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

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This paper investigates the role of intermediate input sources in explaining export patterns. I present a multi-country trade model of endogenous quality whereby consumers in each country differ in their taste for quality, and firms are heterogeneous in their productivities and in their endogenous quality choices. The model features a cost complementarity between exporting and importing from a given market. Therefore, the total cost faced by a firm which does both activities in the same destination is lower than the sum of the individual costs. Exploiting China's full membership to the WTO in late 2001, I test the veracity of the model using data on Chinese manufacturing firms from 2002-2005. I provide evidence that firms which import a greater portion of inputs from a particular country earn a greater portion of export revenue shares from said country. This effect is stronger for smaller firms than for larger ones, for private firms than for state-owned enterprises, and for products with greater scope for differentiation.

Keywords: Trade liberalization, imported intermediate inputs, home bias, quality upgrading

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]

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[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).

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 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 empirical 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 coun-

[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.

tries?[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 is 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 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

[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).

[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.

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.

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 Demir's (2012) formulation 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 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;

[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.

[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.

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 (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]

[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

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

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.

[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

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 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.

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

once quality and productivity are heterogeneous across differentiated products.

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 with the

[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)

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.

2.1 Overview of 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 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 imported inputs and exports.[19] Firms that import intermediate inputs export a wider range of products, have more trade partners, and earn

[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.

[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%).

Table 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 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 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 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.

more export revenue, on average, than firms that export only.

Table 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 16 and Table 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 three categories grew from 2002 to 2005. Figure 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 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 (Figures 2 and 3). Figure 2 plots the estimated coefficients (and confidence intervals) when regressing log of export sales on

[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 16 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.

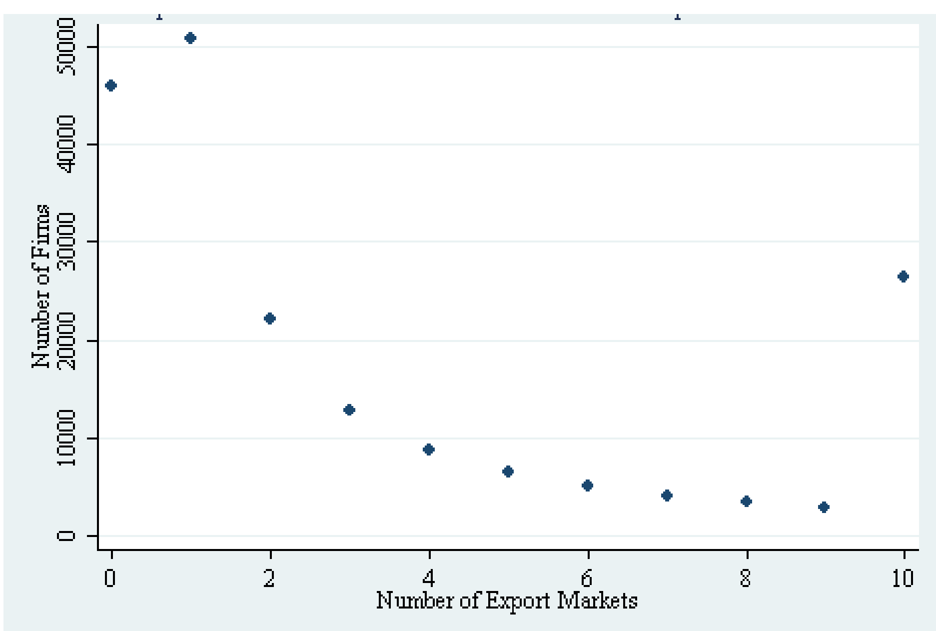

Figure 1: Number of Firms vs Number of Export Destinations 2002-2005

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 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. A qualitatively similar pattern holds when regressing the number of export destinations on dummy variables for the number of import partners and industry (Figure 3). 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.

