of models abstract away from input bundle considerations.[3] I incorporate features from both modeling approaches in this study.

First, I motivate interest in analyzing the CCFTA– enforced in October 2006– using data on aggregate Chilean trade flows and sectoral contributions to GDP over time. I show that the agreement had large effects on bilateral trade patterns and its implementation is strongly correlated with a contraction in Chilean manufacturing. I argue that these trends imply potentially large impacts of the CCFTA on Chilean labor markets and relative demand for skill.

Next, I detail a heterogeneous firm model with three factors of production: unskilled labor, skilled labor, and intermediate inputs. The model allows firms to endogenously increase their

[1] Exceptions include Bustos (2011) for Argentine manufactures, Frazer (2013) for Rwandan employees, and Kasahara, Liang, and Rodrigue (2013) for Indonesian manufacturers.

[2] Trade liberalization is the most common method of measuring globalization. Other measures include exchange rate shocks and capital flows across borders such a FDI. Tariff reductions are preferred since they capture a price based form of protection, are easy to measure accurately over time, and reflect a true restriction induced by a trade barrier (Goldberg and Pavcnik, 2007). Note, channels other than trade policy could potentially play significant roles. For example, Mexico after implementing NAFTA experienced FDI changes and a peso crisis which may have played a larger role in explaining inequality changes induced by globalization (Verhoogen, 2008).

[3] Heterogeneous firm models which allow for a quality dimension for inputs assume export markets are more skill-intensive than domestic ones. As a result, increased access to foreign inputs from import liberalization should induce domestic firms to increase their relative demand for skilled workers within industries. However, these types of models are less apt for describing trade-induced reallocations when trade is more closely tethered to comparative advantage predictions or when applied to firms in declining industries pre- and post-trade reform.

share of skilled labor via entry to more demanding export markets and/or through skill-biased technological improvements embedded in imported materials. The theory predicts that both import and output tariff reductions increase relative demand for skilled workers in larger firms. The induced skill upgrades are driven by firms in the middle range of the productivity distribution since the largest firms adopt the skill-biased upgrades prior to liberalization and the smallest firms exit the market post-liberalization. That is, trade volumes and relative demand for skilled labor are determined by productivity, as the most-efficient firms expand to serve the export and import from foreign market while the least efficient firms contract in the face of increased competition.

I test the model's predictions using data on Chilean manufacturing firms. The firm-level dataset I utilize is unique in that it contains direct measures of wages and labor force categories along several dimensions. I am not only able to categorize workers using the conventional "production" and "nonproduction" taxonomy, but I am also able to differentiate between managers and owners, skilled technicians, administrative staff, ancillary product workers, commission workers, and unskilled production workers. This feature allows me to isolate the kinds of upgrading that occurs within the workforce; yielding a more comprehensive understanding of intra-firm changes.

A firm's relative demand for skilled labor could be caused by other economic factors undertaken between 2007 and 2010 if they had differential impacts on heterogeneous firms.[4] To address this issue, my main specification is in first differences which eliminates time-invariant effects that may impact firm behavior. That is, I relate changes in relative skill demand and labor force composition to preferential changes in input and output tariffs from the China-Chile Free Trade Agreement (CCFTA).

The analysis relies on three channels through which Chilean firms may be affected by changes in input and output tariffs. First, a reduction in input tariffs improves access to intermediate inputs for Chilean firms. This increases the returns to skill upgrading. Second, since the tariff reduction schedules were largely reciprocal, Chinese firms also face reduced tariffs and improved

[4]For example, labor market reforms, capital account liberalization, or drastic exchange rate changes could have allowed firms to more easily access import (and export) markets and upgrade skilled labor. I find that no evidence that such an episode occurred concurrently with the CCFTA implementation or in the subsequent years.

access to Chilean markets. From this standpoint, China could become a significant buyer of intermediate and/or final goods from Chilean manufacturers; establishing a channel for output tariff reductions to induce skill upgrading. Third, preferential output tariff reductions on Chilean exports also capture improved access to Chilean markets for Chinese manufacturers; increasing the level of competition domestically and internationally. China has a comparative advantage in unskilled labor and has firmly established its place on the international stage as the preeminent producer of manufactured goods. The increased import competition in domestic goods markets may trigger alterations in skill intensity for Chilean manufacturers. This introduces a channel by which output tariff liberalization causes Chilean manufacturers to contract in the wake of increased import competition.

The empirical identification of the effect of falling trade costs on skill upgrading and labor force composition is based on variation from changes in input and output tariffs between Chile and China across time (2008-2010) and across four-digit ISIC industries. The focus on changes in relative skill demand and employment differences eliminates time-invariant industry characteristics that might be correlated with both or either of the tariffs. Still, a potential concern is that other reforms carried out over the same period could have had heterogeneous effects on industries with different characteristics.[5] I address this concern by showing that results are robust to the inclusion of various controls.

A more critical concern relates to the endogeneity of the CCFTA. There is a growing body of research which shows that regional and bilateral economic integration agreements are formed endogenously. Signatory countries may be motivated by: stagnation in multilateral/WTO negotiations (Bhagwati, 2008; Missios et al., 2016); their ex ante socioeconomic profiles (Burfisher et al., 2001); the spread/ contagion of FTAs across other nations (Baldwin and Jaimovich, 2012; Solis et al., 2009); and by idiosyncratic macroeconomic shocks (Harvie et al. 2006). The nature of FTA formation introduces bias under OLS; inhibiting causal interpretation.

[5]For example, capital account liberalization could have disproportionately benefitted capital-intensive industries. If China's trade policy was also targeting these industry characteristics, the estimates of the effect of tariffs might pick up the impact of this other policy

I address the potential endogeneity in two ways. First, since the manufacturing survey data does not provide information on firms' material input bundles in production, I construct a 2-digit input tariff measure based on input/output tables. This is based on worldwide intermediates for the respective sectors as opposed to Chilean firm or industry bundles. Second, I show that the largest preferential tariff rates from the CCFTA were on products with the highest MFN tariffs. Since MFN tariff rates are set for all WTO members, and are less sensitive to the demands or lobby efforts of specific countries, I instrument for CCFTA output and input tariff changes using initial MFN rates prior to the enforcement of the CCFTA.

I show that reductions in input tariffs induced firms to increase their skill intensity. The coefficient was largest for firms in the third quartile. Input tariff reductions are also associated with an increase in labor force for firms in the fourth quartile, and an increase in non production workers. Output tariffs are associated with a reduction in labor force across firms; suggesting that increased competition induced firms to contract productive activities. I am concerned that the impact of trade liberalization on the demand for laborers within plants will vary substantially across heterogeneous plants (Fieler, Eslava, Xu, 2014; Kasahara, Liang, and Rodrigue, 2013). The results suggest that the employment changes were disproportionately comprised of low skilled production workers. Employment of more highly skilled workers largely remained the same. This suggests that plant contractions occurred in a skill-biased way.

This chapter contributes to the literature studying trade liberalization and employment. Most notably, Bernard, Redding, and Schott (2007) embed heterogeneous firms in a Ricardian model of comparative advantage and obtain results similar to those in a Hecksher-Ohlin environment. Their model predicts that reductions in trade barriers lead to net job creation in industries with comparative advantage and net job creation in the industries with comparative disadvantage. The key difference is that job creation and job destruction occur in both industries, a feature missing from the original HO model.

I also contribute to the literature on trade liberalization and skill upgrading. Bustos (2011) models skill upgrading within firms as complementary to technology upgrading. She argues that a reduction in trade frictions can induce firms to switch technologies, expand trade volumes, and increase the wage-skill premium.

The remainder of the study is organized as follows. Section 2 provides background knowledge on the evolution of Chilean trade reform relative to other Latin American countries, as well as evidence of strong correlations between the enforcement of the CCFTA and sectoral shifts in Chile. Section 3 showcases the theoretical model. Section 4 describes the data utilized throughout the study. Section 5 describes the approach to measuring germane variables. Section 6 discusses the baseline specification and estimation strategy. Section 7 presents the main findings of the paper. Section 8 presents the results from robustness exercises and Section 9 concludes.

2.2 Context and Background

Over the past 25 years, Chile has sustained an exceptional period of economic growth; more than doubling its income per capita and reducing its poverty rate to less than a third of the rate in 1990 (Pellandra, 2015). Chile began to unilaterally implement far-reaching reforms in 1974, reducing its average tariff level from 105% to 10%. Chile is a rare exception in Latin America since most other countries in the region did not liberalize their trade regimes until the 1980s and 1990s. Chile has cemented its position as one of the world's most open economies; shifting trade strategies from unilateral liberalization to bilateral trade agreements. Chile has signed the most free trade agreements in the region (See Appendix: Table 2.5). Today, more than 90% of Chilean exports and imports are covered by trade preferences.[6]

Table 2.5 shows some of the notable trade agreements that were implemented by Latin American countries between 2002-2010. This cross-section represents some of the highest GDP per capita countries in the region. The most noticeable feature of Table 2.5 is the sheer volume of bilateral agreements Chile has signed; becoming the most prolific signatory member of trade agreements. On the contrary, Argentina and Uruguay demonstrate a de facto reticence to signing

[6]Non-tariff trade barriers (NTBs) have had a negligible impact in Chile as the country has embraced free trade since the mid-70s and has actively sought to establish bilateral agreements since the turn of the millennium.

deals outside of the MERCOSUR trade bloc. This speaks to the challenges of forming multilateral agreements since negotiations with outside countries require multinational approval from all full members of MERCOSUR.[7] The slow multilateralism approach contrasts starkly with Chile, which has rapidly established bilateral agreements with a broad swath of countries. In the next section, I hone in on how these FTAs have impacted Chilean trade flows, particularly the CCFTA enforced in late-2006.

2.2.1 Chile and Bilateral Trade Flows: Export and Import Changes 2006-2010

Table 2.6 shows that Chile has signed numerous bilateral agreements to obtain preferential rates from trade partners. However, the mere enforcement of an FTA does not shed light on the resulting intensive margin trade flows. In Table 2.6, I construct measures for import shares, export shares, growth shares, and growth rates in exports and imports for partner-reporter pairs. These measures are constructed using statistics compiled by the UN Comtrade database from 2006-2010. Trade shares capture the overall volume of trade between two countries while the growth rates capture changes in trade patterns that are attributable to various trade partners. The panel of countries selected is congruent with the countries examined in Table 2.5 but the discussion presented focuses on Chile. The share variables capture the percentage of a country's total trade flow in a particular year that occurs with a specific partner. I examine two growth rates. The first growth rate captures the percentage change in exports and imports from 2006-2010 for major trade partners relative to a given country's overall increase in exports or imports worldwide. That is, $GrowthRate^{world} = \left(\frac{Exports_{2010}^{partner} - Exports_{2006}^{partner}}{Exports_{2010}^{world} - Exports_{2006}^{world}} \right)$. The growth rate in parentheses captures the percentage change in exports and imports from 2006-2010 for major trade partners relative to a given country's overall level of export (imports) in 2006. That is $GrowthRate^{partner} = \left(\frac{Exports_{2010}^{partner} - Exports_{2006}^{partner}}{Exports_{2006}^{partner}} \right)$.

The findings for export shares and import shares are presented in the first 4 columns of Table 2.6. The results suggest that Chile transitioned from exporting mostly to European countries

[7]Chile, Panama, Colombia, Panama, and Peru are all associate members of MERCOSUR.

to exporting to China, with Chilean exports to China increasing from 9% of total exports in 2006 to 24% of exports in 2010. There was a similar boom in Chilean imports from China which grew from 11% to 17% . The calculations on import and export shares show that China became a major trade partner for Chile; suggesting that the CCFTA may have precipitated major changes in Chile's economy.

Delving deeper into the data, I also examine export and import growth rates in columns (5)-(8). The most striking observation relates to the changes in exports and export growth for Chile. Chilean exports to China from 2006-2010 represents a 152% increase in Chile's world export growth. Exports from Chile to China more than tripled. This finding is only possible if there were massive substitutions away from OECD exporting to Chinese exporting by Chilean firms. During the same time period, the export growth rate for France (-19), Germany (-12), Italy (-10), and the US (-41) fell significantly. No other country in the region exhibited this level of substitution away from previously prominent export trade partners in favor of China.

While real export and import values grew, the ramifications within industries and across firms are unclear. The rise in trade flows likely stems from an increased presence in Chinese markets facilitated by the CCFTA. However, China has a comparative advantage in the production of low-skilled manufactured goods. One might expect substantial inter- and intra-sectoral heterogeneity in response to the improved access to Chinese markets and increased import competition domestically.

Figure 2.4 shows the evolution of Chilean trade flows from 2003-2010 by sector. The figure tracks Chilean trade flows for manufacturing, commodities (extractive and fuel industries), and all other sectors. Exports to China in all other sectors grows over the eight-year horizon, with the rate of increase becoming more rapid in 2008. Imports from all other sectors from China slightly decreased from 2008-2010. Export commodities to China increase over the eight-year period. Commodity imports from China increased from 2003-2008 but decreased from 2008-2010. Manufacturing exports to and imports from China increased from 2003-20010 suggesting that firms in both countries benefitted from improved market access from the CCFTA.

A priori, one should not expect a rising tide to lift all boats. Vulnerable sectors and vulnerable firms, in particular, may need to significantly adjust their labor force composition to compete or might have to exit the industry altogether. To explore the heterogeneous effects across industries, I conclude the background discussion by examining aggregate changes in Chilean GDP, itemized by sectoral contributions.

2.2.2 Sectoral Changes in Chile

Table 2.7 shows the sectoral breakdown of Chilean GDP between 2003-2006 (pre-CCFTA) and 2008-2010 (post-CCFTA). In 2006, Chile's largest sectors as a percentage of GDP were mining (7.41%), manufacturing (16.52%), and business services (15.62%). From 2003 to 2006, manufacturing was one of the fastest growing sectors at 17%. From 2008-2010, mining grew by 1.24% and made up 13.46% of GDP. This expansion in mining and extractive sectors occurs during the commodity price boom (2005-2010). Contrarily, the manufacturing industry contracted by 4.3% and comprised 10.51% of GDP. The timing of this contraction in manufacturing immediately follows the implementation of the CCFTA, suggesting that the trade agreement increased exposure of Chilean manufacturers to foreign competition.

The categorized GDP statistics suggest that the boom in Chilean exports to China was predominantly fueled by service and extractive sectors. This begs the question, what impacts did the CCFTA have on non-extractive industries? In particular, how did the CCFTA impact labor force composition and skill intensity within Chilean manufacturers? In the next section, I present a model which helps to elucidate the mechanism driving firm-level relative demand for skilled labor and to formulate predictions in response to bilateral trade reform.

2.3 Theory

This section develops a simple model which combines features of heterogeneous firm (Melitz) models with insights from factor proportions (Heckscher-Ohlin) models. The standard Melitz model relies on one factor of production, labor, and assumes all firms use the same production technology. Firms are only heterogeneous in their Hicks neutral productivity parameter (ψ) which shifts marginal costs. Bernard, Redding, and Schott (2007) propose an elegant theoretical model which combines a Melitz model with a two good, two factor, and two country Heckscher-Ohlin model of trade.[8] I extend this work in a similar manner to Bustos (2011). I present a model which melds firm heterogeneity with factor proportions differences in two key ways: 1. I allow for three factors of production (unskilled labor, skilled labor, and intermediate inputs); and 2. I allow export and import activities to potentially generate marginal production cost reductions which alter skill intensity but involve higher fixed costs. The model predicts that the decision to engage in skill-biased activities is predicated on firm size and induced by both input and output liberalization.

I consider the case of two symmetric countries engaging in bilateral trade. Each country is endowed with $\overline{S}$ units of skilled labor and $\overline{U}$ units of unskilled labor. The economy consists of a single monopolistically competitive industry and a continuum of heterogeneous firms producing a horizontally differentiated product, as in Krugman (1979).[9]

2.3.1 Demand

Consumer preferences across varieties are defined over a continuum and captured by the standard CES utility function. All varieties of the good enter the consumer utility symmetrically where $\sigma = 1/(1-\rho) > 1$ is the elasticity of substitution . Consumers choose the amount of variety ω to maximize utility, $U = \left[\int_0^M q(\omega)_i^{1-\sigma}\right]^{1/1-\sigma}$ subject to the budget constraint: $E \geq \int_\omega p(\omega)q(\omega)$; where $q(\omega)$ is the amount of consumption, E is the aggregate level of income, and $p(\omega)$ is the price of each variety. These preferences generate the demand function $q(\omega) = E\mathbb{P}^{\sigma-1}p(\omega)^{-\sigma}$, where $\mathbb{P} = \left[\int_0^M p(i)^{1-\sigma}di\right]^{\frac{1}{1-\sigma}}$ is the price index of the industry and M is the mass of existing varieties. $\mathbb{P}$

[8]Previous studies argue that within sector reallocations and heterogeneity across firms tend to be larger than inter-sectoral shifts.

[9]The conventional approach in deriving heterogeneous firm models maintain the Krugman (1979) simplifying assumption of one factor of production: labor. In these models, labor represents a bundle of inputs. I am interested in skill intensities and wage differentials which necessarily require a model which accommodates different types of input factors.

is also interpreted as the price of the aggregate consumption good.[10]

2.3.2 Technology

Firms are heterogeneous in their productivity in the sense that marginal costs vary across firms using the same inputs. I assume that each variety is produced by a single firm. Prior to entry, firms pay a fixed cost, f_e, incurred in units of the aggregate consumption good. The prospective entrant then draws its productivity ψ from a known cumulative distribution $G(\psi) = 1 - \psi^{-k}$ with $k > 1$. Entrants decide whether or not to produce or exit only after making the initial investment and observing their productivity level.[11]

Firm technology is represented by a Cobb-Douglas production function with a firm-specific productivity index, the factor share in marginal cost α, and the labor-skill share β. Total cost using the initial technology is represented by:

$$TC_l(q,\psi) = \mathbb{P}f + \tfrac{q}{\psi}(w_s^{\beta} w_u^{1-\beta})^{\alpha} v^{1-\alpha}$$

where w_s and w_u are wages of skilled (s) and unskilled workers (u), $\mathbb{P}f$ is a fixed cost for the domestic market, q is the firm's output, v is the total cost of intermediate materials, $\alpha \in (0,1)$ and $\beta \in (0,1)$. Based on their productivity level, firms choose whether or not to enter international markets. Firms may choose to adopt skill biased production practices to service more demanding export markets. This involves higher domestic fixed cost $(\mathbb{P}f\eta_1)$ but lower marginal production costs. These firms must also pay a fixed cost to enter the export market, $(\mathbb{P}f_x)$. Under this technology, total cost is represented by:

$$TC_h(q,\psi) = \mathbb{P}f\eta_1 + \mathbb{P}f_x + \tfrac{q^D}{\gamma_1\psi}(w_s^{\Lambda_1} w_u^{1-\Lambda_1})^{\alpha} v^{1-\alpha} + \tfrac{\tau q^x}{\gamma_1\psi}(w_s^{\Lambda_1} w_u^{1-\Lambda_1})^{\alpha} v^{1-\alpha}$$

where $\eta_1 > 1$, $\gamma_1 > 1$, $\Lambda_1 \in (0,1)$, $\Lambda_1 > \beta$, q^D and q^x are the quantities produced for the domestic and international markets, respectively. Exported goods are subject to per-unit iceberg trade costs so that $\tau > 1$ units must be shipped for one unit to arrive in the foreign country. Firms may

[10] The standard Hecksher-Ohlin (HO) model and its extensions generate predictions based on relative factor endowments and differences in industry intensities across these resources.

[11] Firms that enter the market face a constant probability of a negative shock to productivity that forces their exit.

also import intermediates from abroad. Again, this is associated with higher fixed cost ($\mathbb{P}f\eta_2$), an import entry cost ($\mathbb{P}f_m$), and higher materials cost but lower marginal production costs. The imported materials are assumed to have some skilled biased technological advantage. In this case, total cost is:

$$TC_m(q,\psi) = \mathbb{P}f\eta_2 + \mathbb{P}f_x + \mathbb{P}f_m + \frac{q^D}{\gamma_2\psi}(w_s^{\Lambda_2}w_u^{1-\Lambda_2})^{\alpha}(\tau^{imp}v)^{1-\alpha} + \frac{q^x}{\gamma_2\psi}(w_s^{\Lambda_2}w_u^{1-\Lambda_2})^{\alpha}(\tau^{imp}v)^{1-\alpha}$$

where $\eta_2 > \eta_1$, $\gamma_2 > \gamma_1$, $\lambda_2 \in (0,1)$, $\Lambda_2 > \Lambda_1$, and $\tau^{imp} > 1$ is a variable trade cost on imported materials.

2.3.3 Firm Behavior

The profit maximizing price is a constant markup over marginal costs. Firms will decide on adopting skill biased production techniques after comparing four possible choices. Firms that only serve the domestic market and source intermediate materials locally earn profits:

$$\pi_l^d(\psi) = \frac{r_l^d(\psi)}{\sigma} - \mathbb{P}f \tag{2.1}$$

where $r_l^d(\psi) = E(\mathbb{P}\rho)^{\sigma-1}\left[\left(w_s^{\beta}w_u^{1-\beta}\right)^{\alpha}v^{1-\alpha}\right]^{1-\sigma}\psi^{\sigma-1}$. Firms which export but refrain from a skill biased upgrade in production earn:

$$\pi_l^x(\psi) = (1+\tau^{1-\sigma})\frac{r_l^d(\psi)}{\sigma} - \mathbb{P}f - \mathbb{P}f_x$$

where $r_l^x(\psi) = (1+\tau^{1-\sigma})r_l^d(\psi)$. Profits if firms export and undertake the skill biased production shift are:

$$\pi_{h_1}^x(\psi) = \lambda_1^{\sigma-1}(1+\tau^{1-\sigma})\frac{r_l^d(\psi)}{\sigma} - \mathbb{P}f\eta_1 - \mathbb{P}f_x$$

where $\lambda_1 = \frac{\gamma_1}{\left(\frac{w_s}{w_u}\right)^{\alpha(\Lambda_1-\beta)}}$. Finally, firms that import intermediates from abroad and export earn:

$$\pi_m^x(\psi) = \lambda_2^{\sigma-1}(1+\tau^{1-\sigma})\frac{r_l^d(\psi)}{\sigma} - \mathbb{P}f_m - \mathbb{P}f\eta_2 - \mathbb{P}f_x$$

where $\lambda_2 = \frac{\gamma_2(\tau^{imp})^{\alpha-1}}{\left(\frac{w_s}{w_u}\right)^{\alpha(\Lambda_2-\beta)}}$.

