

INTRA-FIRM TRADE AND PRODUCT CONTRACTIBILITY (long version)*

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Abstract

This paper examines the determinants of intra-firm trade in U.S. imports using detailed country-product data. We create a new measure of product contractibility based on the degree of intermediation in international trade for the product. We find important roles for the interaction of country and product characteristics in determining intra-firm trade shares. Intra-firm trade is high for products with low levels of contractability sourced from countries with weak governance, for skill-intensive products from skill-scarce countries, and for capital-intensive products from capital-abundant countries.

Keywords: Related party trade, imports, contract theory, contractibility, intermediation, human capital, physical capital

JEL classification: F23, F14, L14, L22, L23, L24

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1. Introduction

Research on multinational firms has recently been extended to incorporate elements of contract theory. This literature addresses firms' decisions to source components in-house versus at arm's length and their choices over whether to locate production at home or abroad. It differs from earlier work on multinationals in its emphasis on the costs associated with writing contracts for specialized inputs and on the importance of traded intermediate goods.

This paper provides an empirical examination of the determinants of intra-firm trade. We use detailed U.S. import data to characterize the product and country attributes that determine firms' decisions to import from related parties rather than at arm's length. Theoretical models addressing this issue focus on the ability of the firm to write contracts for the production of specialized inputs. We introduce a new measure of products' revealed contractibility based on the idea that contracting is easier for products that are traded by intermediaries such as wholesalers.

Forty-six percent of U.S. imports occur between related parties in 2000. This aggregate statistic, however, obscures considerable variation in intra-firm intensity across import partners as well as products. Indeed, while 74 percent of U.S. imports from Japan are intra-firm, the figure for Bangladesh is just 2 percent. Likewise, trade between related parties accounts for 2 percent of U.S. imports of rubber and plastic footwear, but more than 70 percent of U.S. imports of autos, medical equipment and instruments. There is also significant variation in intra-firm intensity *across* countries *within* products.

These figures highlight the importance of product and country characteristics – and especially their interaction – in explaining intra-firm trade. Such factors are emphasized in recent theoretical models of multinational firms that stress the role of contracting in firms' decisions both to source components in-house versus at arm's length and to locate production at home versus abroad.¹ These models differ from earlier theories of multinationals in their emphasis on the costs associated with writing contracts for specialized inputs and the attention they pay to traded intermediate goods. Guided by these models, we examine the product and country determinants of intra-firm trade.

Our findings are related to the large theoretical literature on international trade and the boundaries of the firm, including in particular Antràs (2003), Antràs and Helpman (2004), and Grossman and Helpman (2002, 2005). Our findings are also related to the recent empirical literature examining the predictions of these models, including Corcos

¹See, for example, Pol Antràs (2003), Pol Antràs and Elhanan Helpman (2004), and Gene M. Grossman and Elhanan Helpman (2005).

et al. (2008), Defever and Toubal (2007), Nunn and Trefler (2008) and Yeaple (2006). More generally, our findings are related to the recent literature on institutions and trade, including Levchenko (2007) and Nunn (2007).

We find that our measure of contractibility and countries' governance quality are associated with variation in intra-firm trade in interesting and intuitive ways, and that factors associated with engaging in related-party trade differ from those associated with the intensity of intra-firm trade once a link is established. Higher-quality country governance, for example, is associated with a higher probability of related-party trade taking place. Further increases in quality, however, coincide with *lower* shares of related-party trade, presumably due to the greater ease with which arm's-length contracts can be written. With respect to interactions of product and country attributes, improvements in country governance lead to the largest reductions in intra-firm trade in low contractibility products.

2. Data

We use the U.S. Linked/Longitudinal Firm Trade Transaction Database (LFTTD), which links individual U.S. trade transactions to U.S. firms.² For each import transaction, we observe the U.S. firm engaging in the transaction, the ten-digit Harmonized System (HS) classification of the product shipped, the (nominal) value shipped, the shipment date, the source country, and whether the transaction takes place at "arm's length" (AL) or between "related parties" (RP). Import partners are "related" if either party owns, directly or indirectly, 6 percent or more of the other party.³ To concord SIC production and HS trade data, and to expand the sample of countries on which data on country characteristics are available, we focus on the year 1997.

To explore the role of various country characteristics discussed below, we combine these trade data with measures of physical capital abundance, human capital abundance, and population from Robert E. Hall and Charles I. Jones (1999), a composite index of countries' governance quality from the World Bank, and measures of trade and FDI protection from Heritage Foundation/WSJ (2006). We use factor analysis to create a univariate measure of country governance for 1996 from the six World Bank measures reported by Daniel Kaufman, Aart Kraay and Massimo Mastruzzi (2006). The first factor accounts for around 90 percent of the variance of each of the six component measures and

²See Andrew B. Bernard, J. Bradford Jensen and Peter K. Schott (2009) for more details.