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

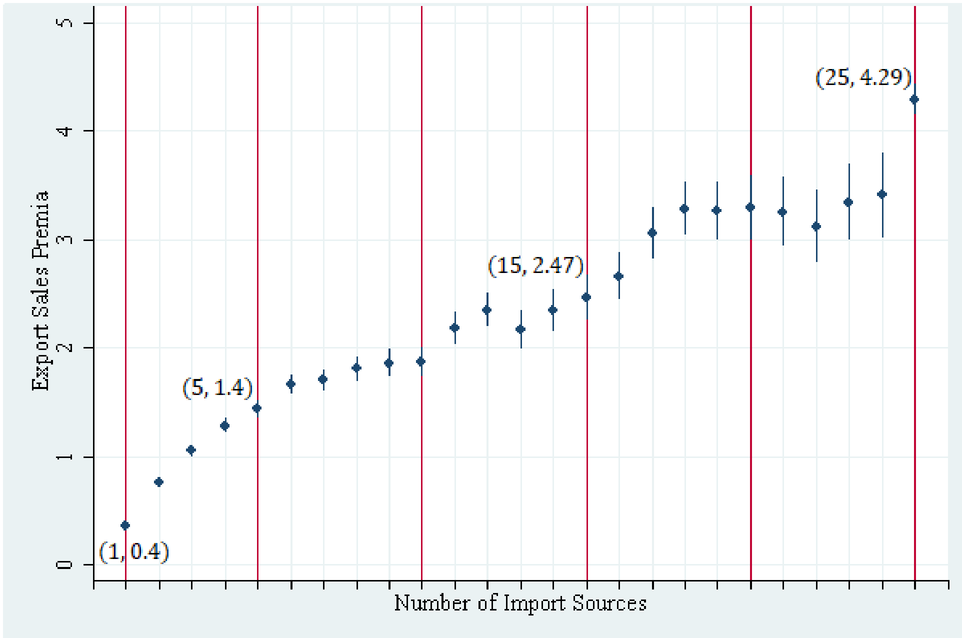

Figure 2: Export Sales Premia and Number of Import Sources 2002-2005

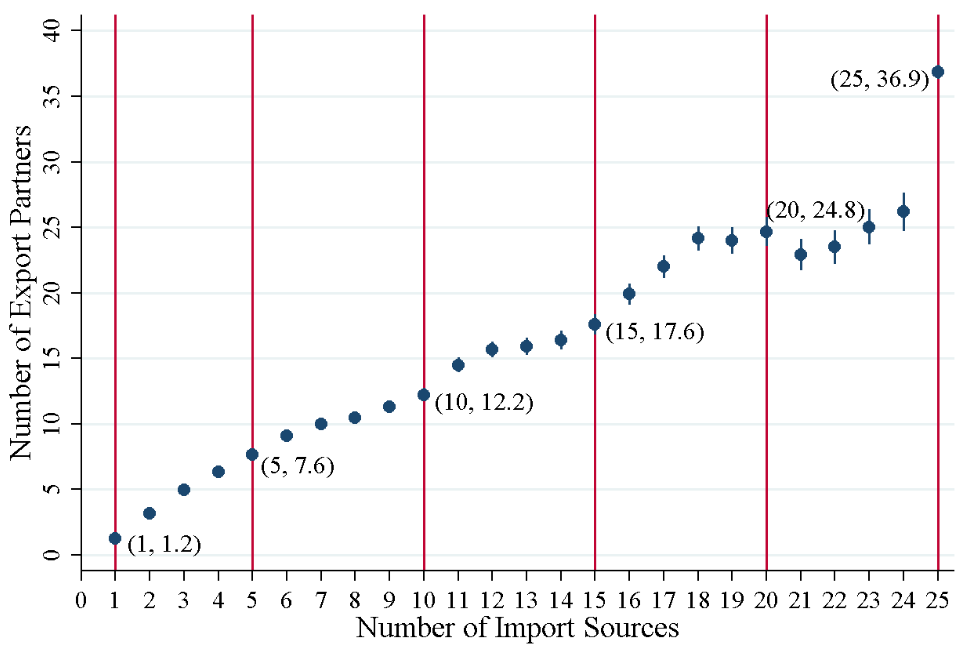

Figure 3: Number of Export Partners and Number of Import Sources 2002-2005

3 Stylized Findings

3.1 Export Patterns and Imported Intermediates Sourcing

This section unearths two stylized facts about Chinese exporters 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 group observations as firm-HS6-destination combinations.

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:

$$expratio_{fpdt} = \alpha + \beta \cdot impratio_{fdt} + \underbrace{\sum_t \delta_t + \sum_j type_j + \sum_p \Gamma_p + \sum_k \eta_k + \gamma Grav_{dt}}_{\text{Controls}} + \varepsilon_{fpdt} \quad (1)$$

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.

[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.

[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.

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.[29]. Results from estimating this specification are presented in Tables 3 to 6.

The results from estimating equation (1) when d denotes **stage of development** (North/South) are presented in Table 3. That is, observations are aggregated 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, the preliminary results suggest that a percentage point increase in the fraction of imports from destination d is

[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.