Note, I limit the permutations of profits and skill upgrades throughout the preceding scenarios to align with the data.

2.3.3.1 Defining Productivity Cutoffs

Exit– To determine whether to enter a market or not, firms compare the total profits of each choice available. The least productive firms will only produce in the domestic market if its variable profits cover its fixed cost of entry. The cutoff productivity in the domestic market can be derived from equation 2.1:

$$\pi_l^d(\psi_d^*) = 0 \iff r_l^d(\psi_d^*) = \mathbb{P}f$$

Export, Non-Upgrading– The marginal exporter does not adopt skill biased production techniques and is indifferent between selling abroad and only serving the domestic market. This cutoff is defined as:

$$\psi_{x_l}^* = \psi_d^* \tau \left(\frac{f_x}{f}\right)^{\frac{1}{\sigma-1}}$$

Export, Upgrading– The marginal upgrader adopts the skill biased production upgrade via exporting activities. They are indifferent between using the original production methods and adopting the upgrade. Equating these profits yields:

$$\psi_{x_h}^* = \psi_d^* \tau \left[\frac{\eta_1 - 1}{(1+\tau^{1-\sigma})(\lambda_1^{\sigma-1}-1)}\right]^{\frac{1}{\sigma-1}}$$

where $\tau\left(\frac{f_x}{f}\right)^{\frac{1}{\sigma-1}} > 1$.

Import, Upgrading– The marginal firm in import markets also serves export markets. Adoption of skill biased advancements via embedded productivity improvements in intermediates can be expressed as a function of ψ_d^* using the zero profit condition for the marginal firm:

$$\psi_m^* = \psi_d^* \tau \left[\frac{f\eta_2 + f_m}{f(1+\tau^{1-\sigma})(\lambda_1^{\sigma-1} - \lambda_1^{\sigma-1})}\right]^{\frac{1}{\sigma-1}}$$

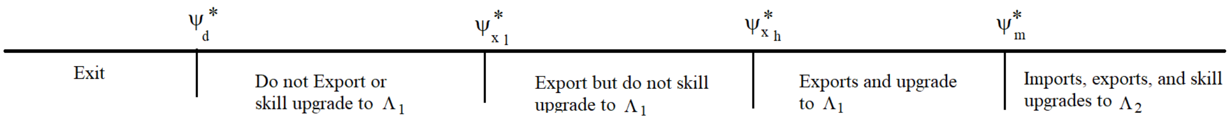

Figure 2.1: International Participation and Skill Upgrading Choices

where $f\eta_2 + f_m > \frac{(\lambda_2^{\sigma-1}-\lambda_1^{\sigma-1})(\eta_1-1)}{\lambda_1^{\sigma-1}-1}$.

The spectrum of international participation and skill biased upgrades are depicted in Figure 2.1. Firm profits are increasing from left to right. As stated in Section 3.3, I impose parameter restrictions to generate these cutoffs. This ordering is closer to observed trends. For example, the case of no exporters using the original production technology is implausible. A less intuitive restriction relates to imports. I assume all importing firms are also exporters. This assumption is in keeping with the observation that a much smaller portion of firms tend to import in firm-level panels relative to exporters. Moreover, a larger fraction of importers also engage in exporting relative to those that only import. When I reorder the import and export cutoffs, the key features of the model are preserved.

2.3.4 Labor Market

It is useful to decompose the aggregate demand for skill among non-upgrading firms, export-induced upgrading firms, and import-induced upgrading firm, $S = S_l + S_h + S_m$ where:

$$S_l = \int_{\psi_d^*}^{\psi_{x_l}^*} s_l^d(\psi)\frac{g(\psi)}{1-G(\psi_d^*)}d\psi + \int_{\psi_{x_l}^*}^{\psi_{x_h}^*} s_l^x(\psi)\frac{g(\psi)}{1-G(\psi_d^*)}d\psi$$

$$S_h = \int_{\psi_{x_h}^*}^{\psi_{x_m}^*} s_h^x(\psi)\frac{g(\psi)}{1-G(\psi_d^*)}d\psi$$

$$S_m = \int_{\psi_m^*}^{\infty} s_m(\psi)\frac{g(\psi)}{1-G(\psi_d^*)}d\psi$$

and $s_l^d(\psi)$, $s_l^x(\psi)$, $s_h(\psi)$, and $s_m(\psi)$ are labor demands for each of the four types of firms defined by the cutoffs. Analogous definitions are derived for $U = U_l + U_h + U_m$.

I can now derive firm-level labor demands for skilled and unskilled labor for each type of firm. Taking derivatives of the total cost functions with respect to w_s and w_u, the relative demand for skill labor by firm groupings are:

$$\frac{s_l^d}{u_l^d} = \frac{s_l^x}{u_l^x} = \left(\frac{s}{u}\right)_l = \frac{\beta}{1-\beta}\left(\frac{w_u}{w_s}\right) \tag{2.2}$$

$$\frac{s_h^x}{u_h^x} = \left(\frac{s}{u}\right)_h = \frac{\Lambda_1}{1-\Lambda_1}\left(\frac{w_u}{w_s}\right) \tag{2.3}$$

$$\frac{s_m}{u_m} = \left(\frac{s}{u}\right)_m = \frac{\Lambda_2}{1-\Lambda_2}\left(\frac{w_u}{w_s}\right) \tag{2.4}$$

These relative demands for skilled labor are independent of output and materials cost and depend only on the endogenous skill upgrading decision. HO models generate differences in relative demand for skill at the industry level. Alternatively, I present a mechanism by which a group of firms will choose to skill upgrade differentially within the same industry.

The equilibrium skill premium is unique and constant across firms, and can be determined by equating the relative supply of skilled labor $\frac{\bar{S}}{\bar{U}}$, a perfectly inelastic curve, to the aggregate relative demand for skill, $\left(\frac{S}{U}\right)^D$, which is downward sloping. The relative aggregate demand for skill $\left(\frac{S}{U}\right)^D$ must be decreasing in the skill premium because all three relative demand functions for skilled labor $\left(\frac{s}{u}\right)_l$, $\left(\frac{s}{u}\right)_h$, and $\left(\frac{s}{u}\right)_m$ are downward sloping. Moreover, as the skill premium increases, the marginal cost disadvantage faced by the least productive, unskilled labor intensive firms decreases; reducing their labor cost relative to larger firms and increasing the share of revenue they earn.

Note, the relative revenue shares between high skill exporters and domestic producers, $\frac{R^h}{R^l}$ are decreasing in the skill premium and in output tariffs. Similarly, the relative revenue shares between importers and domestic producers $\frac{R^m}{R^l}$ is decreasing in the skill premium, output tariffs, and input tariffs.

2.3.5 Trade Liberalization

I now introduce an episode of bilateral liberalization in this framework, allowing both countries to lower tariffs simultaneously. For the purposes of this study, this exercise yields three testable predictions.

Prediction 1. *A reduction in* τ *reduces the "export, skill upgrade" cutoff since* $\frac{\partial \psi^*_{x_h}}{\partial \tau} > 0$ *which increases skill intensity*

Prediction 2. *A reduction in* τ^{imp} *reduces the "import, skill upgrade" cutoff since* $\frac{\partial \psi^*_m}{\partial \tau} > 0$ *which increases skill intensity*

Prediction 3. *A reduction in* τ^{imp} *reallocates market shares and factors of production towards the most productive firms. Skilled worker additions will occur at a relatively faster rate.*

<u>*Discussion*</u>

The model predicts that underlying productivity levels will induce surviving firms to sort into four categories: 1. firms that only serve the domestic market and do not skill upgrade; 2. those that export but do not skill upgrade; 3. those that export and skill upgrade to technology h; and 4. those that import and skill upgrade even more rapidly due to embedded technological advancements.[12] Trade liberalization increases export revenues, decreases the cost of imported materials and makes skill upgrading more profitable. Throughout the theoretical discussion, output and input tariff barriers were variable and measured by τ and τ^{imp} respectively. However, if I instead model trade liberalization as a reduction in fixed costs to enter export and import markets, the general predictions of the model are the same. Note, even though output tariff reductions increase the probability of skill upgrading by decreasing the cutoff threshold, it also increases the mass of firms– and by extension, varieties– in domestic markets. As a result, quantities sold locally may decline. While the prediction is clear theoretically (Prediction 1), these opposing

[12]By design, imported materials and skilled labor are more complementary in the production function.

effects associated with output tariffs make it more difficult to predict its impact on employment decisions empirically. Lastly, the model predicts the largest increase in relative skill demand to occur in the middle range of the productivity distribution since the largest firms adopt upgraded technology before liberalization and the smallest firms exit due to increased competition from trade liberalization.

2.4 Data

The firm-level panel is obtained from the national annual manufacturing survey (Encuesta Nacional Industrial Anual, ENIA) compiled by the official Chilean Statistical Agency (Instituto Nacional de Estadsticas, INE). While the database spans decades, I focus on two years: 2008 and 2010.[13] Data is provided at the plant level with a lower bound of 10 employees for inclusion in the survey. On average there are more than 4,000 plants per year. The survey collects data on production, sales, employment, wages, exports, investment, depreciation, various costs, and other characteristics. Plants are classified according to the 4-digit International Standard Industrial Classification (ISIC Rev 3); covering 1,634 industries. I deflate variables using price deflators provided by the Chilean Statistical Agency.

I consider unskilled labor and auxiliary workers to be production workers. Non production workers are managers, specialized, personal administrators, and sales representatives. Skill intensity is the share of non production workers relative to total labor force. I match the manufacturing survey data with UNCOMTRADE data to obtain reductions in tariff rates from China to Chile at the ISIC 4-digit level.

2.5 Measurement

The ENIA data provide detailed information on survey respondents; including 4-digit industry codes for 1,634 industries under the ISIC Revision 3 classification of goods. For the case

[13]In 2008 then again in 2011, the survey changes methodology, questions asked, and the pool of respondents. Therefore, I am unable to explore a longer panel in this study.

of multiproduct firms, the firm's industry is categorized in accordance with their highest output value (i.e. main product). Each establishment also provides disaggregated information on types of workers, the wage bill accrued by each type of worker, the proportion of revenue earned from exporting, the portion of intermediates imported, and the percentage of foreign ownership.

2.5.1 Tariffs

Tariff data is obtained from the WTO tariff database and is compiled at the HS07 6-digit level. I use concordances, also provided by the WTO, to merge the tariff data with firm level data. Tariffs on final goods are constructed at the 4-digit ISIC revision 3 level by taking the simple average of the 6-digit HS codes within 4-digit ISIC categories.[14]

The manufacturing survey data does not provide information on the components of a firm's input bundle. To derive an input tariff measure, I use a qualitatively similar methodology as Amiti and Cameron (2012). That is, I weight the output tariffs stipulated in the CCFTA by input cost shares, as follows:

$$input\,tariff_i = \sum_j w_{ij,2008} * output\,tariff_{j,t}$$

$$\text{where } w_{ij.2008} = \frac{\sum_f input_{f,i,j,1998}}{\sum_{f.j} input_{f.i.j.1998}}$$

The weights, w_{ij}, are based on 2-digit ISIC level input data in 2008.[15] Input data comes from input-output tables for Chile provided by the OECD Statistics database.[16] Therefore, if industry i uses 80 percent rubber and plastics, and 20 percent chemicals and chemical products, I give an 80 percent weight to the rubber and plastics tariff, and a 20 percent weight to the chemical and chemical products tariff. These cost shares are based on global industry totals including domestic and

[14]Note, it is not possible to weight tariffs by domestic output shares or specific product intensities because only the firm's main product is known from the data.

[15]I assume that the mix of inputs used by a particular industry does not change over the sample period. However, if the mix were to change, fixing the input bundle safeguards against endogeneity issues related to substitutions in the intermediate input bundle.

[16]These weights fundamentally differ from Amiti and Cameron (2012) who use firm-level input data to construct firm-specific weights.

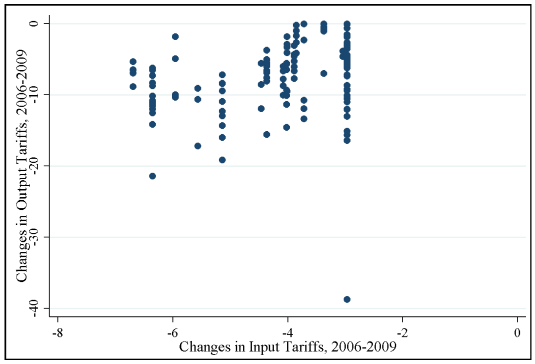

Figure 2.2: Correlation between Changes in Output Tariffs and Input Tariffs

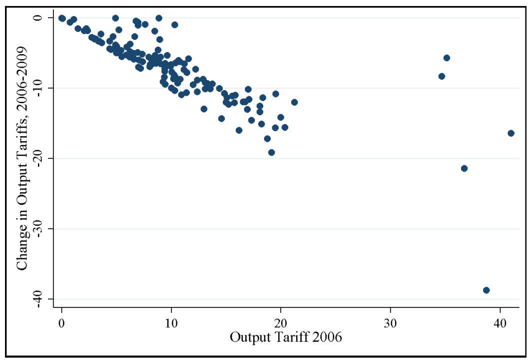

Figure 2.3: Output Tariff Changes vs Initial Tariff Level

imported intermediates. This approach to constructing the input tariff measure avoids endogeneity issues associated with using firm-level input bundles.[17]

The high level of disaggregation in the output tariff measure is a major advantage of the study; allowing me to take advantage of more variation due to the more granular nature of the 4-digit ISIC data. Unfortunately, since the input tariff variable is constructed at the 2-digit ISIC industry level, there is a relatively high correlation (.623) between changes in output tariffs and changes in input tariffs (See Figure 2.2). Despite this correlation, which slightly surpasses the rule of thumb correlation threshold (0.6), this study strives to isolate channels; identifying the separate effects of changes in input and output tariffs on the demand for skilled labor as suggested by the theoretical model.

Both input and output tariffs show declining trends over the period of interest. Figure

[17]For example, if an industry's main input is rubber and plastics then the relevant input tariff is the one on rubber and plastics regardless of whether or not the firm imports rubber.

2.3 shows that the largest output tariff reductions occurred in industries with the highest initial tariff levels. Typically, such an observation would be evidence of exogenous liberalization since all tariff rates approached uniformly low levels. However, FTA policies are endogenous by nature. Countries may have systematically offered large tariff reductions in industries that were already uncompetitive or non-viable domestically. Moreover, countries may offer smaller tariff reductions to industries that are inefficient but have political strength. In that case, even slight exposure to import competition may induce large labor reallocations. In both cases, estimated coefficients would be biased towards zero.[18]

I use an Instrumental Variables (IV) approach to correct for the endogeneity of preferential tariff rates. MFN rates for both countries were established well in advance of the CCFTA formation and occurred independently of their bilateral terms of trade or socioeconomic similarities.[19] Therefore, I use initial MFN input and output tariff rates before the enforcement of the CCFTA to instrument for changes in input and output tariffs.

2.5.2 Relative Skill Demand

My baseline specification uses a conventional worker classification scheme to measure the relative demand for skilled labor: the ratio of nonproduction workers to the total number of workers. These categorizations do not map perfectly into skill levels as it is possible for heterogeneous skills within and across worker groups (Kasahara, Liang, and Rodrigue, 2016). However, the general pattern across groups suggests that non production workers are higher skilled, attain higher levels of education, and earn higher wages, on average. Production workers have less skill, attain lower levels of education, and earn lower wages, on average (Amiti and Cameron, 2012; Goldberg and Pavcnik, 2007).[20]

[18]Input tariffs are generally lower than output tariffs, however, input tariffs also declined substantially over the sample period. A qualitatively similar trend holds. That is, the largest input tariff reductions occurred in industries with the highest initial input tariff levels.

[19]Chile and China have been members of the WTO since 1995 and 2001, respectively.

[20]Using data on Indonesian firms, Amiti and Cameron (2012) find that the nonproduction/production split is highly correlated with level of educational attainment.

The data also provides disaggregated data on specific worker groups and their corresponding compensation schemes. This variation presents an opportunity to abstract away from the typical broad worker groupings. Using disaggregated worker categories, I can explore how changes in tariffs affect firm hiring decisions for specific types of workers. This unearths differential effects of tariff changes within the production and nonproduction groups. For example, within the category of nonproduction workers, managers, specialized technicians, and administrative staff might experience systematically different outcomes due to the CCFTA tariff changes.

2.5.3 Firm Quartiles

The model predicts that firms will choose whether or not to increase their skill intensity based on their underlying productivity. The exact location of export or import upgrading cutoffs are difficult to ascertain and are likely to vary across industries. The theoretical model suggests there is a middle range that should experience the largest upgrades in skill intensity. To approximate the various cutoffs suggested by the model, I group firms into size quartiles using industry-specific beginning of period capital stock. This is appealing for two reasons. First, other measures, such as initial sales revenue, are highly susceptible to industry differences and tend to be contemporaneously determined. Secondly, there is a timing issue due to the enforcement date of the CCFTA and the sample period I investigate. Capital stock decisions are typically made one or more periods ahead of time (i.e. predetermined). This is an important advantage because, assuming a lag or adjustment period in firm responses to the preferential tariff reduction, initial capital stock is the most suitable measure available of pre-CCFTA conditions.

2.6 Estimation Strategy

My estimation strategy relates how changes in 2-digit industry level input tariffs and changes in 4-digit industry level output tariffs affect changes in the labor force and the demand for skill by Chilean manufacturing firms. Relative skill demand is measured by the share of non production workers in a firm's work force. Labor force impacts are measured by the logarithm of the firm's total number of employees (and of various worker subgroups where applicable). The baseline specification is:

$$\Delta ln(y)_{f,i} = \beta_1 \Delta(input\,tariff)_i + \beta_2 \Delta(output\,tariff)_i + \Delta\varepsilon_{f,i} \tag{2.5}$$

where f denotes a firm and i denotes a 4-digit industry, y denotes a host of log-transformed dependent variables, such as: total employment; employment of production workers; and employment of non-production workers. Differencing eliminates concerns with regards to time-invariant variables.[21]

A priori, I expect a reduction in input tariffs to increase the relative demand for skilled labor, particularly for firms in the middle range of the distribution. The relative demand for skill within smaller firms is not expected to have a statistically significant relationship with import tariff reductions. Input tariff reductions should also be associated with an increase in employment at large firms as labor is reallocated towards the most productive firms. Lower input tariffs also reduce the marginal costs of production for Chilean manufacturers since they have improved access to intermediates from abroad (Fan, Li, and Yeaple, 2014; Feng, Li, and Swenson, 2016). Facing lower production costs, firms are incentivized to expand production, resulting in increased hires. Therefore, β_1 is expected to be negative. That is, as input tariff changes decrease- so the gap between previous tariffs and current tariffs widen- firms choose to hire more workers in total.

The expectation for output tariff changes is ambiguous since it captures two opposing effects. From the perspective of a Chilean manufacturer, a reduction in output tariffs improves their access to the Chinese consumer market but due to the general reciprocity in tariff rates, this also exposes Chilean firms to increased intra-industry competition from rival Chinese manufacturers. Since China is known internationally as the preeminent manufacturing hub, possessing absolute and comparative advantages in the industry, I expect the latter effect to dominate. That is, reductions in output tariffs should be associated with a firm's contraction in their labor force,

[21] The main variable, assumed to be time-invariant in this analysis, is firm productivity. The specification also abstracts away from changes in the relative supply of skilled labor- which are economy-wide- as well as city-specific shocks that differentially affect certain areas in Chile.

on average. Thus, β_2 should yield positive coefficients when relating changes in output tariffs to changes in overall employment. An important caveat for this analysis relates to firm size. Larger firms with a greater presence on the international stage may benefit from intranational labor reallocations towards more productive firms, thereby increasing their demand for workers in response to changes in the output tariffs.[22]

2.7 Main Findings

In this section, I present the main results using the sample of Chilean manufacturers. I estimate a first-differenced specification; eliminating concerns with respect to time-invariant characteristics. To address the endogeneity of bilateral trade agreements, I use initial MFN tariffs before the implementation of the CCFTA to instrument for changes in output and input tariffs. I also examine differential effects along the firm distribution, grouping firms into quartiles based on beginning of period capital stock. Each table includes the estimated IV coefficients as well as the corresponding OLS estimates for comparison.

2.7.1 Effects of Tariffs on Skill Intensity

I estimate the following specification to explore the impact of tariff reductions on skill intensity:

$$\Delta Skill\,Intensity_{f,i} = \beta_1 \Delta(input\,tariff)_i + \beta_2 \Delta(output\,tariff)_i + \Delta\varepsilon_{f,i} \tag{2.6}$$

The results from estimating equation (2.6) using IVs are presented in Table 2.1. Column 1 relates changes in skill intensity to reductions in input and output tariffs for the full panel of manufacturers. The results are congruent with expectations. The estimated coefficient for output tariff is negative but insignificant. For input tariff changes, I find that the average reduction, 4.86 percentage points, leads to a 0.096 $[= (e^{-0.0199} - 1) \cdot 4.86]$ percentage point increase in skill intensity across all firms.