³This dataset excludes the U.S. Postal Service and firms in agriculture, forestry and fishing, railroads, education, public administration and several smaller sectors.

we use this factor as the indicator of governance in our empirical work.

We measure products' capital and skill intensity using data from the 1997 U.S. Census of Manufactures. We assign all ten-digit HS products within a particular four-digit SIC industry the average physical capital or skill intensity of all plants whose output is concentrated in that industry. Physical capital intensity is measured as the log of the book value of plant and equipment per employee while skill is non-production workers as a share of employment. Industry headquarters intensity is measured by the average share of firm employment at headquarters and auxiliary establishments.

3. Intra-firm imports

This section documents the extent of U.S. intra-firm imports by trading partner and industry. To maximize our ability to report results across countries and industries, we use recently published, publicly available data on related-party trade from the Foreign Trade Division of the U.S. Census Bureau.⁴ The industry data on related-party trade is reported according to the North American Industry Classification System (NAICS) and, as a result, differs from the more detailed Harmonized System codes available in the LFFTD and employed in the subsequent regression analysis.

3.1. *By Country*

We begin by considering variation in related-party imports across countries in 2000. The data are summarized in Table 1 which reports the level of imports and the share of related-party imports by country. Over 46 percent of U.S. imports are intra-firm and there is wide range in intensity of intra-firm trade across countries. For the average country, 23.8 percent of exports to the U.S. are intra-firm and more than a quarter of countries have intra-firm shares less than 5 percent. On the low end, imports from Bangladesh are almost entirely arms-length transactions, with just 2 percent of the total value of imports taking place inside the firm. In contrast, imports from Japan and Ireland are dominated by intra-firm transactions. In 2000, 76 percent of the value of imports from Ireland and 74 percent of the imports from Japan were conducted by multinationals trading with related foreign divisions. Anecdotal publicly-available evidence would suggest that the intra-firm imports of Ireland and Japan stem from different types of organizations. Japanese intra-firm shipments to the U.S. are likely trades between Japanese parents and

⁴We choose 2000 as it is the year closest to the product-country import data used in our empirical specifications below. The original data source for all the results in this section is <http://sasweb.ssd.census.gov/relatedparty>.

U.S. subsidiaries, while Irish intra-firm shipments are more likely to be between Irish subsidiaries and U.S. parents, or U.S. affiliates of European multinationals.

In general, countries that account for low shares of U.S. intra-firm imports are less developed and have lower overall import volumes, while high-income countries in the OECD generally report above average intra-firm imports to the United States. Imports from China, the fourth largest source of U.S. imports in 2000, are still largely conducted between unrelated parties with just 18 percent exchanged inside the firm.

3.2. *By Industry*

As with the country-level data, industries vary widely in the extent to which their trade takes place within firms.⁵ Imports of leather, textiles and apparel are dominated by arms-length transactions while more than half of imports in transportation equipment, computers and electronics products and chemicals are conducted between related parties. Table 2 reports the manufacturing industries with the 20 highest and 20 lowest shares of related-party trade in 2000 using 6-digit NAICS industries. Footwear industries are heavily represented in the low end of the distribution of intra-firm trade shares. In rubber and plastic footwear, for example, intra-firm imports account for just 1.8 percent of total imports. Imports of autos and related equipment, medical equipment and pharmaceuticals, and instruments, on the other hand, are dominated by intra-firm transactions. In each of these industries, more than 70 percent of all imports are between related parties.

These industry averages obscure important variation across countries within products. Figure 1 shows the distribution of imports of Photo Films, Plates and Chemicals (NAICS 325992) across countries. This industry has fifth highest share of intra-firm imports. The figure shows both the share of intra-firm imports from each country (line - left axis) and the level of overall imports (bar - log scale right axis). The countries are sorted by the share of intra-firm imports in total imports in 2000. While the industry as a whole has a high level of intra-firm trade, there is substantial variation across countries. Half the countries, including most of the major exporters by volume, have intra-firm shares greater than 70 percent. Most of the remaining countries, including a number of middle income and developing countries, have little or no related-party trade to the U.S..

This pattern of heterogeneous intra-firm shares across countries within industries is the norm rather than the exception. Figure 2 shows the same picture for imports of Other

⁵In this section we use publicly available data from the foreign trade division of the Census Bureau. As a consequence these table use the NAICS industry classification system. In our regression results below we use the much more disaggregated 10-digit products of the Harmonized System.