[29]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 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 in North and South subgroups respectively. Columns (4)- (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. ** $p < 0.05$, *** $p < 0.01$.

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).

Next, I estimate equation (1) when d denotes a particular **income** level and present the results in Table 4. Observations are at the firm-product-income level. Column (1) examines the full

Table 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	0.265***	0.0204***	0.0723***	0.0520***	0.0886***
(by Income)	(0.00560)	(0.00317)	(0.0148)	(0.0113)	(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. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

panel while Columns (2)-(5) present the results for each income quartile in isolation. By and large, the estimates in Table 4 are larger than those presented in Table 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 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.

Table 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	0.148***	0.0850***	0.186***	0.101***	0.0770***
(by Region)	(0.00419)	(0.00740)	(0.00744)	(0.00821)	(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) Other European Countries	(8) Africa	(9) Oceania	(10) Latin Am. and the Caribbean
Imp-Ratio	0.0414***	0.205***	0.0762***	0.145***	0.104***
(by Region)	(0.00824)	(0.0359)	(0.0219)	(0.0194)	(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. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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 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.

The results from Table 6 are in keeping with the theme presented in Tables 3 to 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. *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.*

Table 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 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.[30] 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:

$$expratio_{fpdt} = \alpha + \beta \cdot impratiosans_{fdt} + \underbrace{\sum_t \delta_t + \sum_j type_j + \sum_p \Gamma_p + \sum_k \eta_k + \gamma \cdot Grav_{dt}}_{\text{Controls}} + \varepsilon_{fpdt} \quad (2)$$

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 $\left(\text{i.e. } \frac{\sum_p Imp_{fpht} - Imp_{fpdt}}{\left(\sum_h \sum_p Imp_{fpht}\right) - Imp_{fpdt}} \right.$ where $\left. h \in \{income, region, north/south\}\right)$. 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.[31] 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,

[30] In Table 6, the relationships between *expratio* and *impratio* at the country and regional levels support the cost complementarity mechanism. Alternately, the relationships between *expratio* and *impratio* at the North/South and regional levels support the standard quality upgrading argument.

[31] 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.

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 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 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 3.2 is compatible with cost complementarities.

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.

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

4 Theoretical Model

In this section, I detail a partial equilibrium model to explain the aforementioned stylized facts and to guide 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 derived 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.

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.[32] I present the discussion from the point of view of the Southern (less-developed) country.

4.1.1 Demand

The representative consumer in each country has a two-tier utility function.[33] 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.[34] The lower-tier is a CES aggregate of differentiated goods with elasticity of substitution denoted $\sigma = 1/(1-\rho) > 1$.[35] For simplicity, the price of the homogeneous good is normalized to 1. Consumers choose quantity, $q(\omega)$, to maximize utility:

$$U_{ij} = x_{j0}^{1-\mu}\left(\int_{\omega\in\Omega_j}[a_{ij}(\omega)s(\omega)^{\gamma_j}q_{ij}(\omega)]^{\frac{\sigma-1}{\sigma}}d\omega\right)^{\frac{\mu\sigma}{\sigma-1}} \quad s.t.\ R_j \geq x_{j0} + \int_{\omega} p_{ij}(\omega)q_{ij}(\omega)d\omega \tag{3}$$

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

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

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

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

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 $s(\omega)$.[36] 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.[37]

4.1.2 Intermediate Sector

Laborers in each country supply "jobs" to produce the final good for firms in the differentiated good sector.[38] 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 $r_{N_1} = r_{N_2} = ... = r_{N_n} > r_S$

[36]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.

[37]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.

[38]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).

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, $\phi > 0$ 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.[39] 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:

$$s(\phi, I) = \left[\phi^{-b} + \Psi(I)^{-b}\right]^{\frac{-1}{b}} \tag{4}$$

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.[40] 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

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

[40] 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 $\frac{\partial^2 s}{\partial \Psi^2} < 0$.

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:

$$C(\phi, I) = \phi^{-\alpha}\left[r_s \int_0^I a(t)dt + \tau^{imp} r_N \int_I^1 a(t)dt\right] \tag{5}$$

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 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 $p_{ij}^{con}(\phi) = \tau_{ij} p_{ij}(\phi) + t_{ij}$.