[22] I assume some rigidity in labor movements and persistence in occupational field. This study does not use worker or household survey data so there is no tractable method to show job firing and/or hiring.

Table 2.1: Heterogeneous Effects– Skill Intensity and Tariffs

Dependent Variable:	Δ Skill Intensity				
	(1) All	(2) Quartile 1	(3) Quartile 2	(4) Quartile 3	(5) Quartile 4
Δ Output Tariff	-0.00134	-0.000486	-0.00116	-0.00188	-0.00145
	(0.00171)	(0.00306)	(0.00408)	(0.00326)	(0.00337)
Δ Input Tariff	-0.0199***	-0.00385	-0.0315**	-0.0208*	-0.0240*
	(0.00629)	(0.0125)	(0.0139)	(0.0122)	(0.0124)
N	3528	889	838	873	829
OLS Results:					
Δ Output Tariff	-0.00110	-0.00381	-0.000271	-0.000761	-0.0000389
	(0.00131)	(0.00238)	(0.00305)	(0.00256)	(0.00267)
Δ Input Tariff	-0.0195***	0.00569	-0.0327**	-0.0234**	-0.0265**
	(0.00573)	(0.0114)	(0.0127)	(0.0110)	(0.0113)
First Stage:					
	(1) All	(2) Quartile 1	(3) Quartile 2	(4) Quartile 3	(5) Quartile 4
MFN Output Tariff_{2006}	-.5442	-.5614	-.5181	-.5453	-.5506
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MFN Input Tariff_{2006}	-.6414	-.6512	-.6318	.6368	-.6432
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DWH F-stat	1622.73	454.00	403.90	382.61	339.69
DWH p-value	0.0000	0.000	0.000	0.000	0.000
AR F-stat	13.74	0.19	6.63	4.51	4.46
AR χ^2	27.51	0.39	13.31	9.05	8.96
AR p-value	0.0000	0.8252	0.0013	0.0108	0.0113
KP-UnID LM	637.09	157.67	139.95	163.64	159.63
KP-UnID p-value	0.0000	0.000	0.000	0.000	0.000
KP Wald F-stat	619.84	170.221	120.09	173.34	151.07
SY weak ID CV	7.03	7.03	7.03	7.03	7.03

Notes: This table examines the relationship between reductions in tariffs and skill intensity=$\frac{NonProduction}{TotalLaborforce}$
These results test Predictions 1 and 2 from the theoretical model. First stage results present the estimated coefficients and p-values (in parentheses). For all other estimates, standard errors are in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Columns 2 to 5 repeat the analysis on quartile subsamples of firms. I obtain insignificant estimates from the lowest quartile of firms for both tariff measures. This result is plausible since the smallest firms are not induced to increase skill intensity. Columns 3, 4, and 5 all match ex ante predictions. Firms in the second quartile of the distribution were predicted to increase skill intensity at the fastest rate. A mean reduction in input tariffs leads to a 0.15 percentage point increase in skill intensity for firms in the second quartile of the distribution. Input tariff reductions are associated with an increase in the demand for skill labor for firms in the third and fourth quartiles but these estimated coefficients are only significant at the 10% level.

Notably, the OLS estimates were almost identical to the IV specifications. The first stage results are not the focal point of the paper but they do perform as predicted. Preferential tariff reductions are negatively associated with the initial MFN rate. The Durbin-Wu-Hausman F-tests of endogeneity confirms the presence of potentially endogenous variables. I use the Kleibergen-Paap (KP) Wald Statistic to reject the null of weak instruments. The various diagnostics and econometric tests suggest that the IV approach is appropriate.

The results presented in Table 2.1 highlight multiple channels. Output tariffs capture dual effects: improved access to Chinese markets and increased import competition. The discussion in Section 2.2.2 suggested that the manufacturing sector shrunk immediately after the enforcement of the CCFTA. Coupled with the insignificant parameter estimates for output tariffs across firms and within quartiles, the results hint at import competition as a culpable factor in negating any expansionary impacts from output tariff reductions.

On the contrary, input tariff reductions had a significant impact on skill intensity, particularly for firms in the second quartile. This is congruent with the theoretical model which predicts that firms in the middle range of the productivity distribution should upgrade technology at a faster rate.

Table 2.2: Heterogeneous Effects– Employment and Tariffs

Dependent Variable:	Δ log(Emp)				
	(1) All	(2) Quartile 1	(3) Quartile 2	(4) Quartile 3	(5) Quartile 4
Δ Output Tariff	0.0505***	0.0263*	0.0604***	0.0365**	0.0586***
	(0.00983)	(0.0154)	(0.0192)	(0.0178)	(0.0198)
Δ Input Tariff	-0.107***	-0.0420	-0.135**	-0.0708	-0.203***
	(0.0349)	(0.0607)	(0.0653)	(0.0624)	(0.0715)
N	3528	889	838	873	829
OLS Results:					
Δ Output Tariff	0.0392***	0.0266**	0.0428***	0.0314**	0.0322**
	(0.00748)	(0.0126)	(0.0143)	(0.0136)	(0.0152)
Δ Input Tariff	-0.0813**	-0.0467	-0.100*	-0.0635	-0.131**
	(0.0316)	(0.0543)	(0.0574)	(0.0565)	(0.0646)
First Stage:					
	(1) All	(2) Quartile 1	(3) Quartile 2	(4) Quartile 3	(5) Quartile 4
MFN Output Tariff_{2006}	-.5442	-.5614	-.5181	-.5453	-.5506
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MFN Input Tariff_{2006}	-.6414	-.6512	-.6318	.6368	-.6432
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DWH F-stat	1622.73	454.00	403.90	382.61	339.69
DWH p-value	0.0000	0.000	0.000	0.000	0.000
AR F-stat	13.74	0.19	6.63	4.51	4.46
AR χ^2	27.51	0.39	13.31	9.05	8.96
AR p-value	0.0000	0.8252	0.0013	0.0108	0.0113
KP-UnID LM	637.09	157.67	139.95	163.64	159.63
KP-UnID p-value	0.0000	0.000	0.000	0.000	0.000
KP Wald F-stat	619.84	170.221	120.09	173.34	151.07
SY weak ID CV	7.03	7.03	7.03	7.03	7.03

Notes: This table examines the relationship between a firm's labor force and tariff reductions. The dependent variable is the change in log(Total Labor Force) from 2008 to 2010. Tariff reductions are captured by changes in output tariffs and input tariffs. These results test Prediction 3 from the theoretical model. First stage results present the estimated coefficients and p-values (in parentheses). For all other estimates, standard errors are in parentheses.
All regressions include robust standard errors. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

2.7.2 Heterogeneous Effects of Tariff Changes on Employment

In this section, I investigate another major prediction from the theoretical model. Trade liberalization induces intra-sectoral reallocations from less productive firms to more productive firms. As a result, one would expect input tariff reductions to be associated with firm expansion in profits and inputs, namely labor, to meet the increased level of demand from foreign markets. This effect should be concentrated in the upper quartiles of the productivity distribution. On the contrary, output tariff reductions, so far, have ostensibly operated as a measure of Chinese import competition as opposed to improved access to Chinese markets. I expect output tariff reductions to be associated with reductions in the size of the labor force.

Table 2.2 relates changes in tariff rates to the size of the work force. I find that a mean reduction in input tariffs leads to a 0.5% increase in labor force (Column 1). Conversely, the mean reduction in output tariffs (7.96) is associated with a 0.41% decrease in labor force.

The analysis is more interesting when I disaggregate results by quartile. Estimated coefficients for reductions in input tariffs are insignificant for quartiles 1 and 3. However, the relationship for firms in the top quartile is very large. A 25% reduction in input tariffs in the fourth quartile is associated with a 4.59% (5 worker) increase above the average level of 113. For firms in the fourth quartile, a similar reduction in input tariffs is associated with a 3.16% (2 worker) increase above the average level of 59. Output tariff reductions are positive and significant for quartiles 2,3, and 4.

The results suggest that the net impact of the CCFTA on employment was expansionary for the average firm. However, the analysis on heterogeneous effects suggests that the net effect was contractionary for firms in the first quartile of the distribution. For firms in the upper quartiles, the estimated effects suggest they expanded production and likely market share. The strength of the relationship is largest for firms in the fourth quartile; adding credence to the theoretical model. As increased import competition truncates the probability of survival for smaller firms, market shares and resources flow towards the largest, and presumably, more productive firms.

2.7.3 Tariff Changes: Production vs Non-Production Workers

The analysis in Table 3 is a corollary to Section 7.2. Here, I disaggregate and group workers into two categories: production vs non production. Non-production workers, on average, are more educated and of higher skill. The theory predicts that market and resource reallocations will be diverted towards the most productive and largest firms in the industry. As a result, the input tariff reductions should lead to an increase in both production and non-production labor for firms on the upper end of the productivity distribution.

Output tariff reductions should be associated with reductions in both worker populations. Because the import competition effect appears to dominate the improved market access opportunity, output tariff reductions should induce a reduction in firm scale and productive activity which involves culling the work force.

Surprisingly, I find no statistically significant relationship between input tariffs the change in production workers across firms or within quartiles, though the estimates possess the expected sign. However, a 30 percentage point output tariff reduction is associated with a 1.59% decrease in the average population of production workers. The result is largest for firms in the fourth quartile of the distribution.

For non production workers, there is a contractionary effect between output tariff reductions and the number of non production workers, on average. However, the heterogeneous impact analysis shows no statistically significant relationship between output tariff changes and changes in the population of non production workers within quartiles (Columns 2-5). A 30 percentage point reduction in input tariffs increases employment of non production workers by 3.4% (3 workers) on average. However, the result is driven by firms in the fourth quartile.

Connecting the results for each worker group indicates a key feature of firm decisions. As firms downsize operations in response to increased competition, they reduce their labor force in a skill-biased way in response to output tariff changes. Since the rate at which they fire production workers is faster than the rate at which they fire non-production workers, the post-liberalization composition of the work force might increase relative skill intensity of labor even though absolute

Table 2.3: Compositional Changes– Production vs Non Production Workers

Panel A: Dependent Variable:	Δ log(# Production Workers)				
	(1) Tariffs Only	(2) Quartile 1	(3) Quartile 2	(4) Quartile 3	(5) Quartile 4
Δ Output Tariff	0.0516***	0.0237	0.0540***	0.0438**	0.0626***
	(0.0109)	(0.0171)	(0.0205)	(0.0205)	(0.0222)
Δ Input Tariff	-0.0593	-0.00543	-0.0742	-0.0377	-0.156*
	(0.0386)	(0.0686)	(0.0714)	(0.0708)	(0.0808)
R^2	0.00992	0.00734	0.0115	0.00913	0.000737
N	3465	868	824	865	814
OLS:					
Δ Output Tariff	0.0420***	0.0308**	0.0426***	0.0367**	0.0326*
	(0.00818)	(0.0140)	(0.0155)	(0.0154)	(0.0166)
Δ Input Tariff	-0.0399	-0.0294	-0.0571	-0.0244	-0.0810
	(0.0348)	(0.0613)	(0.0633)	(0.0640)	(0.0729)
Panel B: Dependent Variable:	Δ log(# Non Production Workers)				
	(1) Tariffs Only	(2) Quartile 1	(3) Quartile 2	(4) Quartile 3	(5) Quartile 4
Δ Output Tariff	0.0276***	0.0176	0.0281	0.0201	0.0302
	(0.0103)	(0.0172)	(0.0234)	(0.0182)	(0.0203)
Δ Input Tariff	-0.119***	-0.0428	-0.137*	-0.103	-0.217***
	(0.0368)	(0.0635)	(0.0796)	(0.0679)	(0.0705)
R^2	0.00992	0.000518	0.00476	0.00552	0.00900
N	3465	789	755	805	764
OLS:					
Δ Output Tariff	0.0243***	0.0108	0.0235	0.0253*	0.0185
	(0.00790)	(0.0132)	(0.0173)	(0.0141)	(0.0157)
Δ Input Tariff	-0.110***	-0.0249	-0.128*	-0.123**	-0.177***
	(0.0329)	(0.0566)	(0.0690)	(0.0608)	(0.0630)

Notes: This table examines the relationship between a firm's labor force and tariff reductions. The dependent variable in Panel A is the change in log(Production Workers). The dependent variable in Panel B is the change in log(Production Workers). Tariff reductions are captured by changes in output tariffs and input tariffs. Standard errors are in parentheses. All regressions include robust standard errors.

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

size of the workforce is smaller. Changes in input tariffs are found to have no effect on the population of production workers but have a strong effect on the demand for skilled labor for the larger, more productive firms in the data.

2.7.4 Effects of Tariffs on Worker Groups

Next, I go beyond the broad production vs non-production worker dichotomy to examine how tariff reductions relate to more narrowly defined worker categories. In ascending order by average skill level, these groups are: production workers with low qualifications, auxiliary workers, sales and commission workers, specialized technicians in production, administrative staff, and managers/owners in the plant. The results are presented in Table 2.4.

I find that reductions in input tariffs increased demand for auxiliary workers; the higher skilled, low-skill worker. A 20 percentage point reduction in tariffs is associated with a 2.8% increase in demand for auxiliary workers and a 2.35% increase in demand for commission workers. However, tariff reductions also increased demand for commission workers; the lowest skill, high-skilled workers. Output tariff reductions are associated with reductions in the number of auxiliary workers, administrative staff, and specialized workers. No clear pattern emerges from this analysis but it does suggest that measures of relative skill demand are sensitive to worker groupings and specifications.

2.8 Robustness and Extensions

The main findings relate tariff reductions to skill intensity and labor attributes. In this sector, I expand the vector of explanatory variables to address potential issues of omitted variables and to explore the effect of export/import intensity in the patterns of skill upgrading. I also explore the relationship between tariff changes and other variables of interest. Namely, firm revenue and the wage-skill premium.

Table 2.4: Tariff Changes and Disaggregated Worker Groups

Dependent Variable:	Δ log(Workers)					
	(1) Low Qualif. Workers	(2) Auxiliary Workers	(3) Commission Workers	(4) Specialized Workers	(5) Admin. Workers	(6) Managers
Δ Output Tariff	0.0246*	0.0360***	0.00893	0.0347***	0.0212**	0.0105*
	(0.0134)	(0.00975)	(0.00794)	(0.0112)	(0.00906)	(0.00586)
Δ Input Tariff	-0.0514	-0.154***	-0.125***	-0.0500	0.0126	0.0255
	(0.0491)	(0.0383)	(0.0313)	(0.0402)	(0.0332)	(0.0210)
R^2	0.00233	0.00775	0.00508	0.00270	0.00600	0.00449
N	3608	3608	3608	3608	3608	3608
OLS Results:						
Δ Output Tariff	0.0296***	0.0381***	0.00472	0.0252***	0.0263***	0.0108**
	(0.0103)	(0.00734)	(0.00650)	(0.00850)	(0.00679)	(0.00443)
Δ Input Tariff	-0.0653	-0.155***	-0.108***	-0.0280	-0.00619	0.0202
	(0.0442)	(0.0343)	(0.0283)	(0.0364)	(0.0297)	(0.0192)
First Stage:						
	(1) Low Qualif. Workers	(2) Auxiliary Workers	(3) Commission Workers	(4) Specialized Workers	(5) Admin. Workers	(6) Managers
MFN Output Tariff_{2006}	-.5457	-.5457	-.5457	-.5457	-.5457	-.5457
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MFN Input Tariff_{2006}	-.6411	-.6411	-.6411	-.6411	-.6411	-.6411
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DWH F-stat	1663.01	1663.01	1663.01	1663.01	1663.01	1663.01
DWH p-value	0.000	0.000	0.000	0.000	0.000	0.000
AR F-stat	5.58	5.58	5.58	5.58	5.58	5.58
AR χ^2	11.18	11.18	11.18	11.18	11.18	11.18
AR p-value	0.0037	0.0037	0.0037	0.0037	0.0037	0.0037
KP-UnID LM	664.11	664.11	664.11	664.11	664.11	664.11
KP-UnID p-value	0.000	0.000	0.000	0.000	0.000	0.000
KP Wald F-stat	658.94	658.94	658.94	658.94	658.94	658.94
SY weak ID CV	7.03	7.03	7.03	7.03	7.03	7.03

Notes: This table examines the relationship between various worker groups and tariff reductions. Low qualification production workers and auxiliary workers are classified as production workers. Commission workers, specialized technicians, administrative staff and managers are non production workers. All regressions include robust standard errors (presented in parentheses).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

2.8.1 Accounting for Import/Export Intensity

The theoretical model relies on an extensive margin effect– access to international markets– to generate skill upgrading predictions. However, Amiti and Cameron (2011) conduct an empirical study– relating tariff reductions to changes in the wage-skill premium– which suggests that there may be differential impacts of trade reform along the gradient of import and export intensities. To test the robustness of the baseline findings and to address intensive margin differences in international markets across firms, I estimate the following specification to explore the impact of tariff reductions skill intensity:

$$\begin{aligned} \Delta Skill\,Intensity_{f,i} = \beta_1 \Delta(input\,tariff)_i + \beta_2 \Delta(input\,tariff)_i * (impshare)_{f_i} \\ \beta_3 \Delta(output\,tariff)_i + \beta_4 * \Delta(output\,tariff)_i * (expshare)_{f_i} + \Delta\varepsilon_{f,i} \end{aligned} \tag{2.7}$$

The results from estimating equation (2.7) using IVs are presented in Table 2.8. Column 1 presents the result across all firms for the analysis conducted in Section 2.7.1. Column 2 includes the full set of controls. This specification includes firm-level characteristics, such as percentage of government and foreign ownership. Note, the estimate for output tariff reductions remains insignificant in this specification. The average effect of a mean reduction in input tariffs increases skill intensity by 0.17 percentage points in non-importing firms. Among importers, evaluating *import share* at the mean (9.6 %), the effect of a mean reduction in input tariffs is 0.13 percentage points increase in skill intensity. For firms that import more intensively, for example at the 50^{th} percentile, the mean reduction in input tariffs increases skill intensity by 0.04 percentage points. This suggests that as firms import more intensively, the input tariff reductions induce them to increase skill intensity at a slower rate. There were no differential effects for firms that export more intensively.

Columns 3 to 5 repeat the analysis on quartile subsamples of firms. I obtain insignificant estimates from the lowest quartile of firms for both tariff measures. Again, this result is plausible since the smallest firms are not induced to increase skill intensity. Columns 4, 5, and 6 all match ex ante predictions. Firms in the second quartile of the distribution were predicted to increase skill intensity at the fastest rate. A mean reduction in input tariffs leads to a 0.28 percentage point increase in skill intensity for non-importing firms in the second quartile of the distribution. Again, I find evidence of differential results for importing firms in the second quartile which increased skill intensity by 0.18 percentage points in response to an input tariff reduction. The estimate on input tariff reductions was also large for firms occupying the third quartile.

The main result from this analysis is that firms with a greater share of inputs sourced from abroad appear to increase skill intensity at a slower rate relative to non-importers. This may reflect the fact that previous importers have already adopted skill upgrading techniques that increased their relative demand for skilled labor. Alternatively, two key assumptions in the theoretical model may not hold in practice. More specifically, if skill upgrading is predicated on intensive margin flows in international markets and imported intermediates are relatively more complementary with unskilled workers, then importing firms should increase skill intensity at slower rate. However, the results presented throughout this study suggest that this latter argument is unlikely.

2.8.2 The Effect of Tariff Changes on Sales

The main focus of this paper relates to labor market effects and skill intensity. However, the theoretical model which guides the empirical analysis also makes prediction with respect to firm sales. In this section, I explore the relationship between firm revenues and tariff changes induced by the CCFTA.

Table 2.9 presents the results from estimating equation (2.7) where changes in the logarithm of total sales is the dependent variable. When changes in output and input tariffs enter the specification in isolation (Column 1), I find that both types of tariffs have a contractionary effect across all firms but these estimates are statistically insignificant. This pattern holds across all firms and within each quartile of the distribution; generally suggesting that the tariff reductions had no impact on total sales for non-importers and non-exporters.

I find evidence of differential impacts for active firms in international markets. Column 2 suggests that input tariff reductions had no statistically significant impact on sales for non-importing firms. On the contrary, a reduction in input tariffs is associated with an increase in total sales for importing firms. Disaggregating by quartile, the estimate for changes in output tariffs is insignificant across all specifications. For import tariffs, the coefficient is negative but insignificant.

The results in Table 2.9 suggest that reductions in output (input) tariffs had no impact on total sales for non-exporting (non-importing) firms. However, input tariff reductions are associated with increased sales revenue for firms that import more intensively. A possible explanation of this result is that increased access to cheaper materials facilitated an increase in earnings. If imported intermediates are imperfect substitutes for unskilled labor, and complementary with skilled laborers, then a reduction in input tariffs should precipitate a rise in total sales for skill-intensive firms. Moreover, if the fall in demand for unskilled workers is reflected by increased usage of imported intermediates then one would expect the fall in input tariffs to have a positive relationship with sales revenue for more intensive importers.

2.8.3 Effects of Tariffs on Skill Premia

The theoretical model predicts a unique wage-skill premium across firms. In practice, skill premia– the relative wage of non production to production workers– may vary over time and across firms. In this section, I relate tariff reductions to changes in the wage-skill premium. Ex ante, it is difficult to form expectations on the relationship. Since China has a comparative advantage in unskilled labor, one might expect output tariff reductions to increase the returns to the relatively abundant Chilean factor: skilled labor. On the other hand, if imported materials are somewhat complementary with unskilled labor, an input tariff reduction might reduce the wage-skill premium within firms.