Footwear (NAICS 316219).⁶ This industry has sixth lowest share of intra-firm imports but again there is a wide variation in related party shares ranging from 100 percent to zero. This variation in intra-firm imports shares within industries across countries motivates our use of both country and product characteristics and their interaction in our subsequent empirical work.

4. "Revealed Contractibility"

We assume that products passing through intermediaries are the easiest over which to contract. As a result, we measure products' "revealed" contractibility as the weighted average wholesale employment share of firms importing the product, using firms' import value as weights,

$$IMED_p = \sum_f \frac{W_f}{EMP_f} \frac{M_{pf}}{M_p}. \quad (1)$$

The first term in the intermediation measure is the share of wholesale employment (W_f) in firm f 's total employment (EMP_f).⁷ The second term is the import share of firm f in ten-digit HS product market p , with M_{pf} and M_p representing firm f 's imports of product p and total U.S. imports of product p , respectively. Intermediation ranges between zero and unity: if no firms importing product p have any wholesale establishments, $IMED_p = 0$. On the other hand, if product p is imported exclusively by firms with 100 percent employment in wholesaling, $IMED_p = 1$.

Table 3 reports the intermediation measure for HS2 industries in 1997. Industries are sorted according to intermediation, from low to high. Across industries, intermediation averages 0.241, ranging from 0.012 in non-railway vehicles (HS 87) to 0.631 in lead (HS 78), with an interquartile range of 0.123 to 0.345. Agricultural goods and relatively labor intensive industries such as apparel and footwear generally have the highest measured intermediation, while more "sophisticated" products such as vehicles, pharmaceuticals, chemicals and photographic goods have the lowest measures of intermediation.

Intermediation and intra-firm import shares are inversely related across two-digit HS categories, as shown in Figure 1. There is however substantial independent variation in the two variables, as industries with similar levels of intermediation span a wide range of intra-firm intensity. Footwear (HS 64) and Organic Chemicals (HS 29), for example, have

⁶Only countries with more than \$100,000 of U.S. imports are shown.

⁷We observe employment at the establishment level and therefore assign all employees in an establishment to the major industry of the establishment. Firms with a single establishment necessarily have 100 percent employment in a single industry. Wholesale is NAICS sector 42.

comparable levels of intermediation, 0.135 and 0.136 respectively. However, more than half of Organic Chemicals imports are conducted by related parties while the intra-firm trade share for Footwear is less than 10 percent.

5. Determinants of intra-firm trade

Our empirical analysis uses cross-sectional data on intra-firm and total U.S. imports of product p from county c in 1997. Our empirical specification regresses measures of intra-firm trade (IF_{pc}) on product characteristics (X_p), country characteristics (Z_c) and interactions between product and country characteristics ($X_p \times Z_c$):

$$IF_{pc} = \theta + \alpha X_p + \beta Z_c + \gamma (X_p Z_c) + \epsilon_{pc}, \quad (2)$$

We consider two measures of intra-firm trade: the share of intra-firm imports in U.S. imports, which we refer to as the “intensive” margin, and a dummy variable which is equal to one if there are positive intra-firm imports for a product from a country, which we call the “extensive” margin. In constructing the interaction terms, we subtract the sample mean from each variable entering the interaction term. This normalization ensures that the main effects of each variable can be interpreted as the effect at the sample mean.

Our choice of product and country characteristics is motivated by the recent theoretical literature on contractual frictions and international trade. This literature emphasizes the relative importance of relationship-specific investments by headquarters and supplier firms and the degree of verifiability of these investments. In Antràs (2003), capital intensity captures the relative importance of headquarters’ investments, and hence we include industry capital intensity and country capital abundance. To allow for the possibility that other factor intensities matter, we also include industry skill intensity and country skill abundance. In Antràs and Helpman (2004), headquarters investments are interpreted more broadly, and hence we include the direct measure of headquarters intensity noted above. In Grossman and Helpman (2005), the degree of verifiability of relationship-specific investments can vary with product and country characteristics, and hence we include revealed product contractibility and country governance as further independent variables. Finally, we explore the impact of policy-based barriers by including measures of trade and FDI protection as country characteristics.