4.3 Partial Equilibrium

The preferences described in equation (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

(5)– and the quality of the final good– as shown by equation (4). The firm solves:

$$\max_{p_{ij}(\phi,I),I\in[0,1]} \pi_{ij}(\phi,I) = \{q_{ij}(\phi)[p(\phi,I) - \tau_{ij}C(\phi,I)] - f_{ij} - f_{ij}^{m}\epsilon_{ij} + \zeta_{ij}\epsilon_{ij}, 0\} \quad \textit{subject to}$$
$$q_{ij}(\phi) = \frac{(R_j - x_{j0}) \cdot \left(a_{ij}(\phi,I)s(\phi,I)^{\gamma_j}\right)^{\sigma-1}}{\mathbb{P}_d^{1-\sigma}}[p_{ij}^{con}(\phi,I)]^{-\sigma} \tag{6}$$

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:

$$p_{ij}(\phi,I) = \left(\frac{\sigma}{\sigma-1}\right)C(\phi,I) + \left(\frac{1}{\sigma-1}\right)\frac{t_{ij}}{\tau_{ij}} \tag{7}$$

and

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

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:

$$\gamma_j\left(C(\phi,I) + \frac{t_{ij}}{\tau_{ij}}\right)\frac{\partial s(\phi,I)}{\partial I} - s(\phi,I)\frac{\partial C(\phi,I)}{\partial I} = 0 \tag{8}$$

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 9); and 2. a higher I lowers the quality of the product (equation 10) which lowers its demand.[41] These two points are shown below:

[41] Using the result from equation 8 shows that the partial derivative of $q(\phi,I)$ with respect to I is negative.

$$C(\phi, I) = \phi^{-\alpha}\left[r_s \int_0^I a(t)dt + \tau^{imp} r_N \int_I^1 a(t)dt\right]$$
$$\Rightarrow \frac{\partial C(\phi, I)}{\partial I} = \phi^{-\alpha} r_S[a(I)] - \tau^{imp} r_N[a(I)] \quad (9)$$
$$\Rightarrow \frac{\partial C(\phi, I)}{\partial I} = \phi^{-\alpha}[r_S - \tau^{imp} r_N] \cdot a(I) < 0$$

$$s(\phi, I) = [\phi^{-b} + \Psi(I)^{-b}]^{\frac{-1}{b}} \Rightarrow \frac{\partial s(\phi, I)}{\partial I} = \frac{\partial s(\phi, I)}{\partial \Psi}\frac{\partial \Psi}{\partial I} \quad (10)$$

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
   - From equation (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 (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 (4): $\frac{\partial q(\phi,I)}{\partial s} > 0$

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.

4.5 Profits and Productivity Cutoffs

Given a Southern firm's rule for endogenously choosing I in a particular market (equation 8), I can now discuss profits and cutoff productivities. Using the firm's 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:

$$\pi_{ij}(\phi, I) = \frac{r_{ij}}{\sigma} - f_{ij} - f_{ij}^{imp}\epsilon_{ij} + \zeta_{ij}\epsilon_{ij} \tag{11}$$

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:

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

$$\Rightarrow \quad (\phi_{ii}^*)^\alpha = \left[\frac{\sigma(f_{ii})}{R_i - x_{i0}}\right]^{\frac{1}{\sigma-1}} A(T) \frac{1}{\rho \mathbb{P}_i a_{ii}} \tag{12}$$

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

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

$$\Rightarrow \quad (\phi_{ij}^*)^\alpha = \left[\frac{\sigma(f_{ij})}{R_j - x_{j0}}\right]^{\frac{1}{\sigma-1}} A(T) \frac{\tau_{ij}}{\rho \mathbb{P}_j a_{ij}} \tag{13}$$

Using equation (12), I can express equation (13) in terms of the exit cutoff:

$$(\phi_{ij}^*)^\alpha = (\phi_{ii}^*)^\alpha \left[\frac{f_{ij}}{f_{ii}} \frac{(R_i - x_{i0})}{(R_j - x_{j0})}\right]^{\frac{1}{\sigma-1}} \tau_{ij} \frac{\mathbb{P}_i a_{ii}}{\mathbb{P}_j a_{ij} s_j^{\gamma_j}} \tag{14}$$

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

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

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

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

$$(\phi^*_h)^\alpha = (\phi^*_{ii})^\alpha \tau_{ij} \left[\frac{(f^{imp}_{ij} - \zeta_{ij})}{f_{ii}} \frac{(R_i - x_{i0})}{(R_j - x_{j0})} \right]^{\frac{1}{\sigma-1}} \frac{\mathbb{P}_i a_{ii}}{\mathbb{P}_j a_{ij} s_j^{\gamma_j}} \left[\frac{A(T)^{1-\sigma}}{A(t)^{1-\sigma} - A(T)^{1-\sigma}} \right] \tag{15}$$

Comparing the export cutoff with the importing cutoff:

$$\left(\frac{\phi^*_h}{\phi^*_x} \right)^\alpha = \left[\frac{(f^{imp}_{ij} - \zeta_{ij})}{f_{ij}} \right]^{\frac{1}{\sigma-1}} \left[\frac{A(T)^{1-\sigma}}{A(t) - A(T)^{1-\sigma}} \right]^{1-\sigma} > 1 \tag{16}$$

I obtain a similar sorting outcome to Bustos (2011) with respect to market size and fixed costs of exports. I also show that 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.