Results are presented in Table 2.10. Column 1 suggests that output tariffs lead to an increase in the wage-skill premium while input tariffs have the opposing effect for non-importing and non-exporting firms. The estimated coefficient for output tariff reductions is not robust to the addition of controls. Columns 2, 4, 5, and 6 show that input tariffs are associated with reductions in the wage-skill premium for all firms. However, this reduction was the smallest amongst firms in the fourth quartile and monotonically grew in magnitude as firm productivity decreases. This suggests larger firms paid higher relative wages to attract more skilled workers even though the real wedge between wage levels narrowed overall.

This result is inconsistent with standard labor economics since a shift in relative demand for skilled workers should be coupled with increased relative wages for skilled workers, if the supply of labor is held fixed. The most probable explanation is that there is no relationship between tariff reductions in the manufacturing sector and the economy-wide wage-skill premium. Firms in the manufacturing sector may be price takers in wages. The wage-skill premium may be dictated by growing industries such as mining and other extractive sectors. Alternatively, there may also be skill upgrading within worker groups. I assume workers within each category are homogeneous, however, firms may be hiring higher skilled production workers over time (Kasahara, Liang, Rodrigue, 2016)

2.9 Conclusion

There is considerable debate about the impacts of trade reform on labor market outcomes; particularly for middle-income countries. To add to this discussion, I provide evidence that Chile's sectoral contributions to GDP and international trade flows underwent significant changes after entering the Chile-China Free Trade Agreement (CCFTA) in October 2006. I investigate the impact of this bilateral agreement on skill intensity and labor force composition for Chilean manufacturers. I present a model where firms endogenously increase their relative demand for skilled labor via participation in international markets. The model accounts for input and output tariffs explicitly and predicts that liberalization in either trade barrier may induce firms to increase their demand for skilled labor.

I test the veracity of these predictions using data on Chilean manufacturers from 2008-2010. I find that reductions in output tariffs are associated with a decrease in the size of the labor force across firms. This suggests that increased import competition effects dominated the expansionary effects associated with improved access to Chinese markets. The contraction in labor occurs in a skill-biased way, with unskilled labor comprising the bulk of the labor force contraction. Reductions in input tariffs were associated with increased skill intensity and the hiring of more skilled workers. These effects exhibit heterogeneous impacts and were concentrated within firms towards the upper end of the productivity distribution.

I also find that tariff reductions had no effect on the total sales for non-importers and non-exporters. However, input tariff reductions are associated with large increases in sales revenue for firms that import intermediates more intensively. Input tariff reductions are also associated with a decrease in the wage skill premium across all firms, with the rate of decrease being faster in importing firms. This suggests that firms may be upgrading skill within worker categories. Alternatively, manufacturing firms may be price takers in labor markets; with wages determined exogenously. The wage-skill premium may be more closely tethered to changes in growing industries such as mining and other extractive industries.

2.10 Appendix

Table 2.5: Latin America: Notable Trade Agreements 2002-2010

Country	Customs Union	FTAs	PTAs
Argentina (2nd) and Uruguay (4th) (MERCOSUR Mar 1991)		MERCOSUR-Israel (Dec 2007) MERCOSUR-Peru (Nov 2005)	MERCOSUR-Mexico (Jan 2007) MERCOSUR-Colombia-Ecuador-Venezuela (Apr 2008)
Chile (1st)		Colombia (May 2009) Panama (Mar 2008) European Union (Feb 2003) USA (Jan 2004) EFTA (Dec 2004) China (Oct 2006) Australia (March 2009) Japan (Sept 2007) South Korea (Apr 2004) Peru (Mar 2009) New Zealand, Singapore, Brunei Darussalam (Jul 2005)	Ecuador (Jan 2010) India (Aug 2007)
Colombia (9th)		Chile (May 2009) El Salvador, Guatemala, Honduras (Aug 2007)	MERCOSUR-Colombia-Ecuador-Venezuela (Apr 2008)
Panama (3rd)		Central America (Aug 2007) Singapore (Jul 2006) Chile (Mar 2008) Taiwan (Aug 2004)	Chile (May 2009)
Peru (11th)		MERCOSUR-Peru (Nov 2005) USA (Feb 2009) China (Mar 2010) Singapore (Aug 2009) Canada (Aug 2009) Chile (Mar 2009)	

Notes: This table shows the trade deals signed between 2002-2010 for a cross-section of Latin American countries.

Table 2.6: Latin America: Within- and Across- Country Export Growth

Country	% Exports 2006	% Exports 2010	% Imports 2006	% Imports 2010	% Δ Exports (↑) Growth Rate	% Δ Imports (↑) Growth Rate	% Δ Exports (↓) Growth Rate	% Δ Imports (↓) Growth Rate
ARG	Brazil 17 Chile 9 China 7 USA 9	Brazil 21 Chile 7 China 9 USA 5	Brazil 35 China 9 USA 13	Brazil 32 China 13 Germany 6 USA 11	Brazil 31 (66) Canada 5 (200) China 11 (56) Iran 8 (21199)	Brazil 26 (42) China 21 (130) Germany 8 (95) USA 8 (33)		
CHL	China 9 Italy 5 Japan 11 Holland 7 S. Korea USA 16	Brazil 6 China 24 Japan 11 S. Korea 6 USA 10	Argentina 12 Brazil 11 China 11 USA 16 S. Korea 6	Argentina 8 Brazil 8 China 17 Japan 6	Australia 6 (274) Belgium 12 (111) Brazil 12 (40) China 152 (209) Japan 10 (12) USA 17	China 30 (112) Colombia 7 (283) Germany 6 (73) Japan 10 (117) Mexico 6 (90) USA 19 (52)	France -19 (-57) Germany -12 (-48) Italy -10 (-23) Mexico -7 (-22) Holland -11 (-39) USA -41 (-31) Venezuela -11 (-51)	Angola -8 (-99.9)
COL	Ecuador 5 USA 5 Venezuela 11	USA 43	Brazil 7 China 8 Mexico 9 USA 27 Venezuela 6	Brazil 6 China 13 Mexico 9 USA 26	Brazil 6 (411) China 11 (307) Netherlands 8 (195) USA 47 (61)	Argentina 7 (141) China 24 (231) France 6 (158) Germany 5 (66) Mexico 11 (58) USA 24 (42)	Venezuela -11 (-51)	Venezuela -10 (-81)
PAN	Colombia 16 Costa Rica 5 USA 9 Venezuela 20	Colombia 16 Costa Rica 5 USA 20 Venezuela 16	China 20 Hong Kong 12 USA 19	China 25 Singapore 10 USA 20	Colombia 14 (25) Costa Rica 5 (29) USA 58 (183)	China 37 (86) Mexico 7 (104) Singapore 32 (3203) USA 24 (58)		Hong Kong -12 (-45) N. Ant. -10 (-99.5)
PER	Canada 7 Chile 6 China 10 Switzerland 7 USA 24	Canada 9 China 15 Switzerland 11 USA 17	Brazil 10 Chile 6 China 10 Ecuador 7	Brazil 7 China 17 USA 19	Canada 15 (93) China 28 (114) Germany 6 (75) Switzer 20 (113)	China 25 (204) Japan 6 (128) USA 23 (117)		
URU	Argentina 8 Brazil 15 Russia 6 USA 14	Argentina 9 Brazil 21 China 5 Russia 5	Argentina 23 Brazil 23 China 7 USA 7 Venezuela 12	Argentina 17 Brazil 18 China 18 USA 13 Venezuela 8	Argentina 10 (78) Brazil 32 (128) China 8 (106) Venezuela (195)	Argentina 8 (23) Brazil 12 (36) China 21 (200) Russia 6 (487) USA 15 (147)	USA -15 (-64)	

Notes: This table shows percentages and growth rates for Chilean imports and exports from 2006 to 2010 by trade partners for a cross-section of Latin American countries.

Table 2.7: Chilean GDP: Sectoral Breakdown

Sector	Real Pesos 2003	Real Pesos 2006	Growth Rate 2006	Real Pesos 2008	Real Pesos 2010	Growth Rate 2010
Agriculture	1842431	2323864	5.5	2711891	2603169	-2.49
Fishing	627436	727576	1.1464	405094	346794	-1.33
Mining	4321570	4436556	1.316	13164592	13218971	1.24
Manufacturing	8398990	9896182	**17.14**	10506172	10318155	**-4.3**
Elec., Gas, and Water	1461211	1664077	2.32	2498997	3081725	13.33
Building	3531381	4173721	7.35	6891485	6642910	-5.69
Commerce				7916055	8614056	15.97
Trade, Rest., Hotels	4950883	6161215	13.856	1250229	1315771	1.50
Transport	3540880	4240162	8.0059	4462918	4352219	-2.53
Communications	1170554	1441490	3.10	1856790	2166158	7.08
Financial Services	7650974	9352006	19.47	4868571	5413871	12.48
Business Services				11443187	12252735	18.52
Home Ownership	2977722.946	3258422	3.213	4600617	4801816	4.60
Personal Services	5911638.572	6549766	7.305	9502672	10283205	17.86
Public Admin.	2214717	2427450	2.435	3808922	4171397	8.29
GDP	51156415.26	59890971	100	93847932	98219034	100

Notes: This table examines the sectoral contributions and their growth rates with respect to GDP from 2003 to 2006 and from 2008 to 2010.

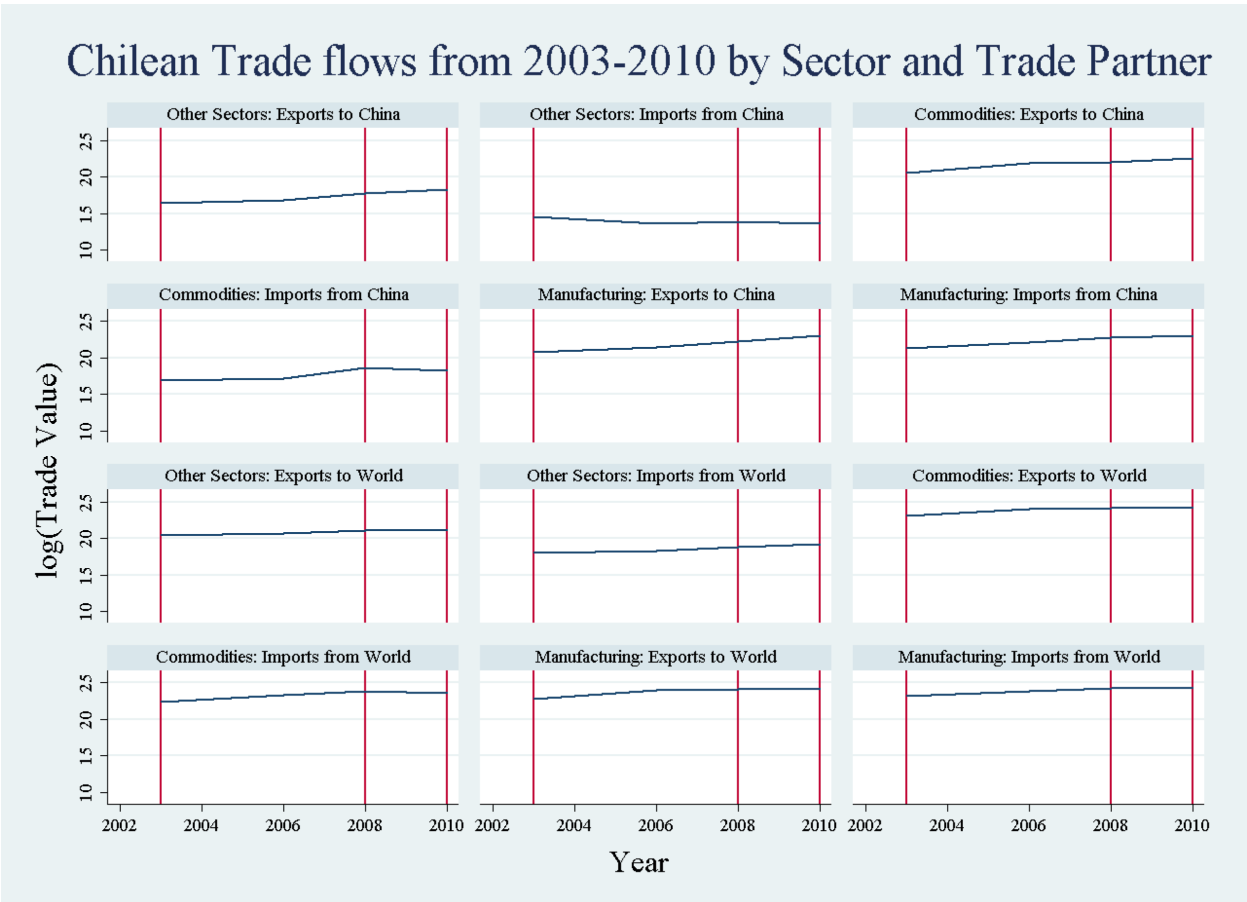

Figure 2.4: Chilean Trade Flows from 2003-2010 by Sector and Trade Partner

Table 2.8: Robustness– Skill Intensity and Tariffs

Dependent Variable:	Δ Skill Intensity					
	(1) Tariffs Only	(2) Full Panel	(3) Quartile 1	(4) Quartile 2	(5) Quartile 3	(6) Quartile 4
Δ Output Tariff	-0.00134	-0.00286	-0.000956	-0.000222	-0.00747*	-0.00156
	(0.00171)	(0.00218)	(0.00426)	(0.00563)	(0.00410)	(0.00386)
Δ Input Tariff	-0.0199***	-0.0351***	-0.0142	-0.0579***	-0.0295**	-0.0414***
	(0.00629)	(0.00693)	(0.0141)	(0.0160)	(0.0136)	(0.0129)
Δ Output Tariff* Export Share		0.00416	-0.00160	0.0000530	0.0159**	-0.000325
		(0.00386)	(0.00601)	(0.00820)	(0.00745)	(0.00964)
Δ Input Tariff* Import Share		0.0859***	0.0756	0.198***	0.0858*	0.0351
		(0.0246)	(0.0503)	(0.0535)	(0.0465)	(0.0472)
Import Share		0.423***	0.347	1.018***	0.347*	0.225
		(0.114)	(0.238)	(0.252)	(0.210)	(0.218)
Export Share		-0.152***	-0.191***	-0.224**	-0.0400	-0.180*
		(0.0452)	(0.0739)	(0.0897)	(0.0845)	(0.108)
r2	0.00774	0.0374	0.0290	0.0661	0.0412	0.0432
N	3528	3287	827	783	814	777
OLS Results:						
Δ Output Tariff	-0.00110	-0.00185	-0.00506*	0.00105	-0.00357	-0.0000261
	(0.00131)	(0.00152)	(0.00277)	(0.00374)	(0.00297)	(0.00294)
Δ Input Tariff	-0.0195***	-0.0345***	-0.00348	-0.0577***	-0.0353***	-0.0407***
	(0.00573)	(0.00624)	(0.0125)	(0.0141)	(0.0122)	(0.0120)
First Stage:						
	(1) Tariffs Only	(2) Full Panel	(3) Quartile 1	(4) Quartile 2	(5) Quartile 3	(6) Quartile 4
MFN Output Tariff$_{2006}$	-.5442	-.5090491	-.48403	-.51366	-.5509	-.4959
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MFN Input Tariff$_{2006}$	-.6414	-.6367	-.6369	-.6328	-.63776	-.6382
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DWH F-stat	1622.73	918.29	186.39	269.65	258.93	189.33
DWH p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AR F-stat	13.74	33.33	3.06	8.03	12.51	9.04
AR χ^2	27.51	66.83	6.17	16.22	25.27	18.27
AR p-value	0.0000	0.0000	0.0457	0.0003	0.0000	0.0001
KP-UnID LM	637.09	616.71	168.46	135.28	152.90	148.25
KP-UnID p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
KP Wald F-stat	619.84	280.14	57.37	63.44	88.32	73.87
SY weak ID CV	7.03	7.03	7.03	7.03	7.03	7.03

Notes: This table examines the relationship between reductions in tariffs and skill intensity=$\frac{NonProduction}{TotalLaborforce}$ These results test Predictions 1 and 2 from the theoretical model. First stage results present the estimated coefficients and p-values (in parentheses). For all other estimates, standard errors are in parentheses.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2.9: Extension– Tariff Changes and Firm Revenue

Dependent Variable:	Δ log(# Total Sales)					
	(1) Tariffs Only	(2) Full Panel	(3) Quartile 1	(4) Quartile 2	(5) Quartile 3	(6) Quartile 4
Δ Output Tariff	0.0229	-0.00675	0.0821	-0.0672	-0.0401	-0.0496
	(0.0263)	(0.0339)	(0.0571)	(0.0754)	(0.0684)	(0.0656)
Δ Input Tariff	0.0212	0.126	-0.0221	0.135	0.113	0.121
	(0.0915)	(0.0973)	(0.177)	(0.219)	(0.185)	(0.170)
Δ Output Tariff* Export Share		0.115**	0.0179	0.203*	0.155*	0.144
		(0.0545)	(0.106)	(0.116)	(0.0900)	(0.105)
Δ Input Tariff* Import Share		-1.056**	-0.588	-0.726	-0.955	-1.251
		(0.413)	(0.624)	(1.036)	(0.825)	(1.000)
Import Share		-3.144*	-0.804	-2.202	-2.536	-3.508
		(1.848)	(2.966)	(4.583)	(3.519)	(4.305)
Export Share		3.239***	2.596*	3.830***	3.434***	3.624***
		(0.647)	(1.396)	(1.360)	(0.999)	(1.158)
R^2	0.00355	0.0367	0.0690	0.0213	0.0319	0.0320
N	3357	3346	838	799	823	796
OLS Results:						
Δ Output Tariff	0.0866***	0.0794***	0.0859**	0.0804*	0.0429	0.0592*
	(0.0184)	(0.0206)	(0.0381)	(0.0433)	(0.0408)	(0.0353)
Δ Input Tariff	-0.124	-0.0293	-0.0274	-0.177	-0.0284	-0.0421
	(0.0827)	(0.0849)	(0.153)	(0.189)	(0.161)	(0.152)
First Stage:						
	(1) Tariffs Only	(2) Full Panel	(3) Quartile 1	(4) Quartile 2	(5) Quartile 3	(6) Quartile 4
MFN Output Tariff_{2006}	-.5494	-.5182	-.5777	-.5368	-.5209	-.4403
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MFN Input Tariff_{2006}	-.6420	-.6358	-.6242	-.6331	-.6465	-.6374
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DWH F-stat	6034.23	3435.22	1111.92	981.66	635.17	608.61
DWH p-value	0.000	0.000	0.000	0.000	0.000	0.000
AR F-stat	22.78	27.97	7.28	10.88	10.01	3.65
AR χ^2	45.58	55.99	14.60	21.83	20.08	7.32
AR p-value	0.000	0.000	0.0007	0.000	0.000	0.0257
KP-UnID LM	2016.29	2179.47	572.61	513.75	557.46	453.23
KP-UnID p-value	0.000	0.000	0.000	0.000	0.000	0.000
KP Wald F-stat	1873.44	973.32	232.13	220.64	255.97	227.20
SY weak ID CV	7.03	7.03	7.03	7.03	7.03	7.03

Notes: This table examines the relationship between reductions in tariffs and total sales. First stage results present the estimated coefficients and p-values (in parentheses). For all other estimates, standard errors are in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2.10: Extension– Tariff Changes and the Wage-Skill Premium

	(1) Tariffs Only	(2) Full Panel	(3) Quartile 1	(4) Quartile 2	(5) Quartile 3	(6) Quartile 4
Δ Output Tariff	-0.0137***	-0.00878*	-0.0161	-0.0197*	-0.00650	-0.00776
	(0.00448)	(0.00473)	(0.0109)	(0.0110)	(0.00805)	(0.00854)
Δ Input Tariff	0.0855***	0.0877***	0.0875*	0.126***	0.0956**	0.0878**
	(0.0189)	(0.0206)	(0.0450)	(0.0463)	(0.0391)	(0.0356)
Δ Input Tariff* Import Share		0.192***	0.561***	0.203*	0.0731	0.121
		(0.0545)	(0.202)	(0.111)	(0.0981)	(0.0803)
Δ Output Tariff* Export Share		0.0548***	0.0489*	0.0400**	0.0583***	0.0518***
		(0.00739)	(0.0257)	(0.0163)	(0.0128)	(0.0123)
Import Share		0.190*	-0.195	0.291	0.161	0.227
		(0.108)	(0.280)	(0.297)	(0.198)	(0.158)
Export Share		0.0923	-0.0149	0.306*	0.158	-0.0160
		(0.0848)	(0.272)	(0.168)	(0.146)	(0.154)
R^2	0.00901	0.0712	0.0723	0.0804	0.0720	0.0849
N	2228	1884	408	425	492	527
OLS Results:						
Δ Output Tariff	-0.0137***	-0.00878*	-0.0161	-0.0197*	-0.00650	-0.00776
	(0.00448)	(0.00473)	(0.0109)	(0.0110)	(0.00805)	(0.00854)
Δ Input Tariff	0.0855***	0.0877***	0.0875*	0.126***	0.0956**	0.0878**
	(0.0189)	(0.0206)	(0.0450)	(0.0463)	(0.0391)	(0.0356)
First Stage:						
	(1) Tariffs Only	(2) Full Panel	(3) Quartile 1	(4) Quartile 2	(5) Quartile 3	(6) Quartile 4
MFN Output Tariff_{2006}	-.5494	-.5182	-.5777	-.5368	-.5209	-.4403
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MFN Input Tariff_{2006}	-.6420	-.6358	-.6242	-.6331	-.6465	-.6374
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DWH F-stat	6034.23	3435.22	1111.92	981.66	635.17	608.61
DWH p-value	0.000	0.000	0.000	0.000	0.000	0.000
AR F-stat	22.78	27.97	7.28	10.88	10.01	3.65
AR χ^2	45.58	55.99	14.60	21.83	20.08	7.32
AR p-value	0.000	0.000	0.0007	0.000	0.000	0.0257
KP-UnID LM	2016.29	2179.47	572.61	513.75	557.46	453.23
KP-UnID p-value	0.000	0.000	0.000	0.000	0.000	0.000
KP Wald F-stat	1873.44	973.32	232.13	220.64	255.97	227.20
SY weak ID CV	7.03	7.03	7.03	7.03	7.03	7.03

Notes: This table examines the relationship between reductions in tariffs and the wage-skill premium. First stage results present the estimated coefficients and p-values (in parentheses). For all other estimates, standard errors are in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

CHAPTER 3

Firm-Level Trade Flows and Preferential Tariff Reductions: A Short-Run Analysis of ACFTA

3.1 Introduction

Prominent trade models predict that the removal of a trade barrier will precipitate an increase in firm participation and trade volumes in international markets.[1] These models assume instantaneous adjustment to the long-run equilibrium, perfect information, and proportional trade liberalization across all partner countries. In practice, countries tend to pursue bilateral tariff reductions via free trade agreements which offer tariff advantages below the MFN rate for a specified range of goods. I show that firms are only responsive to input tariff liberalization in the short-run and increase intra-bloc imports as preferential rates deviate more substantially from MFN tariffs. I also provide support for cost complementarities in destination-specific imports and exports as an influential mechanism for explaining within-firm trade patterns over time.[2]

The past two decades of trade relations have been characterized by a proliferation in regionalism and a stagnation in multilateralism (Baldwin and Jaimovich, 2014; Bhagwati, 2008).[3] This trend has prompted researchers to evaluate the implications of countries' pursuits of bilateral trade liberalization obtaining mixed findings.[4] Previous studies have focused on long-run effects of

[1]Trade economists have impugned the ability of neoclassical (standard Ricardian and Heckscher-Ohlin) models to explain observed trade patterns. These models depend on differences in opportunity costs to motivate trade– heterogeneity in productivity at the international level with respect to Ricardian models and differences in factor endowments with respect to Heckscher-Ohlin (HO) models. These early models yield strong, testable trade predictions; namely that "different" countries (North-South) trade more and will trade very different goods and/or goods with very different factor contents. Observed data belie these expectations as the majority of trade occurs between similar countries that trade in similar goods which can be predicted by the Melitz-esque monopolistically competitive industry models which are ubiquitous in firm-level literature today.

[2]Previous studies have shown that improved access to intermediates can increase aggregate exports via quality upgrading (Fan, Li, and Yeaple, 2014) and productivity increases (Halpern et al., 2015). However, to date, Chapter 1 of this dissertation is the only study to model and provide evidence of these cost complementarities using firm-product-country level data on Chinese manufacturing firms.

[3]The spread of regionalism is evidenced by the accretion in economic integration agreements. This approach to trade liberalization includes preferential trade agreements, free trade agreements, the formation of common markets, economic unions, and customs unions (Baier, Bergstrand, and Feng, 2014).

[4]Trade liberalization has been widely embraced by all developed countries and most of the developing world.

bilateral agreements on country-level trade flows; largely ignoring the role of firm-level responses.[5]

There is also a vast literature which attempts to explain firm behavior across export markets and within the context of global supply chains; linking a firm's export activity to productivity increases, skill acquisition, and its import intensities. These studies tend to focus on cross-sectional analyses and to analyze unilateral episodes of trade liberalization (e.g. Colombia 1991, Chinas accession to the WTO in 2001). Moreover, they largely abstract away from bilateral reductions in trade barriers, such as those associated with contemporary free trade agreements.

To fill this lacuna, I use firm-product-country data on bilateral trade flows for Chinese firms (2002-2006) to analyze the effect of the ASEAN-China Free Trade Agreement (ACFTA) in goods on intra-bloc and extra-bloc trade flows. I present four descriptive statistics which suggest that destination-year characteristics play a significant role in explaining the evolution of firm activity in international markets. Next, I use panel data techniques to relate preferential trade policy measures to firm-level flows. The nature of the ACFTA implementation allows me to examine the impacts of tariff reductions on trade patterns in isolation since behind-the-border, service, and investment liberalization did not occur concurrently. The results suggest that Chinese firms were unresponsive to preferential output tariff reductions in the short-run. Firm imports were relatively more responsive to preferential rates on import tariffs. The most robust finding provides evidence of cost complementarities in international markets. One possible explanation for these results is that tariff reductions must be coupled with liberalizing domestic policies– covering issues such as competition and antitrust rules, corporate governance, product standards, supervision of financial institutions, tax codes– to influence intra-bloc trade flows. That is, as tariff rates approach zero globally, liberalization of non-tariff barriers becomes relatively more important. Another explanation is adjustment costs. There may be informational constraints and/or predetermined choices

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Of the 195 countries worldwide, 160 are WTO members. The WTO provides an upper bound on tariff rates for membership countries via most favored nations (MFN) tariffs. Deviations from this rate are only permissible if two nations or a coalition of nations assent to a trade agreement, form a trading bloc, or establish a customs union.

[5] Frankel (1997) found positive and significant effects from MERCOSUR, insignificant effects from the Andean Pact, and significant negative effects from membership in the European Community (EC) in certain years. Analyzing the EC, some studies find positive and significant impacts on partner trade flows (Aitken, 1973; Abrams, 1980) while others find insignificant effects (Bergstrand, 1985; Frankel, Stein, and Wei, 1995).

along supply chains which inhibit the firm's ability to transition quickly to markets which offer preferential rates.

The contributions of this paper are four-fold. First, I explore the firm's short-run intensive margin adjustments to the ACFTA in goods. To date, the literature has focused on aggregate international flows and, on medium-to-long run effects of FTAs. Second, I construct a continuous measure of trade reform taking the difference between preferential rates at the product-level and MFN tariffs. The conventional approach to measuring the impact of an FTA is to use a "comprehensive" dummy variable for a country's intra-bloc membership. However, as is the case with the ACFTA in goods, countries may enforce asymmetric preferential tariff reductions and proffer their preferential rates at staggered time periods. The standard approach might introduce measurement error since the degree of trade liberalization for various FTA-country members will vary continuously across goods and the effective preferential tariff rate will vary across countries. Third, I examine the role of cost complementarities in shaping trade patterns by including export- and import-based measures simultaneously in the main empirical specification. Fourth, I examine an episode of tariff reductions in isolation. The ASEAN-China agreements regarding liberalization of trade in services and investment reform were not enforced until 2007 and 2009, respectively. This allows me to analyze the firm-level response in international markets purportedly attributable to changes in preferential tariff rates alone.

In this study, I combine insights from the FTA literature with insights from heterogeneous firm studies. A common approach to quantify the effects of an FTA is to estimate gravity models; relating a country's aggregate trade flows to the enforcement of an economic integration agreement.[6] For my intents and purposes, the FTA literature provides three major insights: 1. corroboration for the empirical relevance of the gravity model in a dynamic setting; 2. evidence that FTA policies are endogenous; and 3. a method for econometrically addressing the endogeneity of FTAs. The first insight is unsurprising but adds credence to the inclusion of gravity-related variables in any empirical specification. The second insight has been shown from multiple vantage points.

[6]The gravity equation has been the workhorse model for cross-country empirical studies for over 50 years. (Baier and Bergstrand, 2007; Magee, 2008; Anderson and van Wincoop, 2003; McCallum, 2005)

Some studies argue that countries are induced to form trade agreements based on initial economic structure (Burfisher et al., 2001), inert or "slow multilateralism" (Krugman, 1991, 1993; Bhagwati, 2008; Missios at al., 2016), idiosyncratic events– such as the dissolution of the USSR (Lester and Mercurio, 2009) and the Asian crisis in 1997 (Harvie et al., 2006)– the quest for geopolitical stability (Mansfield and Pevehouse, 2000; Vicard, 2008), and FTA contagion/ interdependence (Baldwin, 1993; Baldwin and Jaimovich, 2012; Solis et al., 2009).[7] The third insight relates to the use of panel data methods to obtain unbiased parameter estimates.[8,9] Plausible estimates for the average effect of preferential rates on a bilateral flow can be obtained using mean-differenced panel data with country-and-time effects (Baier and Bergstand, 2007; Baier et al., 2014; Yang and Martinez-Zarzoso, 2012).[10,11]

The heterogeneous firm literature provides three main insights. First, a firm's import intensity is intimately linked to its export success. Second, firms respond differently to improved access to foreign markets in accordance with their unobserved productivity level. Third, a firm's fraction of imported intermediates from a particular country is positively associated with the fraction of export revenue it earns in said country. The first insight suggests that partner characteristics and geographical features– sufficient in the context of national trade flows– do not adequately capture the range of explanatory factors to characterize responses at the firm-level. The second insight suggests that country-level flows may mask the industry-specific and/or firm-specific het-

[7] Freund and Ornelas (2010) provide a comprehensive survey of the literature on endogenous FTA formation and its main determinants.

[8] The effects of FTAs are primarily measured by dummy variables. Moreover, countries select into FTAs endogenously, perhaps for reasons that are unobservable to the econometrician and simultaneously correlated with trade flows.

[9] Previous studies have attempted to use instrumental variables (IVs) to adjust for endogeneity (Trefler, 1993; Magee, 2003). However, a major limitation of this approach is that instruments in the FTA probit equation used to identify the trade flow equation– such as political regime, GDP similarities, and relative-factor endowments– are likely correlated with the error term.

[10] Alternatively, one might employ panel techniques which utilize a first-differenced model. The preferred model is contingent upon the assumptions made with regards to the error term over time. The fixed effects estimator is more efficient under the assumption of serially uncorrelated error terms while the first-differenced estimator is more efficient under the assumption that the error term follows a random walk (Baier and Bergstrand, 2007). Both estimators are identical for the case of $T = 2$ (Wooldridge, 2002).

[11] Baier and Bergstrand (2007) demonstrate the bias in estimated coefficients of the cross-section gravity equation. They find that estimated FTA dummy coefficients are highly unstable for five sets of estimated for aggregate international trade flows.

erogeneity in effects due to an FTA. For example, aggregate export values between China and Brunei might increase significantly due to the FTA, however, the manufacturing industry in Brunei may have experienced a dramatic decline in intra-bloc exports due to increased competition. The third insight is based on the premise that there are significant costs associated with accessing various destinations. If there are cost complementarities in accessing a particular market, then there should exist a positive relationship between import sources and export destinations.[12] The effect of the FTA agreement may be amplified or muted depending on the strength of this linkage pre-FTA enforcement.

This study contributes to multiple branches of the trade literature. I further the research on gravity models and the impact of FTAs on trade creation and diversion. The gravity model predicts that trade flows between a pair of countries will be positively correlated in the size of their economies and negatively correlated in the distance between the two.[13] The findings on the effects of FTAs on national trade flows were inconclusive for a protracted spell in the trade literature. Ghosh and Yamarik (2004) note that estimates of FTA impacts were"fragile" and highly dependent on their cross-sectional specification. Baier and Bergstrand (2007) argue that the ambiguity in estimated effects of FTAs is attributable to the endogeneity of FTAs. They propose using panel data techniques to address this issue and provide evidence that unaddressed endogeneity in these studies biases estimates downward. These studies all rely on dummy variables to measure regional trade reform. Since countries propose different reduction schedules for a given range of goods, this method introduces measurement error into the analysis. I correct for this issue by using a continuous measure of trade reform.

I also contribute to the literature on heterogeneous firms, improved access to intermediates, and export performance. Previous studies show that improved access to intermediates is

[12]Eaton, Kortum, and Kramarz (2010) use data on French manufacturing firms and find that 16% of firms export to at least one destination, with participation percentages monotonically decreasing as number of destinations increase; suggesting that few firms export if they export at all. Bernard et al. (2003), using data on US firms, show the exporters sell most of their output domestically, their domestic sales are almost five times larger, and labor productivity is 33% higher in exporting firms relative to non-exporters. Antras et al. (2017) note that countries will source inputs from a wider range of countries and also sell their products in a greater number of markets.

[13]Distance typically refers to bilateral distance between main cities. Distance is also used as a proxy for transportation costs.

linked to intra-firm and intra-sectoral improvements in total factor productivity (Amiti and Konings, 2007; Gopinath and Neiman, 2011; Halpern, Koren, Szeidl, 2015, Kasahara and Rodrigue, 2008), demand for skill workers and inequality (Amiti and Cameron, 2012; Kasahara, Liang, and Rodrigue, 2016; Goldberg and Pavcnik, 2007), expanded product scope (Goldberg et al., 2010; Bernard, Redding, Schott, 2011), quality upgrading (Amiti and Khandelwal, 2013, Manova and Zhang, 2012; Kugler and Verhoogen, 2012; Bas and Strauss-Kahn, 2014), quality sorting (Crozet, Head, and Mayer, 2011; Auer, Chaney, Saure, 2017; Khandelwal, 2010), and endogenous skill acquisition and technology upgrading (Bustos, 2011; Verhoogen, 2008; Kasahara, Liang, and Rodrigue, 2016).

Much of the heterogeneous firm literature abstracts away from instances of regional or bilateral trade liberalization.[14] I fill this void by investigating the impacts of preferential tariff reductions enforced by the ASEAN-China Free Trade Agreement in Goods (2004). Moreover, as noted in Chapter 1 of this dissertation, the heterogenous firm literature has established a robust, positive relationship between a firm's aggregate import behavior and the firm's aggregate performance in export markets. However, previous models have ignored the potential role of import sourcing and cost complementarities in explaining trade flows. In Chapter 1, I extend a standard trade model of endogenous quality to include cost complementarities in international markets and shows that this addition helps describe firm behavior. I incorporate features from this model to guide my analysis.

This study can also be grouped within the taxonomy of trade policy and uncertainty. China's accession to the WTO in late 2001 reduced tariffs to uniformly low levels; with most MFN tariff reductions fully phased in by 2006. The difference between the average preferential tariff rate for intra-bloc ACFTA members and the prevailing MFN rates for WTO members

[14]Many heterogeneous firm studies have explored firm dynamics over time (Aw, Roberts, and Yu, 2011; Atkeson and Burstein, 2010; Constantini and Melitz, 2008), the penchant for examining unilateral episodes of liberalization is understandable. These instances of trade reform involve large variations in tariff rates that are plausibly exogenous which strengthens the case for causal interpretations. However, these type of liberalization episodes are unique in the modern landscape of trade reform since they involve a major reorientation of the nation's economy from protectionist to market-driven. Relative to the formation of free trade agreements and trade blocs, unilateral and multilateral tariff reductions are anomalous.

was small across all goods; particularly in 2005 and 2006. One can potentially frame the short-run preferential reductions as a signal or as aspirational policy to forge, consolidate, and codify intra-regional ties. This is in keeping with Handley and Lim̃ao (2017) which argues that China's accession to the WTO reduced the threat of a US trade war, accounting for one-third of the export growth from 2000-2005. Feng, Li, and Swenson (2016) present a qualitatively similar finding using firm-product data on exports to the US and the EU.

Finally, this paper is related to the nascent literature on extended gravity. Morales, Sheu, and Zahler (2017) develop an elegant dynamic model in which firm exports are dependent on the market similarities of previous export partners. They structurally estimate their model using a moment inequality approach and find that similarities with a previous export destination reduces the cost of foreign market entry significantly. However, this approach is one-sided as it only considers exporter dynamics. Moreover, product quality differentiation is approximated insofar as income-per-capita measures are included but product-level characteristics, such as quality is excluded from the analysis. Nevertheless, this paper makes a tangible contribution to the dearth of studies which provide theoretical and empirical evidence of complementarities in market entry costs over time.

The remainder of the study is organized as follows. Section 2 provides background information on the ASEAN-China free trade agreement (FTA). Section 3 discusses the dataset and presents an overview of established trends. Section 4 introduces the stylized facts which relate the growth of firm participation and trade values in international markets to the introduction of the ACFTA. Section 5 discusses the empirical methodology, main specifications, and endogeneity concerns. Sections 6 presents the main findings and a discussion of the procured results. In Section 7, I conduct robustness exercises, and with Section 8, I conclude.

3.2 ASEAN-China Free Trade Agreement

In this section, I discuss historical context, global conditions and trends, and the stages of implementation of the ASEAN-China Free Trade Agreement (ACFTA). Next, I discuss the key features of the FTA formation that I exploit in this study.

3.2.1 Background

Indonesia, Malaysia, the Philippines, Singapore, and Thailand signed the "Bangkok Declaration" in August 1967 which became the founding document of Association of Southeast Asian Nations (ASEAN).[15] The ASEAN Free Trade Area entered into force in January 1992, and provided a common external preferential tariff schedule to facilitate the flow of goods within ASEAN. By 1999, ASEAN had expanded to include ten country members and made significant strides towards economic integration (Yang and Martinez-Zarzoso, 2014).[16] After the Asian financial crisis in 1997, ASEAN plus three (China, Japan, and South Korea) had a renewed impetus to diffuse risks associated with macroeconomic shocks across the region and to extend its influence in the global arena via increased economic integration.

China's rapid ascent to prominence in international goods markets coincided with the nation's increased interest and influence in regional economic integration. Before 1990, China limited bilateral relations with individual ASEAN members. In the mid-1990s, trade between China and ASEAN grew significantly. In November 2002, China and ASEAN signed the Framework Agreement in China-ASEAN Comprehensive Economic Cooperation. The stated goals of these negotiations were not only to eliminate tariffs, but also to address "behind-the-border" impediments to the flow of goods and services, to loosen restrictions which stymied intra-regional investment and capital flows, and to assuage concerns of state-led initiatives that undermine investors and producers.

The Early Harvest Program (EHP) launched in 2004 and focused on reducing tariffs among members on agricultural goods, such as live animals, meat, fish, dairy-based products, fruits and vegetables. The agreement on trade in goods was signed in November 2004, and entered

[15] This coalition was formed, in part, as opposition to: the communist expansion in Vietnam, Laos, and Cambodia, the rise of communist factions within ASEAN member countries, the war in Vietnam, and the subsequent fall of South Vietnam.

[16] Brunei joined in 1984, Vietnam in 1995, Laos and Myanmar in 1997, and finally, Cambodia in 1999.

into force in July 2005.[17] The agreement on trade in services was signed and implemented in January 2007.[18] In August 2009, ASEAN and China signed the agreement on investment which stipulates protective measures to ensure fair and equitable treatment of investors, discourage discriminatory treatment by nationalized or state-owned enterprises, and prevent expropriation of private enterprises. China and ASEAN viewed these agreements and the period between 2002 to 2009 as transitory before the completion of the ASEAN-China Free Trade Area.[19]

3.2.2 Discussion

The implementation and timing of these agreements introduce variation in three important ways. First, the ACFTA in goods was enforced two and four years before the agreements on services and investment, respectively. This provides fertile ground to analyze firm-level responses to intra-bloc tariff reductions in isolation. If preferential tariff reductions are orthogonal to changes in non-tariff barriers and impediments to investment, I capture the uncontaminated firm response to the tariff reductions. That is, the only source of trade reform from the ACFTA in 2005 and 2006 is the preferential reductions in ad valorem tariffs. Because these preferential rates were not accompanied with investment or domestic policy liberalization, I can accurately measure trade liberalization entirely using tariff reductions.

Secondly, within the trade bloc, countries adopt tariff reductions heterogeneously. Brunei, Indonesia, Malaysia, Myanmar, the Philippines, Singapore, and Thailand received reductions for a country-specific range of goods on exports to China (Chinese imports) in 2005 and 2006. On the other hand, Brunei, Cambodia, Laos, Myanmar, and Thailand implemented tariff reductions on Chinese exports in 2005 and 2006. This introduces the possibility of asymmetric impacts from the

[17] This agreement has been revised twice in 2006 and 2010.

[18] This agreement targeted discriminatory measures and practices with respect to trade in services perpetrated against member countries.

[19] Members explore and undertake economic cooperation in: trade-related issues; agriculture, fishery, forestry and forestry products; information and communications technology; human resource development; investment; trade in services; tourism; industrial cooperation; transport; intellectual property rights; small and medium enterprises; environment; and other fields related to economic and technical cooperation as may be mutually agreed upon by the members.

preferential tariff reduction, conditional on membership status, product category and the bilateral flow considered.

Lastly, the Agreement on Trade in Goods (2004) characterized products as either "Normal Track" or "Sensitive Track".[20] From a political economy perspective, countries might protect certain industries from facing tariffs substantially below the MFN level. This suggests endogeneity of this regional agreement and the mismeasurement associated with using dummy variables to capture trade policy. With respect to estimation, I am able to construct a continuous variable for trade reform using the wedge between preferential rates and MFN rates for bilateral product flows.

In the empirical analysis presented in Section 6, I address these issues and propose a baseline specification which relates actual preferential deviations from the prevailing MFN rate to a firm's product flows with various trade partners.

3.3 The Data

I use finely detailed data on firm-product trade, trade partner characteristics, and tariffs. I draw from five sources to compile the main dataset: 1) CEPII for distance data and other non-economic factors supported by the gravity literature; 2) World Development Indicators (WDI) compiled by the World Bank for socioeconomic profiles at the national level; 3) Chinese customs data for information on firms' participation in trade, producer prices, trade volumes, trade partners, and frequencies ; 4) World Trade Organization (WTO) data on product-level tariffs; and 5) The China FTA Network for the tariff schedules on imports and exports enforced by the ACFTA in goods trade.[21]

The construction of the dataset follows most of the steps detailed in Chapter 1. For expositional convenience, I provide a shallow discussion of the dataset's main features but refer readers

[20]For the Normal Track, all tariff lines in this category have been eliminated by ASEAN-6 (Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore and Thailand) and China as of 1 January 2012. For Cambodia, Lao PDR, Myanmar and Viet Nam, tariff elimination will have to be completed by 1 January 2015, with some flexibility afforded to eliminate tariffs on products not exceeding 250 tariff lines by 1 January 2018.