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 examine 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 equally. 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.[42]

The pervasive factor connecting all the insights and productivity thresholds is the endogenous

[42] This scenario is more representative of the findings presented in Section 3.

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.

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.

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):

$$expratio_{fpdt} = \alpha + \beta \cdot impratio_{fdt} + Controls + Characteristics_f + \varepsilon_{fpdt} \tag{17}$$

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 $\big($ i.e $expratio_{fpdt} = \frac{Rev_{fpdt}}{\sum\limits_{d} Rev_{fpdt}}\big)$, and the import measure is the fraction of a firm's total expenditure on imported intermediates sourced from d $\big($ i.e. $impratio_{fdt} = \frac{\sum\limits_{p} Imp_{fpdt}}{\sum\limits_{d}\sum\limits_{p} Imp_{fpdt}}\big)$. 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.[43]

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 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).

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.

[43] 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.

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.[44] If the access to imported intermediates changes due to changes in 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.[45,46] 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

[44] Firms may also face limitations in working capital available due to credit constraints which effectively increases costs associated with importing inputs (Feng, Li, Swenson, 2016)

[45] 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

[46] 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)

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 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.[47] 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.[48] 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.

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.[49]

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

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

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

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

industry-levels:

$$FirmDuty_{fdt} = \sum_{p=1}^{P_f^M} \left(\underbrace{\left(\frac{Import_{pfd}^{2002}}{\sum_{p=1}^{P_f^M} \sum_{d=1}^{D} Import_{pfd}^{2002}} \right)}_{W_{fd}} \tau_{pt} \right) \tag{18}$$

$$IndusDuty_{jdt} = \sum_{p=1}^{P_j^M} \left(\underbrace{\left(\frac{Import_{pjd}^{2002}}{\sum_{p=1}^{P_j^M} \sum_{d=1}^{D} Import_{pjd}^{2002}} \right)}_{W_{jd}} \tau_{pt} \right) \tag{19}$$

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.[50] The firm-level measure is suggested by the theoretical model and captures intensive margin effects of tariff reductions on the initial import bundle.[51] 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.

[50] 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 8 as firm-wide averages.

[51] 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:

$$ImRER_{jdt} = \sum_{d=1}^{D} \left(\underbrace{\left(\frac{Import_{jd}^{2002}}{\sum_{d=1}^{D} Import_{jd}^{2002}} \right)}_{\omega_{jd}} rer_{ct} \right) \quad (20)$$

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.

6 Main Findings

In this section, I present the main results using a sample of non-processing Chinese manufacturing exporters.[52] 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 robustness checks. The proceeding results are based on the matched data at the firm-product-country level.

[52]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.

6.1 Baseline Results

Table 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.[53] More importantly, 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

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

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 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 the Stock and Yogo critical values; confirming that the selected instruments are appropriate.[54] The KP Lagrange Multiplier (LM) tests reject the null of under-identification, and the Anderson-Rubin tests suggest the model is not misspecified.[55]

Overall, the baseline results support the three major arguments of this study: 1. Imports

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

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

Table 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 (by Country)	0.337*** (0.0196)						
Imp-Ratio (by North/South)		0.352*** (0.136)					
Imp-Ratio (by Region)			0.271*** (0.0229)				
Imp-Ratio (by Income)				0.291** (0.117)			
Imp-Ratio (by North/South sans d)					-0.539*** (0.0536)		
Imp-Ratio (by Region sans d)						-0.170*** (0.0542)	
Imp-Ratio (by Income sans d)							-0.488*** (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
Real Exchange	-.003**	.0005	-.0002	.0005	.002***	-.0012***	.0017***
Industry Tariff	.0169***	.0029***	.015***	.0034***	.0015***	.0042***	.002***
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 (Corresponding)	0.201*** (0.00631)	0.0213 (0.0147)	0.168*** (0.00634)	0.0257** (0.0128)	-0.425*** (0.00542)	-0.696*** (0.0136)	-0.461*** (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. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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.