[21]CEPIII and WDI are relatively common sources as they are publicly available online and these data are relatively facile to combine.

to the appendix of Chapter 1 for more technical details. I obtain information on firm-level bilateral trade flows that were collected and made accessible by the Chinese Customs Office. The data chronicles the activities for the universe Chinese firms participating in trade from 2002-2006. They report the f.o.b. value and quantities of firm exports (imports) in U.S. dollars across 234 destination (source) countries and 6168 products in the Chinese eight-digit Harmonized System (HS 8).[22]

The customs data is vital for observing export and import patterns, measuring trade values, and demarcating intra-bloc members in import and export markets. The recorded values are highly disaggregated. I focus solely on general trade in my analysis; excluding processing firms since they were exempt from tariffs pre-liberalization.[23] Export and Import values are converted into real terms using deflators provided in Brandt et al. (2012). Chinese extra-bloc import and export tariffs are measured as the MFN (most-favored nation) applied tariff at the HS 6-digit level from 2002-2006 (Fan, Li, and Yeaple, 2014; Feng, Li, Swenson, 2016). Both the customs and tariff data are aggregated to the HS 6-digit level.

After matching the customs data with MFN tariff rates, socioeconomic measures, and geographical variables, I merge the dataset with the tariff reduction schedules for Chinese exports to and imports from intra-bloc countries applicable to 2005 and 2006. FTA members are assigned MFN tariff rates from January 2002 to June 2005.[24] Note, tariff schedules vary by country and by good and are subject to phase-ins over one-, five-, and ten-year horizons. As a result, MFN tariff rates persist for a significant portion of product categories.

[22]The first 6 digits of Harmonized System codes are consistent internationally. The number of distinct codes in the Chinese eight-digit HS classification is comparable to that in the 10-digit HS trade data for the United States (Manova and Zhang, 2012).

[23]China has a dual regime in which non-processing firms pay tariffs and processing firms are exempt from tariffs. Processing firms necessarily convert imported inputs into exports and are prohibited from selling in domestic markets. Conversely, firms engaged in ordinary trade must decide whether to import at all or to strictly use domestic intermediates. Therefore, processing and ordinary trade producers face disparate sourcing choices (Koopman, Wang, Wei, 2012; Feng, Li, Swenson, 2016).

[24]An auxiliary analysis applies preferential tariff rates from January 2005 for FTA-members. This yields identical results to those obtained from the July 2005 enforcement date.

3.3.1 Overview of Established Trends

This study uses the same customs data as Chapter 1. I refer readers to that discussion for a more detailed analysis of the panel. I present an abridged version of those findings in this section.

The total number of firms exporting and/or importing goods more than doubles from 2002-2006. The rise in trade participation is chiefly fueled by firms which export only (EO) as opposed to firms that engage in both importing and exporting activities. On average, importing firms are far more successful in export markets than their non-importing counterparts, suggesting a positive relationship between imported inputs and export outcomes.

Generally, the relationship between number of firms and number of export destinations is negative; suggesting that there may be substantial heterogeneity in country-level fixed costs of exporting across countries.[25]Going beyond the broad non-importer vs importer analysis, there is substantial variation in relative size in export markets across firms. I find a weakly monotonic relationship between export revenue and number of import sources.

Lastly, firms that source a greater portion of intermediates from a particular destination tend to earn a greater portion of their export revenue from said destination. This suggests that import sources should not be treated homogeneously since the origins of intermediate goods may have some explanatory salience in explaining export flows. Moreover, when I ignore a particular country's contribution to the share of imports sources from a particular region, the portion of the firm's export revenue earned from that destination tend to fall. This suggests that quality upgrading in isolation is insufficient for explaining a firm's international trade flows. However, it is compatible with a mechanism that permits destination-specific cost complementarities to importing and exporting. I expound on this discussion after presenting some descriptive statistics.

[25]The pattern holds for number of products exported and markets exported to. Most firms export multiple products. Less than 20% of firms export 10 or more products. However, firms exporting 10 or more products earned, more than 65% of all export revenue in the sample.

3.4 Descriptive Statistics

This section presents four descriptive statistics on firm participation and intensive margin changes after the implementation of the ACFTA on goods in 2005. The findings are based on customs data for Chinese firms from 2002-2006. Note, China's accession to the WTO in 2002 introduced significant reductions in tariffs for most products in China. As a result, the wedge between FTA tariffs and MFN tariffs was quite small. The maximum preferential tariff differential on Chinese imports (exports) was 45% (50%).[26] However, across all good, the average difference between FTA vs non-FTA rates is 0.04% for Chinese imports and 0.03% for Chinese exports.

Table 3.1 shows the relationship between firm participation in import markets (Panel A) and export markets (Panel B) with intra-bloc and extra-bloc partners over time. Observations are grouped at the firm-country and firm-product-country levels in the analysis. Before highlighting the dichotomous FTA results, I present some general observations that appear robust across destinations. Table 3.1 shows that the number of participants in import and export markets across all countries has increased rapidly over the five-year horizon. The rate of growth in substantially larger in export markets than the rate of growth in import markets. This is congruent with Section 3.3.1 which only focused on export patterns and noted that EO firms are the most culpable group for the explosion in export market participation.

The table also adds credence to the cost complementarities argument. Columns (2) and (6) show a country's ranking by trade participants for a given level of aggregation. Comparing rankings for import sources and export destinations, I find a close association across countries. There is, ostensibly, some assortative matching between import sources and export partners. Japan was the main import source and second most prominent export destination by Chinese firm participants at the firm-country level. A similar pattern holds for all nontrivial trade partners, regardless of their status with respect to the FTA or WTO membership.[27]

[26]The maximum output tariff reduction on Chinese exports is 50% from Myanmar and Cambodia, and the maximum input tariff faced by Chinese importers is 45% with Thailand.

[27]The assortative matching relationship deteriorates among countries that provide relatively few imported intermediates and purchase relatively few goods from Chinese manufacturers.

Table 3.1: Firm Participation in International Markets 2002-2006

Panel A	# Firm-Country Imports				# Firm-Product-Country Imports			
Country	Rank	2002	2006	Growth Rate	Rank	2002	2006	Growth Rate
Japan	1	16,883	27,984	65.75%	1	147,276	225,172	52.89
USA	2	13,622	24,763	81.79%	2	101,985	152,634	49.66
Taiwan	3	12,484	19,279	54.42%	4	86,761	105,864	22.02
Germany	4	10,647	18,840	76.95%	3	83,301	129,827	55.85
South Korea	5	10,825	17,184	58.74%	5	62,853	79.806	26.97
Hong Kong	6	6,449	12,210	47.18%	7	27,556	51,159	85.65
Italy	7	6,014	10,315	71.52%	6	33,926	52,686	55.30
UK	8	5,512	8,710	58.02%	9	22,781	31,105	36.54
France	9	4,871	7,685	57.77%	8	23,329	33,443	43.35
Australia	13	3,261	4,986	52.90%	16	8,784	12,213	39.04
Non-ASEAN Total		128,569	219,107	70.42%		699,975	1,047,053	49.58 (151%)
Singapore	10	4,696	6,849	45.85%	10	17,727	23,419	32.11
Malaysia	11	3,709	5,934	59.99%	12	10,075	15,380	52.66
Thailand	12	3,098	5,409	74.60%	17	7,805	12,250	56.95
Indonesia	20	2,474	3,549	43.45%		5,240	7,189	37.19
Philippines		1,152	2,095	81.86%		2,195	4,300	95.90
Myanmar		125	153	22%		183	208	13.66
Brunei		6	9	50%		6	10	66.67
FTA^m Preferential		15,260	23,998	57.26%		43,231	62,756	45.16 (82%)
Non-Preferential ASEAN		570	1,450	154.39%		1,015	3,198	215.07 (78%)
Panel B	# Firm-Country Exports				# Firm-Product-Country Exports			
Country	Rank	2002	2006	Growth Rate	Rank	2002	2006	Growth Rate
USA	1	23,728	62,553	163.63	2	146,694	339,968	131.75
Japan	2	24,023	46,350	92.94	3	141,973	234,880	65.44
Hong Kong	3	20,962	43,584	107.92	1	199,975	569,727	184.90
South Korea	4	17,108	39,640	131.70	4	69,796	143,629	105.78
Germany	5	13,008	36,049	177.13	5	54,867	143,994	162.44
UK	6	11,678	31,348	168.44	7	49,291	115,841	135.01
Australia	7	11,485	28,985	152.37	6	55,698	117,274	110.55
Canada	8	10,681	28,773	169.38	8	42,927	105,960	146.84
Taiwan	9	12,044	25,087	108.29	14	37,523	69,149	84.28
Italy	10	10,210	28,646	180.57	9	40,289	106,175	163.53
Singapore	11	11,230	24,232	115.78	10	46,755	88,743	89.80
Netherlands	12	9,137	23,801	160.49	15	32,659	75,538	131.29
Spain	13	8,319	24,975	200.22	12	31,423	92,433	194.16
Non-ASEAN Total		388,080	1,024,858	164.08%		1,596,356	4,045,259	153.41 (105%)
Brunei		478	1176	146.03		1,477	4,204	184.63
Cambodia		1039	2273	118.77		3,952	7,012	77.43
Laos		104	202	94.23		366	577	57.65
Malaysia	14	9600	22714	136.60	11	40,181	92,520	130.26
Myanmar		1096	1926	75.73		3,770	5,757	52.71
Thailand	17	7784	20310	160.92	18	24,004	63,949	166.41
FTA^x Preferential		20,101	48,601	141.78%		73,750	174,019	135.96 (107%)
Non-Preferential ASEAN		29,785	70146	135.51%		115,321	251,322	117.93 (104%)

Notes: This table examines the firm- and firm-product frequencies of Chinese firms in import (Panel A) and export (Panel B) markets. Frequencies are presented by destination. The table also shows growth rates in participation from 2002-2006. I also provide participation totals and growth rates for non-ASEAN countries, ASEAN members that enforced preferential rates in the sample horizon, and ASEAN members that did not. Growth rates for bilateral flow values over time are in parentheses.

While Panel A showcases substantial increases in trade participation across all countries, the operative findings pertain to non-ASEAN countries, ASEAN members which implement preferential tariffs, and ASEAN countries which maintain MFN tariff rates in 2005 and 2006. After the implementation of the FTA, I find that the number of firms importing from non-ASEAN sources grew at a faster rate (70.42%) than those importing from preferential FTA sources (57.26%). Preferential FTA refers to ASEAN member countries that experienced a reduction in tariff rates for their exports to China in 2005 and 2006. Disaggregating the data to explore import participation at the firm-product-country level, I again find that participation in import markets grew faster for non-ASEAN sources (49.58%) than among preferential FTA-member sources (45.16%). These observations belie the orthodox view that FTAs should increase intra-bloc trade at a disproportionately fast rate.

Panel B presents a qualitatively similar observation for export markets. Post-enforcement of the FTA, I find that the number of firms exporting to non-ASEAN sources grew at a faster rate (164.08%) than those exporting to preferential FTA-member countries (141.78%). The trend holds when disaggregating the data at the firm-product-country level where I find that participation in product-export markets in non-FTA destinations (151.02%) grew faster than participation in product-export markets of member countries (135.96%).

I conduct a similar analysis relating real changes in import and export values associated with extra-bloc and preferential FTA members from 2002-2006. These growth rates are shown in brackets beside the participation growth rates in the firm-product-country level analysis. I find that the real value of imports grew at a faster rate for non-ASEAN countries (151%) than for preferential FTA members (82%). The real value of exports grew faster for FTA-member countries (107%) than for non-ASEAN countries (105%), however, the magnitudes of the differences in these real dollar growth rates are almost negligible. These observations and generate the following descriptive statistics.

Descriptive Statistic 3.4.1. *The number of Chinese firms participating in import and export markets grew at a faster rate in non-FTA countries that for FTA-members from 2002-2006.*

Descriptive Statistic 3.4.2. *The real value across non-FTA countries grew faster in imports and at a similar rate for exports relative to preferential FTA-members from 2002-2006.*

I also derive the growth rates in firm participation and trade values for member countries of ASEAN that did not experience a reduction in import tariffs from China and did not enforce preferential tariff rates on Chinese exports in 2005 and 2006, respectively. Interestingly, import participation grew significantly faster at the firm-country (154.39%) and firm-product-country (215.07%) levels relative to extra-bloc and intra-bloc members with preferential rates. However, export participation growth rates at the firm-country (135.51%) and firm-product-country (117.93%) levels were significantly lower than preferential FTA members and non-ASEAN partners. Moreover, trade values for imports and exports grew at a relatively slower rate for ASEAN countries without preferential tariff rates. These observations yield the remaining descriptive statistics.

Descriptive Statistic 3.4.3. *The number of Chinese firms participating in import markets grew fastest among ASEAN member countries that did not experience preferential tariff reductions from 2002-2006.*

Descriptive Statistic 3.4.4. *The growth in import (export) values grew the least among ASEAN member countries that did not experience tariff reductions from China (enforce preferential rates on Chinese exports) from 2002-2006*

These observations intimate that partner characteristics and market size may play a large role in determining trade patterns. For example, the EU and US span relatively higher income countries and larger populations. If these regions demand higher quality goods, sell higher quality intermediates, feature larger markets, and are associated with higher prices, one might expect these growth rates in participation and trade values to be disproportionately higher than those of the relatively poorer and smaller composition of ASEAN countries. It is also important to note that China's accession to the WTO occurs in late 2002. Chang and Lee (2011) examines WTO membership effects on bilateral flows, finding large and robust trade-promoting effects. The absolute magnitude of tariff reductions from WTO membership across all countries dwarfs the reductions from the ACFTA in goods substantially and may in part explain the descriptive statistics. In 2005 and 2006, preferential rates were lower than MFN rates by 0.04 percentage points across all goods, on average. The average MFN tariffs in China fell from 15.88% in 2001 to 9.95% in 2006. China's MFN rates have fallen at a significantly slower rate in subsequent years. By 2010, the average MFN tariff was 9.85%.

Table 3.1 also suggests that there may be differential impacts from a trade agreement with respect to trade flows and time of implementation. The growth rates for preferential FTA members vs non-ASEAN members on international market participation and trade values speak to the impropriety of a comprehensive FTA dummy variable in capturing the effect of an FTA.

The descriptive statistics also appear to be counterintuitive vis-à-vis theoretical foundations and most empirical results. The standard Melitz (2003) model allows for one dimension of firm-heterogeneity: productivity. In this framework, the most productive– and largest, by construction– profit maximizing firm would import from and export to preferential FTA members at a disproportionately faster rate in response to the improved access to intermediates and foreign markets, respectively. Some of the more recent heterogeneous firm models which allow for multiple dimensions of heterogeneity and endogenous quality determination (Fieler, Eslava, and Xu, 2018; Auer, Chaney, Sauré, 2017) would also make a similar prediction as source/destination countries only provide access to intermediates and demand for potentially differentiated products. Note, these models make predictions with respect to long-run equilibrium outcomes. These models do not permit bilateral linkages stemming from previous international access to partner countries as a culpable factor of trade flows. The proceeding sections add rigor to the cursory analysis used to derive these descriptive statistics and advocates for an alternative explanation that extends the prevailing arguments in the literature to include cost complementarities.

Remark: The descriptive statistics are also compatible with the mechanism presented in the extended gravity literature. If one expands the purview of extended gravity to include import patterns, then a model which generates reduced entry costs to new markets based on the characteristics of previous export and import partners can also predict these stylized facts. However, extended gravity models are more applicable to extensive margin differences across firms. Cost complementarity models generate the additional prediction that firms should have a positive correlation between where they import intermediates from and where they export products to.

3.5 Empirical Methodology

In this section, I detail the baseline specification, measurement of key variables, potential sources of endogeneity, and remedies to said endogeneity issues. The primary analysis is conducted using yearly trade flows where observations are aggregated to the firm-product-country level.

3.5.1 Baseline: Estimating Equation for FTA and Flow Complementarity

The main specifications combine features from an augmented gravity model and heterogeneous firm models. The first specification explores firm-level trade flows in levels:

$$ln(\Lambda_{fpjt}) = \alpha_0 + \gamma Bloc_{pjt} + Controls_{fpjt} + \varepsilon_{fpjt} \tag{3.1}$$

where Λ represents the logarithm of real trade flows for firm f of product p with country j in year t. $Controls$ is an eponymously named vector which includes the logarithm of partner GDP, $ln(GDP_{jt})$– which captures the size of partner economies– the logarithm of GDP per capita, time-invariant bilateral variables such as the logarithm of bilateral distance, a multilateral resistance term to capture remoteness, and dummy variables for a common language, colonial ties, and contiguity. $Controls$ also include firm, product, and destination fixed effects.

$Bloc_{pjt}$ is a vector of ACFTA-related variables. This includes three dummy variables: $Asean_{jt}$, which is equal to 1 if the trade partner is a member of ASEAN in 2005 and 2006, and zero otherwise; FTA^x_{jt}, a dummy variable for preferential FTA partners that enforced reductions on Chinese exports in 2005 and 2006; and FTA^m_{jt}, a dummy variable for preferential FTA partners that received reduced tariff rates on their exports from China in 2005 and 2006. There is also a continuous variable, $Tariff\ Wedge$, which captures the difference between the MFN tariff rate on a product and the preferential rate from the ACFTA. For non-preferential rates, $Tariff\ Wedge$ equals zero.

The second specification is similar to equation (1):

$$ln(\Lambda_{fjt}^{share}) = \alpha_0 + \gamma Bloc_{jt} + Controls_{fjt} + \varepsilon_{fjt} \tag{3.2}$$

where the $Bloc$ and $Controls$ vectors are unchanged but the dependent variable is the share of a particular flow. For example, when the flow is exports, $\Lambda_{fpjt}^{share} = \frac{Exports_{fjpt}}{\sum_j Exports_{fjpt}}$ (i.e. the share of revenue from selling a product to a particular country divided by the total export revenues from selling the product worldwide).

3.5.2 Endogeneity Concerns

Any membership to a bilateral economic integration agreement is likely endogenous. The decision of signatory countries to enact the ACFTA in goods, and subsequently enact agreements on services and investment, could depend on unobserved heterogeneity endemic to member countries– such as country-specific domestic regulations, political structure or regime– that are possibly correlated with trade flows. If right-hand-side variables for trade flows are correlated with the error term, then omitted variable (and selection) bias may be a major source of endogeneity.

Krishna (1998) argues that FTAs are more likely to garner political support relative to multilateral agreements, and can disincentivize multilateral liberalization which might have been feasible initially. This presents a channel through which expected industry profits and lobbying can systematically shape how preferential tariff rates are levied. Missios et al. (2016) make a similar theoretical argument in a three country model.[28]

Baier and Bergstrand (2004) attempt to identify the determinants of FTAs. They present

[28] They show that the pursuit of a customs union among countries prevents global free trade from emerging as a coalition-proof Nash equilibrium.

robust empirical evidence that country pairs with similar economic characteristics are more likely to enter into bilateral trade agreements. Baldwin and Jaimovich (2012) argue that the spread of regionalism is contagious and partly driven by "defensive" FTAS (i.e. signatory countries enter the agreement to reduce discrimination from third-country FTAs).[29]

The preponderance of evidence suggests that FTA measures are endogenous. One popular approach to address this endogeneity, predominantly used in cross-section data, is the instrumental variables (IV) approach. However, selecting a suitable IV can be difficult since most exclusion variables that are correlated with the probability of forming an FTA are also correlated with the prevailing trade flow.

Another source of endogeneity in equation (1) has been identified by the heterogeneous firm literature. Unobserved productivity may jointly determine the firm's export and import decisions. Moreover, a particularly powerful firm/ coalition of firms may more effectively lobby for protection or liberalization to suit their needs (Facchini and Willmann, 2005; Grossman and Helpman, 1994; MaCalman, 2004). This introduces endogeneity issues due to simultaneity bias.

I rely on panel data techniques to address both sources of endogeneity and apply a fixed effects model to equations (3.1) and (3.2).[30] I assume unobserved variables affecting FTA formation and trade flows, as well as unobserved firm-productivities, are time-invariant in the sample period. Under this assumption, the demean process in the fixed effects model eliminates these potential sources of endogeneity as it allows me to control for all deterministic, time-invariant effects, such as distance, contiguity, regional preferences, and institutional differences.[31] The inclusion of year

[29]This relates to the domino/contagion effect of regionalism (Baldwin, 1993). Whalley (1993) argues informally that Western Hemispheric regionalism was largely defensive, focusing on fears of US aggressive unilateralism instead of trade diversion. That is, the implementation or deepening of one FTA can induce excluded countries to impose new FTAs that were previously shunned.

[30]I run a Hausman test and a robust version of the Hausman test to check whether or not time-invariant, unobserved factors are uncorrelated with the error term and reject the random effects model in both cases. Kepaptsoglou et al. (2010) conduct a survey of the gravity-related literature on aggregate trade flows published over the past 15 years and argue that the fixed effects model yield better results. The propriety of fixed effects over random effects models is even more stark using plant-level data, and in microeconometrics generally.

[31]Time-invariant heterogeneity is likely a source of endogeneity bias. These effects are best controlled for using bilateral "fixed effects" since this allows for arbitrary correlations of unobserved time-invariant effects with the ACFTA-related variables. This correlation is assumed to be zero in the random effects model which would yield biased estimates and is implausible given previous findings.

fixed effects allows me to control for time-varying macroeconomic effects that impact all firms and partner countries equally in a given year. However, previous research and the descriptive statistics presented in Section 3.4 suggest that partner characteristics can change significantly over time. To obtain plausible estimates, I also control for country-and-time fixed effects, Π_{jt}, which capture destination specific characteristics in a given year, such as preference shocks, changes in the political landscape, catastrophic events, changes in product standards, tax reform, multilateral resistance, and prevailing within-country factors in the macroeconomy. Π_{jt} controls for the additive year and time fixed effects common in the literature, as well as time-variant partner characteristics that may influence trade flows. The model of interest using the modified fixed effects model becomes:

$$ln(\Lambda_{fpjt}) = \alpha_0 + \gamma_1 TariffWedge_{fpjt} + \Pi_{jt} + \varepsilon_{fpjt} \tag{3.3}$$

Note, the inclusion of country-and-time fixed effects preclude the interpretation of $ASEAN_{jt}$, FTA^m_{jt} and FTA^x_{jt}; the traditional method for capturing and quantifying the effects of trade policy. This shows two key limitations when using dummy variables to measure trade reform. First, reform might affect a narrow range of products or industries, especially in the short run. Moreover, deviations from the MFN rate might differ significantly across products and/or preferential countries. In that case, the dummy for trade reform can introduce significant measurement error into the analysis. Second, dummies are subsumed by the country-and-time fixed effects making policy analysis impossible. The continuous variable still allows for an interpretation of trade reform effects without a worldwide panel with dyadic effects. I highlight the need for a continuous variable measure of trade reform in the next section.

Lastly, based on the theoretical argument presented in Chapter 1, I also examine the role for cost complementarities in explaining trade flows. Equation (3.3) then becomes:

$$ln(\Lambda_{fpjt}) = \alpha_0 + \gamma_1 TariffWedge_{fpjt} + \delta Complementarity_{fjt} + \Pi_{jt} + \varepsilon_{fpjt} \tag{3.4}$$

where $Complementarity_{fjt}$ is a vector of three cost complementarity variables which link trade flows from a particular country: Λ'_{fjt}, Λ'_{fjt}*$interact$, and $(\Lambda'^{Asean})_{fjt}$*$interact$. Λ'_{fjt} is the real value, in logs, of the firm's complementary trade flow. That is, if the dependent variable (Λ_{fjt}) is the firm's export revenue earned from country j, Λ'_{fjt} is the value of imports the firm purchases from country j. Λ'_{fjt}*$interact$ is an interaction term between the log value of the complementary trade flow from the respective country and a dummy variable for the preferential FTA. A similar process uses the *Asean* variable to construct the interaction term: $(\Lambda'^{Asean})_{fjt}$*$interact$.

Equation (3.4) cannot be estimated using OLS since trade flows and complementary trade flows (Λ and Λ') may be jointly determined by the firm's unobserved productivity; introducing endogeneity issues. Again, since I initially assume productivity to be time-invariant, the demean process eliminates the simultaneity bias present in equation (3.4).

Some studies perform a "plus one" transformation before taking the logarithm of a trade flow. The advantage of this approach is an increase in sample size since years where the observed trade flow equals zero can be included in estimation. However, this approach introduces bias stemming from measurement error. I refrain from this practice in the baseline analysis. My use of highly disaggregated customs data is an important consideration in this decision since I am still able to construct a large sample without the "plus one" transformation.

The share analogs of equations (3.3) and (3.4) are derived in a similar fashion. The only difference is that the $Complementarity$ vector uses Λ'^{share} to capture the share of a firm's trade flow with a particular country relative to that flow internationally. The specifications with shares are more pointedly included in accordance with the cost complementarity mechanism which predicts an assortative matching between a firm's import source and its export revenue intensities.[32]

3.5.3 Pitfalls of Using Dummies to Measure the Impact of Trade Reform

The most straightforward application of the gravity model to customs data relates trade flows at the firm-country level to dummy variables of trade reform. To motivate the need for

[32]The share specification is also advantageous since it avoids the issue of dropped observations associated with log-transforms when no complementary flow is observed.

country-and-year fixed effects, and to highlight the measurement error bias introduced by the usage of trade reform dummies, I conduct an initial analysis in accordance with previous studies. The results are presented in Table 3.2. Panel A (B) presents the results when the dependent variable is export-related (import-related).

Ex ante, I expect the estimated coefficients on all ACFTA-based variables to be positive. The orthodox prediction is that preferential rates from the ACFTA in goods should induce firms to trade with preferential-ASEAN members at a disproportionately higher rate. The overall effect on the trade bloc should also be positive, however, the effects for ASEAN members which did not experience any reduced rates in imports and/or exports are difficult to predict a priori. All specifications include controls for gravity variables.[33]

In Panel A, column 1 presents estimated coefficients of dummy variables for ASEAN membership and the proposed preferential tariff reductions on Chinese exports. The estimates suggest that membership to ASEAN leads to a 4.27% increase in export value to ASEAN countries. However, the estimate for proposed reductions to output tariffs experiences slower growth at 1.2% relative to extra-bloc members. This result reflects the observation for growth rates in participation and trade values discussed in Section 3.4, but seem counterintuitive and implausible. Column 2 includes time fixed effects to control for macroeconomic trends and global trends. Here, the estimated coefficient for ASEAN membership is negative and the estimate for imposed output tariff reductions is positive but insignificant which, again, seems implausible. Column 3 includes a dummy for ASEAN members that received tariff reductions on their products from China (i.e. Chinese imports). Its inclusion relates to cost complementarities which link import liberalization to export flows. In this specification, I obtain an insignificant estimate for ASEAN membership, a positive and significant estimate for preferential ASEAN rates on Chinese exports, and a statistically significant negative estimate for preferential rates on Chinese imports. Almost immediately, these results corroborate Ghosh and Yamarik (2004) which argues that the estimated treatment

[33]These specifications feature log(GDP) and log(GDP per capita) as the time-varying gravity variables. In supplementary regressions, I also include different permutations of log(Population). The estimated coefficients for the variables of interest are robust to these changes.

Table 3.2: Firm-Country Flows and Dummy Variables for Trade Reform

Panel A	log (Exports$_{fj}$)			Export Share$_{fj}$		
	(1)	(2)	(3)	(4)	(5)	(6)
	With Export FTA Dummy	With Year FEs	With Both FTA Dummies	With Export FTA Dummy	With Year FEs	With Both FTA Dummies
Asean	0.0418***	-0.111***	-0.0213	-0.00122*	-0.00229***	0.00189
	(0.00838)	(0.00821)	(0.0176)	(0.000715)	(0.000725)	(0.00156)
FTA^x	-0.0306**	0.0122	0.0265**	0.00180*	0.00443***	0.00509***
	(0.0129)	(0.0124)	(0.0127)	(0.00109)	(0.00109)	(0.00111)
FTA^m			-0.108***			-0.00503***
			(0.0188)			(0.00167)
Gravity	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	No	Yes	Yes	No	Yes	Yes
R^2	0.00784	0.0748	0.0748	0.00500	0.00707	0.00707
N	2798180	2798180	2798180	2869887	2869887	2869887
Panel B	log (Imports$_{fj}$)			Import Share$_{fj}$		
	(1)	(2)	(3)	(4)	(5)	(6)
	With Import FTA Dummy	With Year FEs	With Both FTA Dummies	With Import FTA Dummy	With Year FEs	With Both FTA Dummies
Asean	0.160*	0.315***	0.303***	0.0129	0.00718	0.00664
	(0.0953)	(0.0955)	(0.0956)	(0.00955)	(0.00957)	(0.00958)
FTA^m	-0.441***	-0.472***	-0.517***	-0.0134	-0.0122	-0.0142
	(0.0965)	(0.0965)	(0.0974)	(0.00967)	(0.00967)	(0.00976)
FTA^x			0.114***			0.00509
			(0.0338)			(0.00339)
Gravity	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	No	Yes	Yes	No	Yes	Yes
R^2	0.00520	0.00677	0.00680	0.0000853	0.000328	0.000334
N	690997	690997	690997	690997	690997	690997

Notes: This table relates exports (Panel A) and imports (Panel B) to dummy variables of preferential trade policy. The dependent variable is the logarithm of real flows in Columns 1-3 and country-level shares in the respective flows for Columns 4-6. All regressions control for time varying gravity variables. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

effect of an FTA is "fragile" to the empirical specification.

Columns 4-6 preserve the ordering of inclusion for the explanatory reform dummies when the dependent variable is a firm's export share from a particular country. The results are qualitatively similar. I obtain largely implausible estimates that are not reconciled by the addition of year fixed effects. Moreover, the estimates continue to display "fragility" as estimated coefficients vacillate in sign, magnitude, and level of significance across specifications.

The estimates are more perturbing for import-related trade (Panel B). Columns 1-3 suggest a positive effect for ASEAN membership and for preferential output tariff reductions imposed on Chinese exports (the complementary flow) on a firm's level of imports. However, I obtain statistically significant, negative estimates for preferential-ASEAN members that received tariff reductions on their exports to China (i.e. Chinese imports). This counterintuitive result is likely attributable to omitted variable bias. As alluded to earlier, the full vector of appropriate controls must include country-and-time fixed effects to correct for endogeneity.

Overall, Table 3.2 illustrates that measuring trade reform using dummy variables might yield implausible estimates, likely due to omitted variable bias. Dummies also introduce measurement error since tariff liberalization varies across products and countries. Country-and-time fixed effects, recommended by Baier and Bergstrand (2007), help to correct for these sources of endogeneity but absorb dummy variable measures of trade reform. To facilitate the analysis of trade reforms while obtaining plausible estimates, I disaggregate data to the firm-product-country level and relate a continuous variable of trade reform, $Tariff\ Wedge$, to firm-level trade flows. This is the best method for eliminating bias since it more accurately measures the degree of trade liberalization actually faced by firms. Moreover, it varies over time, across products and across countries. Due to the timing of liberalization agreements throughout the evolution of ACFTA, the reductions in tariffs fully capture trade reform in 2005 and 2006, as liberalization of services and investment had not yet been enacted. That is, the change in ad valorem tariff rates fully capture the FTA liberalization since member countries only eliminated bilateral tariff rates during the sample horizon.

3.6 Main Findings

This section presents the main results using firm level customs data on Chinese manufacturers. The purpose of this study is to evaluate the impact of a free trade agreement on firm-level flows. To address the simultaneity issue introduced by unobserved firm productivity and the omitted variable bias from the endogeneity of FTA policy, I rely on fixed effects estimation to control for time-invariant effects and preferential deviations from MFN tariffs to measure trade reform. I also explore the role of complementary trade flows in explaining within-firm behavior in international markets.

3.6.1 Baseline Results

Section 3.5.3 detailed the shortcomings of using dummy variables to measure trade reform with firm-country data. In order to capture price differentials and opportunity costs in marginal savings from the FTA, I depart from the literature by disaggregating the data to the firm-product-country level. Moreover, I use the tariff wedge (the difference for a given product between the MFN rate and the rate faced with the partner country) to measure trade reform. Table 3.3 presents the results when the dependent variables are the logarithm of export value (Panel A) and export shares (Panel B).

For continuity, Columns 1 and 2 reflect the standard approach to estimation. I again obtain implausible results for FTA^m. The estimates for FTA^x seem plausible but likely suffer from omitted variable bias. The average tariff duty is excluded from export regressions due to a lack of sufficient variation. More specifically, average duty and the tariff wedge measure I construct is perfectly colinear for exports. Columns 3 and 4 present the preferred specifications. I obtain insignificant estimates for the continuous trade policy measure. I find evidence of the cost complementarity with a 10% increase in imports being associated with a 0.09% increase in imports from a particular country. A qualitatively similar pattern holds for export shares as the dependent variable.

Table 3.3: FE Estimates– Firm-Product-Country Flows and ACFTA Rates, 2002-2006

Panel A	$\log(\text{Exports}_{fpj})$			
	(1) Year FEs	(2) With Preferred Measure	(3) With Country-Year Fixed Effects	(4) With Complementarity
Asean	0.00259 (0.0148)	0.00177 (0.0149)		
FTA^x	0.0266** (0.0107)	0.0268** (0.0110)		
FTA^m	-0.0762*** (0.0159)	-0.0753*** (0.0159)		
Output Tariff Wedge		-0.000871 (0.00353)	-0.00584 (0.00380)	-0.00608 (0.00380)
$\log(\text{Imports}_{fj})$				0.00857*** (0.000314)
Asean* $\log(\text{Imports}_{fj})$				-0.0114** (0.00462)
FTA^m $\log(\text{Imports}_{fj})$				0.00363 (0.00475)
R^2	0.00818	0.00818	0.00984	0.0101
N	8570117	8563007	8563007	8563007
Panel B	$\text{Export Share}_{fpj}$			
	(1) Year FEs	(2) With Wedge	(3) Pref. Measure	(4) Complete
Asean	0.0135*** (0.00218)	0.0134*** (0.00218)		
FTA^x	0.00624*** (0.00155)	0.00564*** (0.00159)		
FTA^m	-0.0154*** (0.00233)	-0.0152*** (0.00233)		
Output Tariff Wedge		0.000799 (0.000518)	0.000526 (0.000557)	0.000513 (0.000557)
Import Share				0.00364*** (0.000989)
Asean* Import Share				0.00701 (0.0165)
FTA^m* Import Share				-0.0262 (0.0182)
R^2	0.00363	0.00364	0.00653	0.00654
N	8802563	8795453	8795453	8795453

Notes: This table examines the relationship between firm exports and FTA rates. Each regression includes gravity controls and robust standard errors (presented in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.4 presents the results when the dependent variables are the logarithm of import value (Panel A) and import shares (Panel B). Columns 1 and 2 present the results for specifications without country-and-time fixed effects. The estimates for FTA^m, the dummy for a trade partner receiving tariff reduction from China in 2005 and 2006, is negative and significant, even when I include the continuous trade reform measure. This suggests that improved access to intermediates within ACFTA had a negative effect on import value and is likely due to omitted variable bias. Columns 3 and 4 suggest that a 10 percentage point reduction in average tariff rates leads to a 0.05% increase in imports from a particular country. The results highlight the importance of using the correct specification. Column 4 also shows that a 10 percentage point deviation from the MFN rate increases imports from preferential-ASEAN source countries by 0.14%. This suggests that firms are responsive to import tariffs across countries and to bilateral preferential reductions stemming from the ACFTA, even in the short-run.

Column 5 (Panel A) includes controls for complementary trade flows (i.e. exports). The estimated tariff and trade reform coefficients are larger than predicted in Columns 3 and 4. I find that a 10 percentage point tariff reduction is associated with a 0.08% increase in imports from a particular country. A 10 percentage point deviation from the MFN tariff is associated with a 0.22% increase in preferential-FTA imports while a 10% increase in exports from a particular country is associated with a 0.3% increase in imports from a particular country. The strength of the complementarity linkage is smaller but still positive for ASEAN members, with a 10% increase in exports increasing intra-bloc imports by 0.098%

Panel B presents the results when product-import share from a particular country is the dependent variable. I obtain positive estimates for average tariff rates which superficially seem counterintuitive. However, these estimates are economically insignificant and likely driven by quality differences and essentiality of specific inputs in production. I explore these features more explicitly in Section 3.6.2. The estimated coefficients for tariff wedge are insignificant. The cost complementarity variables suggest a positive relationship between export share and import share.

The product level analysis highlights the importance of estimating the correct specification

Table 3.4: FE Estimates– Firm-Product-Country Flows and ACFTA Rates, 2002-2006

Panel A	log(Imports$_{fpj}$)				
	(1) with Year FEs	(2) With Preferred Measure	(3) With Tariffs Faced	(4) With Preferential Rate Diff	(5) With Complementary Trade Flows
Asean	0.209***	0.204***			
	(0.0659)	(0.0659)			
FTA^x	0.0288	0.0291			
	(0.0219)	(0.0219)			
FTA^m	-0.285***	-0.294***			
	(0.0670)	(0.0673)			
Avg. Duty		-0.00577***	-0.00507***	-0.00517***	-0.00830***
		(0.00129)	(0.00130)	(0.00130)	(0.00195)
Input Tariff Wedge		0.0135**		0.0141**	0.0221*
		(0.00674)		(0.00677)	(0.0113)
log(Exports$_{fj}$)					0.0303***
					(0.00129)
Asean* log(Exports$_{fj}$)					-0.0210**
					(0.00869)
FTA^x log(Exports$_{fj}$)					0.0177
					(0.0134)
R^2	0.00788	0.00791	0.00920	0.00920	0.00853
N	3577041	3569582	3569582	3569582	1896958

Panel B	Import Share$_{fpj}$				
	(1) with Year FEs	(2) With Preferred Measure	(3) With Tariffs Faced	(4) With Preferential Rate Diff	(5) With Complementary Trade Flows
Asean	0.0219**	0.0220**			
	(0.00944)	(0.00944)			
FTA^x	0.0160***	0.0160***			
	(0.00314)	(0.00315)			
FTA^m	-0.0250***	-0.0249***			
	(0.00960)	(0.00965)			
Avg. Duty		0.000273	0.000407**	0.000407**	0.000408**
		(0.000185)	(0.000186)	(0.000186)	(0.000186)
Input Tariff Wedge		-0.000397		-0.0000934	-0.0000172
		(0.000966)		(0.000970)	(0.000970)
Export Share$_{fj}$					0.00191*
					(0.00104)
Asean* Export Share$_{fj}$					-0.0314***
					(0.00891)
FTA^x Export Share$_{fj}$					0.0308**
					(0.0156)
R^2	0.000555	0.000554	0.00177	0.00177	0.00178
N	3577058	3569599	3569599	3569599	3569599

Notes: This table examines the relationship between firm imports and FTA rates. Each regression includes gravity controls and robust standard errors (presented in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

and some new features of firm-behavior. The larger the wedge between MFN rates and preferential rates for imported inputs, the more likely the firm is to source the product within the trade bloc. That is, the larger the cost savings from preferential rates, the greater the firm's incentive to purchase the good at the preferential rate. Surprisingly, the findings for the tariff wedge measure is only significant at the 10% level in my most plausible estimates of import values and insignificant for estimates of product export share. Moreover, preferential output tariffs on Chinese goods increases import shares for preferential rate countries, but decreases import shares for ASEAN members overall. This suggests that trade diversion in import markets occurs more within the trade bloc than across membership status. The results also continue to support the cost complementarity explanation for firm-level flows.

The GATT and the WTO have been very efficacious in reducing border barriers such as tariff rates, however, these institutions have been less successful in liberalizing domestic policies such as competition and antitrust rules, corporate governance, product standards, worker safety, regulation and supervision of financial institutions, environmental protection, tax codes, etc. (Lawrence, 1996; Gilpin, 2000). I examine a time period in which the ACFTA in goods implemented tariff reductions without accompanying reductions in investment and trade in services barriers. By 2010, the ACFTA expanded to include a wider scope of other trade-related policies. Previous research shows significant growth in intra-bloc trade due to the ACFTA over a longer horizon. The results from this section suggest that, as tariff reductions approach zero, other policies become relatively more important in influencing trade flows and are therefore crucial for deriving significant impacts from the ACFTA (Preeg, 1998).

3.6.2 Scope for Product Differentiation

Table 3.5 explores how results may vary along the gradient of product characteristics. I use the United Nations Conference on Trade and Development (UNCTAD) classification system to classify goods by the level of skill required in production, technology composition, and potential for differentiation. The six classifications are: 1. low skill and technology-intensive, 2. medium skill and technology-intensive, 3. high skill and technology intensive, 4. mineral fuels, 5. non-fuel primary commodities, and 6. resource-intensive manufactures. The estimates for exports and imports are presented in Panel A and Panel B, respectively.

Given the results presented in Table 3.3, I expect the output tariff wedge measure of trade reform to be insignificant across all goods, a priori. Section 3.6.1 provides robust evidence that a firm's exported products had no relationship with the preferential output tariff rates stipulated by the ACFTA. On the other hand, I expect positive and significant estimates on the input tariff wedge measure for imports. This relationship should be concentrated in goods with a wider scope for product differentiation (i.e. technology-intensive products). The complementary trade flow variable will likely be positive and significant for both imports and exports. However, it is difficult to predict the sign and/or significance for the interacted complementarity variables.

The estimated coefficients presented in Panel A are congruent with ex ante predictions. I find no evidence of a statistically significant relationship between the output tariff wedge and a firm's intra-bloc exports to a particular country. The complementary trade flow, imports from a particular country, is positive and significant for all six product categories. The relationship is largest for low skill and medium skill technology-intensive goods. I find evidence of differential effects for ASEAN members in medium skill and technology intensive products, as well as resource-intensive products. Preferential FTA import partners only differed from these estimates for resource-intensive goods.

Panel B is also congruent with ex ante predictions. Reductions in average tariffs are associated with increased imports of all good categories except for medium skill technology-intensive products and non-fuel commodities. The input tariff wedge is only significant for the medium skill technology-intensive good. This suggests that the preferential reductions were particularly relevant a category of good with greater scope for product differentiation. However, the results largely suggest no effect. The estimate for the firm's complementary trade flow, exports, is stable across all specifications, except for mineral fuels. The estimates for differential effects using interactions for ASEAN and preferential-FTA membership are largely insignificant across all product classes.