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 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 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 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)
Product-Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
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 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.

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 10 presents the results when the dependent variable is export share at the firm-product-

Table 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	0.382***	0.318***	0.391***	0.383***	0.286***	0.213***
(by Country)	(0.0351)	(0.0383)	(0.0273)	(0.0843)	(0.0757)	(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
Real Exchange	-.0018***	-.0022	-.0015	.0014	-.0009	-.0007
Firm Tariff	.0045***	.0043***	.004***	.0045***	.0045***	.0047***
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	0.235***	0.189***	0.289***	0.195***	0.138***	0.137***
(Corresponding)	(0.0175)	(0.0220)	(0.0151)	(0.0390)	(0.0261)	(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. ** $p < 0.05$, *** $p < 0.01$

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 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).

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 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 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.

Table 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)
Product FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
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. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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 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.

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.

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 8 to 11 as firm-wide averages.[56]

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

I first replicate the exercise conducted in Table 8 with the dataset of single-product firms. The findings are reported in Table 12. The estimated coefficients diverge from baseline estimates but adds

[56] 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 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. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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 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.[57] However, the results are much more stable/comparable with the baseline results. Again, this supports the cost complementarity mechanism I propose.

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 6.2 (Table 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 13.

The estimated coefficients for import share are exactly as expected. Resource-intensive 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 9 and corroborates the quality ladder assertion unambiguously.[58]

[57] The corresponding results from Table 8 for the "like me but not me" exercise were quantitatively similar for all specifications.

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

Table 13: Scope for Differentiation: Single Sector Exporters

	Dependent Variable: Export Ratio (by Country)					
	(1) High Skill	(2) Medium Skill	(3) Low Skill	(4) Mineral Fuels	(5) Non-Fuel Comms	(6) 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) (Country)	(2) (Country)	(3) (Country)	(4) (Country)	(5) Country	(6) Country
Real Exchange	-.0009	.0026	.0036**	-.0048	.0027	.0029
Firm Tariff	.0099***	.0033***	.006***	.0033***	.008***	.007***
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. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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 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 14) are almost identitical to those presented in the baseline specification (Table 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 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. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

8 Conclusion

One of the more prominent arguments in the trade literature is that access to imported intermediates induces 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 derive a theoretical model which relates a firm's export patterns to its imported intermediate sources, 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 the fraction of imports sourced from a particular destination. To address endogeneity concerns, I estimate the empirical model using IVs; instrumenting import shares with real exchange rate changes, firm-level tariff cuts, and industry-level tariff cuts. I find that a one percentage point increase in a firm's fraction of imports from a particular country leads to a .34 percentage point increase in the share of product-export revenue from said country. The relationship 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.

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9 Appendix

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).[59] 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.
  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

[59] 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).

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.

9.2 Optimal Profit

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

$$\pi^*(\phi, I) = \frac{(R - x_0) \cdot \left(a(\phi, I)s(\phi, I)^{\gamma}\right)^{\sigma-1}}{(\sigma - 1) \cdot \mathbb{P}^{1-\sigma}} \left[\frac{\sigma}{\sigma - 1}\right]^{-\sigma} C(\phi, I)^{1-\sigma} \tag{21}$$

Result 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 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 $a(\cdot)$.

9.3 Comparative Statics (ϕ)

Rewrite equation (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 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 9.2 predicts that there is a positive correlation between input quality and firm-productivity. Ostensibly, Result 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.

9.4 Comparative Statics (γ)

From equation (7):

$$D_I = \gamma(C(\phi, I) + t)\frac{\partial s(\phi, I)}{\partial I} - s(\phi, I)\frac{\partial C(\phi, I)}{\partial I} = 0 \tag{22}$$

Totally differentiate equation (1.14) with respect to γ and I to get: [60]

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

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

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 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 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).

9.5 Comparative Statics (t)

Totally differentiate equation (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 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 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.

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

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.

9.6 Comparative Statics (λ)

Totally differentiate equation (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 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 9.5 has been established from a static perspective. Presumably, in the real world, λ monotonically increases over time. By design, Result 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 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 16: Number of Products Exported- Customs Data

# Export Products	# Firms (%)	% Value	# Firms (%)	% Value	# Firms (%)	% Value
(HS 6-digit)	All Years		2002		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 17: Number of Export Partners- Customs Data

# Export Markets	# Firms (%)	% Value	# Firms (%)	% Value	# Firms (%)	% Value
(Countries)	All Years		2002		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.