Table 3.5: Product Scope– Preferential Rates and Firm-Product-Country Flows, 2002-2006

Panel A	log(Exports$_{fpj}$)					
	(1) Low Skill	(2) Medium Skill	(3) High Skill	(4) Mineral Fuels	(5) Non-Fuel Comms	(6) Resource-Intensive
Output Tariff Wedge	-0.00145 (0.0208)	-0.00675 (0.00953)	-0.000577 (0.00598)	-0.00174 (0.0102)	-0.00965 (0.0146)	-0.00972 (0.0121)
log(Import)$_{fj}$	0.00851*** (0.000808)	0.0114*** (0.000737)	0.00658*** (0.000839)	0.00643*** (0.00149)	0.00896*** (0.00180)	0.00791*** (0.000489)
Asean* log(Import)$_{fj}$	0.00938 (0.0155)	-0.0216** (0.00939)	0.00430 (0.00823)	-0.0272 (0.0392)	0.0000598 (0.0246)	-0.0249*** (0.00941)
FTA^{m} log(Import)$_{fj}$	-0.0205 (0.0157)	0.0134 (0.00963)	-0.0132 (0.00858)	0.0220 (0.0396)	-0.0153 (0.0253)	0.0193** (0.00973)
Gravity	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0136	0.0146	0.0154	0.0200	0.0108	0.00802
N	1197349	1594429	898357	405227	214323	3874750

Panel B	log(Imports$_{fpj}$)					
	(1) Low Skill	(2) Medium Skill	(3) High Skill	(4) Mineral Fuels	(5) Non-Fuel Comms	(6) Resource-Intensive
Avg. Duty	-0.0205* (0.0111)	-0.000166 (0.00406)	-0.0206*** (0.00387)	-0.0387** (0.0158)	0.00207 (0.00540)	-0.0137*** (0.00436)
Input Tariff Wedge	-0.0629 (0.0424)	0.0478** (0.0193)	0.0131 (0.0208)	-0.0674 (0.0732)	0.00986 (0.0343)	-0.0100 (0.0488)
log(Export)$_{fj}$	0.0336*** (0.00362)	0.0333*** (0.00224)	0.0257*** (0.00240)	0.0136 (0.00953)	0.0330*** (0.00575)	0.0333*** (0.00450)
Asean* log(Export)$_{fj}$	-0.0663** (0.0269)	-0.0290* (0.0165)	-0.000190 (0.0146)	-0.0176 (0.0751)	-0.0512 (0.0343)	-0.0626* (0.0322)
FTA^{x}* log(Export)$_{fj}$	0.0709 (0.0481)	0.00195 (0.0253)	0.0176 (0.0224)	-0.187 (0.157)	0.0307 (0.0443)	0.103* (0.0529)
Gravity	Yes	Yes	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0149	0.00964	0.00898	0.0203	0.0324	0.0168
N	270703	619011	448226	40920	81931	217670

Notes: This table examines the effects of preferential trade reform on different types of products. Panel A presents results for log(exports), Panel B presents the results for log(imports). All regressions include gravity controls, country-and-year fixed effects, and robust standard errors (presented in parentheses).* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The evidence suggests that preferential reductions in output tariffs had no significant impact on the firm's intra-bloc exports. This is unsurprising since China's main export partners are large and relatively wealthy countries. The firm-level trade creation in exports would presumably be larger if output tariff reductions came from more prominent trade partners in export markets. Assuming that firms establish distributional connections and learn about foreign markets over time, they may be very inelastic to market access and competitive benefits imposed by preferential output tariff rates. In contrast, the preferential reductions in input tariffs, particularly for medium skill technology-intensive goods, suggest that firms are more elastic to cost savings in intermediates. However, the absence of a significant estimate for the other product categories also suggests that firms were generally inelastic in the short-run. This might be potentially explained by information asymmetry or lags in the firm's apprisal of tariff declines. The confluence of informational adjustment and search costs, quality differences across destinations, and the essentiality of specific inputs in the production process likely explain the tenuous relationship between preferential output/input tariff rates and trade flows. Moreover, since these tariff reductions were implemented in isolation, neglecting liberalization of investment and behind-the-border practices, it appears that deviations from the already low MFN rates were insufficient to alter firm behavior.

Lastly, the results show a strong linkage between import and export with a particular country over time and within goods. The findings were relatively stronger for exports as an explanatory variable for imports. This reflects the pattern of firm participation in international markets since most firms are EO firms. More importantly, the results suggest that intensive margin increases in importing (exporting) lead to increases in exporting (importing) regardless of product characteristics. The intimacy of this link highlights the importance of bilateral supply chain linkages and show that they are relatively insensitive to marginal price deviations in isolation. One might speculate that tariff reductions accompanied with greater investment and domestic policy liberalization would have induced more trade creation within the trade bloc.

3.6.3 Firm Ownership

The results presented thus far suggest there are asymmetric impacts of preferential tariff reductions on a firm's international product flows. Firm import patterns appear to be somewhat responsive to preferential tariff reductions on imported materials, while their export behavior is generally unresponsive to preferential output changes. I find robust evidence supporting the cost complementarity linkage in bilateral flows over time. However, these results may gloss over the role of organizational structures in shaping a firm's sensitivity of trade flows to preferential trade liberalization. In this section I address this issue by investigating the impact of preferential tariff reform on trade flows, distinguished by firm ownership characteristics. I continue to use the base specification (equation 3.4) to investigate six ownership structures: 1. collectives, 2. foreign firms, 3. joint-ventures, 4. private firms, 5. sino-foreign cooperatives and 6. state-owned enterprises (SOE).[34] The results are presented in Table 3.6, and the dependent variables are the logarithm of exports (Panel A) and imports (Panel B).

Ex ante, I expect the insignificant parameter estimates for the output tariff wedge to persist. With respect to import flows, I expect significant and positive coefficient estimates of the input tariff wedge for SOEs and foreign firms. In section 3.6.2, I posited that informational lags and search costs may have slowed firm-level reactions to preferential import liberalization. However, SOEs and foreign firms– if owner nationalities are from a preferential trade member– should have an informational advantage in updating and responding their knowledge of tariff rates and distribution networks. I expect the cost complementarity linkage to persist, particularly for private firms, sino-foreign cooperatives, and foreign firms contingent on the owner's nationality belonging to extra-bloc members.

The results presented in Panel A are in keeping with expectations. I find that, on average, there were no significant impacts of the preferential output tariff wedge on a firm's exports to a par-

[34] Sino-Foreign cooperatives are a type of joint venture between a Chinese and a foreign company within China. The Chinese company typically provides labor, land usage rights, and the physical building, while the foreign company brings in machinery, technology, and key equipment. Foreign companies are typically located on Hong Kong, Macau, and Taiwan

Table 3.6: Ownership– Preferential Rates and Firm-Product-Country Flows, 2002-2006

Panel A	log(Exports$_{fpj}$)					
	(1) Collectives	(2) Foreign	(3) Joint Ventures	(4) Private	(5) Sino-Foreign Coop	(6) SOE SOE
Output Tariff Wedge	-0.0210 (0.0132)	0.00842 (0.0138)	-0.0245* (0.0137)	0.000175 (0.00702)	-0.0228 (0.0363)	-0.00289 (0.00560)
log(Import)$_{fj}$	0.00612*** (0.000951)	0.0139*** (0.00157)	0.0126*** (0.00167)	0.0135*** (0.000841)	0.0179*** (0.00472)	0.00582*** (0.000379)
Asean* log(Import)$_{fj}$	-0.00161 (0.0148)	0.0231 (0.0263)	-0.0231 (0.0351)	-0.0107 (0.00800)	0.00312 (0.0151)	-0.0105* (0.00637)
FTA^{m}* log(Import)$_{fj}$	-0.00703 (0.0152)	-0.0214 (0.0266)	0.0322 (0.0355)	-0.0000487 (0.00876)	0 (.)	0.00926 (0.00652)
Gravity	Yes	Yes	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0142	0.0270	0.0210	0.0225	0.0246	0.00470
N	681264	647511	621919	2913213	87762	3609661
Panel B	log(Imports$_{fpj}$)					
	(1) Collectives	(2) Foreign	(3) Joint Ventures	(4) Private	(5) Sino-Foreign Coop	(6) SOE SOE
Avg. Duty	0.00859 (0.0120)	-0.00399 (0.00400)	-0.00696 (0.00488)	0.00414 (0.00890)	0.0245 (0.0173)	-0.0162*** (0.00272)
Input Tariff Wedge	0.228*** (0.0645)	0.00812 (0.0193)	-0.00853 (0.0316)	0.0389 (0.0425)	-0.139 (0.105)	0.0313* (0.0176)
log(Export)$_{fj}$	0.0370*** (0.00875)	0.0290*** (0.00212)	0.0336*** (0.00277)	0.0369*** (0.00501)	0.00311 (0.0114)	0.0262*** (0.00243)
Asean*t log(Export)$_{fj}$	-0.0748 (0.0527)	-0.0209 (0.0142)	0.000871 (0.0223)	-0.0511 (0.0380)	-0.00718 (0.0950)	-0.0490*** (0.0163)
FTA^{x}* log(Export)$_{fj}$	0.182** (0.0758)	-0.00152 (0.0240)	-0.0293 (0.0314)	0.00567 (0.0553)	-0.124 (0.131)	0.0445* (0.0250)
Gravity	Yes	Yes	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0261	0.0171	0.0128	0.0184	0.0353	0.00555
N	53853	535277	290769	194900	23318	798829

Notes: This table examines the effects of preferential trade reform by type of ownership. Panel A presents results for log(exports), Panel B presents the results for log(imports). All regressions include gravity controls, country-and-year fixed effects, and robust standard errors (presented in parentheses).* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

ticular country for any of the ownership configurations. I find the complementarity in trade flows to be positive and significant across all organizational structures. The relationship is particularly large for foreign firms, private firms, and sino-foreign cooperatives.

With respect to imports, Panel B shows a positive relationship between the input tariff wedge and imports for collectives and SOEs. The estimate for SOEs is unsurprising. The estimate for collectives is initially unexpected but moving beyond a cursory analysis, it becomes more plausible. Collectives are comprised of relatively large numbers of businesses and/or professionals in a related field. This allows members to pool resources and share information amongst themselves. As a result, collectives, by their nature, are less susceptible to the information restrictions that might inhibit privately owned firms. The complementary trade flow, exports, is also found to have a positive and significant relationship across ownership structures. This linkage is particularly pronounced for privately owned firms and collectives.

3.7 Robustness Checks

I perform three robustness checks to bolster the findings presented in Section 3.6. This entails the expansion of baseline measures to include time-varying firm-level variables, dynamic panel estimation techniques, and timing considerations related to the implementation of preferential rates. As discussed throughout the main findings, intra-bloc product exports appear to be uncorrelated with preferential reduction on output tariffs for Chinese products. This relationship holds for the robustness analysis. As a result, the remainder of the analysis only discusses the robustness of the estimated effects between preferential input liberalization and intra-bloc firm imports.

3.7.1 FTAs, Flow Complementarity, and Time-Varying Firm Characteristics

In section 3.5.2, I argue that the firm optimization problem for exports and imports may be jointly determined by unobserved productivity. In the baseline specification, I assume that productivity is deterministic, and therefore controlled for using the standard fixed effects approach.

However, firm productivity may change over time. Halpern, Koren, and Szeidl (2015) argue that improved access to intermediates increased firm productivity in Hungarian firms. Similar findings have been shown for Chile (Kasahara and Rodrigue, 2008), India (Topalova and Khandelwal, 2011), and Indonesia (Amiti and Konings, 2007).[35]

To correct for this potential source of endogeneity, I include a vector of time-varying firm-level factors. This includes the logarithm of wages, the logarithm of labor force, the logarithm of capital, and TFP. I use the Olley Pakes/Levinsohn-Petrin method to estimate TFP.

I obtain information on firm-level primitives by matching the customs data with manufacturing survey data compiled by the National Bureau of Statistics (NBS). While the customs data span the universe of general trade flows for firms of all sizes and industries, by matching with the manufacturing survey, I restrict the sample to manufacturing firms. Moreover, the NBS survey require that firm reach a minimum threshold of 5 million RMB in sales revenue to be included in the survey. Therefore, the sample used in the proceeding analysis is truncated to focus on trade flows for medium to large manufacturers. This limits the scope of the interpretation for the estimated coefficients.

I repeat the baseline analysis for this panel of manufacturers, controlling for time varying productivity. The results are presented in Table 3.7. Even when controlling for firm characteristics, I obtain negative and significant estimates for FTA^m, stressing the need for country-and-year fixed effects. The estimated coefficients for firm productivity is stable across all specifications. A 10% increase in productivity is associated with a 3.9% increase in import flows. As predicted by heterogeneous firm models, this suggests that more productive firms tend to import more goods from abroad. I also find a positive relationship between a firm's export flows to a particular country and their import flows. A 10% increase in exports is associated with a 0.15% increase with a particular country. The main variable of interest, $Input\ Tariff\ Wedge$, is not significant for any specification which impugns the strength of the correlation between preferential import liberalization and firm-level flows.

[35] Results have been mixed for Brazil. Schor (2004) argues that there is a positive effect while Muendler (2004) finds no effect for improved imported intermediate access on firm productivity.

The negative and insignificant coefficient for the trade policy variable is likely a function of the truncated sample. Medium to large manufacturing firms may have well-established global supply chains in production. The results may also be reflective of adjustment costs.

3.7.2 Dynamic Panel Methods

The essential panel methods for linear models are fixed effects (FE) and random effects. The FE estimator provides consistent estimates of time-varying regressors under a limited form of endogeneity– explanatory variables may be correlated with individual fixed effects but not with the error term (Cameron and Trivedi, 2008). In this section, I consider a richer type of endogeneity. Specifically, I consider the case when explanatory variables are correlated contemporaneously with the error term.

To this end, I use the Arellano-Bover/ Blundell- Bond GMM estimator for dynamic panels. A notable advantage of this approach is that it permits the usage of lags of the dependent variable as IVs for current flows. The results are presented in Table 3.8. Across the various specifications, I still obtain positive estimates for the Input Tariff Wedge. However, the results are only significant at the 5 and 10 percent levels in Columns (4) and (5), respectively.

3.7.3 Accounting for "Phased-in" FTAs and Lagged Terms-of-Trade Effects

In this section, I account for a key attribute of FTAs. Namely, that tariff reductions on different products are phased-in over time; typically over a one-, five- or ten-year horizon. I also consider the possibility that a change in the terms of trade due to the formation of the ACFTA may exert a lagged impact on trade flows. Since this study restricts analysis to two years of the ACFTA implementation, I can only include a one period lag of the trade reform measure $Tariff\ Wedge$. Note, the phase-in nature of free trade agreements may also explain some of the insignificant estimates obtained in previous sections. If phase-in periods for a particular product are long, the entire economic (or treatment) effect cannot be fully captured with contemporaneous reductions only.

The results are presented in Table 3.9. Columns (1) and (3) show that the lagged trade reform measures had no significant effect on intensive margin of intra-bloc trade flows. Adding greater support to the arguments that: 1. firms need time to adjust to reformations in trade policy; and 2. trade reform should be accompanied by liberalization in domestic policy and behind-the-border impediments to trade.

Next, I turn my attention to the potential "strict exogeneity" issues stemming from reverse causality. That is, does the expectation of future preferential tariff reductions affect current trade flows. If the ACFTA exhibits strict exogeneity, current trade flows should be uncorrelated with future preferential tariff reductions. Columns (2) and (4) relates the firm's import flows to future tariff reductions and find no statistically significant effect. This suggests that there were no feedback effects from tariff reductions.

3.8 Conclusion

The gravity model has been the most favored empirical tool to evaluate the impacts of free trade agreement (FTA); focusing on long-run effects using aggregate data on trade flows. This approach typically relies on 'comprehensive' dummy variables to capture bilateral liberalization from FTAs which introduces measurement error into the empirical specification. This study analyzes the short-run effect of the ASEAN-China Free Trade Agreement (ACFTA) in goods (2004). Using firm-product-country level customs data from 2002-2006, I measure the ACFTA's preferential tariff reform more accurately by constructing a measure of the wedge between MFN applied tariffs and destination- and product-specific intra-bloc preferential rates. The timing of signatory countries and of reform policies are crucial. There is heterogeneity in the ASEAN countries which proposed and/or received preferential rates with China. Moreover, these tariff reductions fully capture trade liberalization between ASEAN and China, since reforms for behind-the border effects and investment liberalization did not occur during the sample horizon.

I find evidence of asymmetric effects of preferential rates on a firm's intensive margin trade flows in the short-run. Preferential output tariff reductions had no effect on intra-bloc product exports. On the other hand, I find that input tariff reductions had a positive impact on import flows to ASEAN countries that received preferential rates from China. The results suggest that firm are more responsive to preferential import liberalization than output liberalization, in the short-run. This result for preferential import tariffs was concentrated in collectives and SOEs, suggesting that adjustment lags, search costs associated with locating distributional networks, and informational lags in learning about tariff reductions may have played important roles.

As a corollary, the muted response to preferential tariff reform stresses the importance of liberalizing domestic policies such as competition and antitrust rules, corporate governance, product standards, worker safety, regulation and supervision of financial institutions, environmental protection, tax codes, etc. (Lawrence, 1996; Gilpin, 2000). The results suggest that, as tariff rates approach zero, other liberalization policies become relatively more important in influencing trade flows.

Applying the methodology outlined throughout this paper to a longer panel of firm-product-country data presents fertile ground for future research. Also, formulating measures to capture non-tariff (non-price) liberalization might also be useful in a longer panel.

Table 3.7: ACFTA and Imports: Time-Varying Firm Characteristics

Panel A	$\log(\text{Imports}_{fpj})$				
	(1) with Year FEs	(2) With Preferred Measure	(3) With Tariffs Faced	(4) With Preferential Rate Diff	(5) With Complementary Trade Flows
Asean	0.284	0.281			
	(0.208)	(0.208)			
FTA^x	0.140***	0.137***			
	(0.0502)	(0.0503)			
FTA^m	-0.396*	-0.379*			
	(0.210)	(0.211)			
Avg. Duty		-0.00508*	-0.00613**	-0.00603**	-0.00799*
		(0.00301)	(0.00303)	(0.00303)	(0.00448)
Input Tariff Wedge		-0.0144		-0.0132	-0.0164
		(0.0149)		(0.0149)	(0.0249)
$\log(\text{Export})_{fpj}$					0.0154***
					(0.00266)
Asean* $\log(\text{Export})_{fpj}$					-0.00432
					(0.0222)
FTA* $\log(\text{Export})_{fpj}$					-0.0284
					(0.0299)
TFP	0.365***	0.366***	0.365***	0.365***	0.330***
	(0.0100)	(0.0100)	(0.0101)	(0.0101)	(0.0152)
Gravity	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes
Country-Year FEs	No	No	Yes	Yes	Yes
R^2	0.0174	0.0175	0.0203	0.0203	0.0195
N	783831	782074	782074	782074	415984

Notes: This table replicates the baseline estimation after the inclusion of estimated productivity. All regressions include robust standard errors (presented in parentheses). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.8: Dynamic Panel Methods: Arellano-Bover/ Blundell-Bond Estimates and Imports

	log(Imports$_{fpjt}$)					
	(1) One Lag of Imports	(2) Two Lags of Imports	(3) FTA Measure	(4) Complementarity	(5) Lag Labor Force	(6) Lag Exports
log(Imports)$_{fpjt-1}$	0.409***	0.421***	0.424***	0.436***	0.437***	0.453***
	(0.00787)	(0.0110)	(0.0111)	(0.0136)	(0.0138)	(0.0136)
log(Imports)$_{fpjt-2}$		-0.0000147	0.00184	0.0219**	0.0396***	0.0333***
		(0.00789)	(0.00794)	(0.00985)	(0.00957)	(0.0101)
TFP	-0.0307	0.659***	0.658***	0.920***	0.955***	0.881***
	(0.0240)	(0.0491)	(0.0492)	(0.0715)	(0.0751)	(0.0653)
Input Tariff			0.0239	0.210**	0.148*	0.109
Wedge			(0.0377)	(0.0834)	(0.0832)	(0.0894)
Avg. Duty			0.0529***	0.00818	0.0322	0.0160
			(0.0156)	(0.0242)	(0.0251)	(0.0269)
log(Export)$_{fpjt}$				0.0173***	-0.00985	0.0128*
				(0.00627)	(0.00765)	(0.00704)
Asean*				-0.0335*	-0.0244	-0.0241
log(Export)$_{fpjt}$				(0.0201)	(0.0198)	(0.0207)
FTA^{x}				-0.0539**	-0.0543**	-0.0561**
log(Export)$_{fpjt}$				(0.0269)	(0.0266)	(0.0283)
[1em] log(Export)$_{fpjt-1}$						-0.0841***
						(0.0176)
Gravity	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	261558	105357	105172	64683	64683	57495

Notes: This table using dynamic panel GMM estimation to investigate the relationship between preferential tariff rates and import flows. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.9: Lags and Leads from ACFTA policy– Imports

	(1) Lag Pref. Rates	(2) Lead Pref. Rates	(3) Lag Pref. Rates	(4) Lead Pref. Rates
Avg. Duty	-0.0124	-0.00688	-0.0146	-0.00829
	(0.00883)	(0.00636)	(0.00950)	(0.00686)
Input Tariff	-0.0513	-0.0490	-0.0372	-0.0417
Wedge_t	(0.0382)	(0.0434)	(0.0414)	(0.0460)
Input Tariff	-0.00590		-0.0145	
Wedge_{t-1}	(0.0386)		(0.0409)	
Input Tariff		0.0239		0.00936
Wedge_{t+1}		(0.0411)		(0.0441)
$\log(\text{Export})_{fpj}$	0.0103^{***}	0.0246^{***}	0.00732^{*}	0.0176^{***}
	(0.00369)	(0.00397)	(0.00402)	(0.00428)
Asean*	-0.0159	0.00154	0.00589	0.0117
$\log(\text{Export})_{fpj}$	(0.0314)	(0.0335)	(0.0348)	(0.0357)
FTA^x*	-0.00626	0.0549	-0.0381	0.0518
$\log(\text{Export})_{fpj}$	(0.0398)	(0.0469)	(0.0432)	(0.0486)
TFP			0.399^{***}	0.488^{***}
			(0.0294)	(0.0264)
Gravity	Yes	Yes	Yes	Yes
Firm Controls	No	No	Yes	Yes
R^2	0.0155	0.0312	0.0245	0.0443
N	154055	147088	132601	127892

Notes: This table examines the effects of changes in terms of trade, which allows tariff reductions from the previous period to potentially affect current trade flows. I also examine the effect of future tariff changes on current flows. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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