Table 4 reports the results of estimating specification (2). Columns (1) and (3) use the extensive margin as the dependent variable, so the sample comprises all product-country cells with positive imports, including those with zero intra-firm trade. Columns (2) and

(4) focus on the intensive margin, and the sample is all observations with positive intra-firm trade. Columns (3) and (4) control for the non-random selection of observations with positive intra-firm imports using the Heckman two-stage estimation procedure. The two stages are separately identified by functional form and the excluded variable from the second-stage regression. For the excluded variable, we choose the cost of phone calls to the US, which arguably affects the fixed costs of establishing an affiliate but not the relative variable costs of intra-firm versus arms-length trade.⁸

We find an important role for revealed contractibility on both the intensive and extensive margins of intra-firm trade. Consistent with the recent theoretical literature on contractual frictions in international trade, columns (1) and (2) show that higher revealed product contractibility is associated with less intra-firm trade. The role of the contracting environment varies across the intensive and extensive margins. Increases in governance quality raise the probability that foreign affiliates are present (column 1), but are associated with lower shares of intra-firm trade (column 2). This result suggests good governance promotes the establishment of related-party trade but not its intensity once established, which is consistent with the idea that arm's-length contracting is easier in countries with good governance. This non-linearity in the role of the country contracting environment is not formally developed in existing theoretical models. Similar differences between the intensive and extensive margins are present for population and FDI protection.

Results in Table 4 also indicate the significance of interactions of product and country characteristics in determining intra-firm trade. While the main effects for intermediation and country governance are both negative in column (4), the interaction term has a positive coefficient. That is, improved governance is associated with less intra-firm trade, especially for goods with lower revealed contractibility.

In contrast to previous work, we also find a role for industry skill intensity and country skill abundance. The main effects of industry skill intensity on intra-firm trade are positive for both the intensive and extensive margins; the main effects of country human capital abundance are negative; and the estimated coefficients on the skill interaction terms are negative. Therefore, greater industry skill intensity increases the share of intra-firm trade, and leads to larger increases in more skill-scarce countries. In contrast, greater country skill abundance reduces the share of intra-firm trade, and leads to larger reductions in more skill-intensive products. As in Antràs (2003), industry capital intensity

⁸The likelihood ratio test of $\rho=0$ yields a chi-squared statistic of 26.21, rejecting the null of independent equations.

and country capital abundance play a role in determining the share of intra-firm trade. The positive coefficient on the interaction between industry capital intensity and country capital abundance implies that intra-firm trade shares are high for capital-intensive products coming from capital-abundant countries. Both FDI and trade protection influence intra-firm trade; headquarters intensity is not statistically significantly associated with intra-firm trade shares.

In Table 5, we repeat the OLS specification from column (2) in Table 4 with a complete set of country and product fixed effects to examine the robustness of the results on the interaction terms. The contractibility-governance and human capital interactions retain their sign and significance while the interaction on physical capital is insignificant.

5.1. Robustness

In this section we explore the robustness of the results to alternative specifications. Column 1 of Table 6 repeats the preferred specification from column 4 in Table 4. In columns 2-4, we drop sectors that contain firms that do not conform strictly to the existing theoretical models. The literature on multinationals and contracting envisions a producing firm headquartered in an advanced country importing intermediate goods, potentially from its affiliates. Our results in column 1 include all imports, including imports of final goods and imports by U.S. affiliates of foreign multinationals. Column 2 excludes sectors that are intensive in foreign-owned firms, column 3 drops final goods products and column 4 drops both at once.⁹ None of the coefficients change sign or significance and all the main conclusions are robust to these sample changes.

In the final three columns of Table 6, we include additional regressors considered in related empirical work. Column 5 adds a measure of industry R&D intensity, the R&D to sales ratio which is only available for a subset of industries.¹⁰ The R&D coefficient is positive and significant, confirming results in Antràs (2003), Yeaple (2006) and others. Adding industry R&D intensity eliminates the significance of the physical capital interaction as well as that of human capital intensity. Finally in columns 6 and 7, we add the measure of contractibility suggested by Nunn (2007) based on the proportion of each

⁹To identify sectors that are intensive in foreign affiliate imports, we use the Bureau of Economic Analysis measure of US imports shipped to affiliates by the foreign parent group by sector. We construct a measure foreign input intensity by dividing the imports shipped to affiliates by employment in an industry. High foreign affiliate industries are those above the mean. Data is available at http://www.bea.gov/scb/account_articles/international/iidguide.htm#FDIUS. We follow the classification of Sitchinava (2007) to identify product categories that are final good imports. All columns of Table 6 report the second stage of a Heckman specification with the cost of phone calls as the excluded variable in the second stage.

¹⁰R&D are available from the NSF at http://www.nsf.gov/statistics/iris/history_pub.cfm.

industry's intermediate inputs that are relationship-specific and therefore susceptible to potential contracting problems.¹¹ Column 7 includes an interaction of the Nunn measure with the country governance measure. The Nunn measure is positive and significant, as found by Nunn and Trefler (2008), but does not affect the revealed contractibility measure or its interaction. The interaction term is negative and significant, which combined with the negative main effect of country governance implies that improvements in country governance are associated with the largest reductions in intra-firm trade in sectors with more relationship-specific inputs. These results suggest that the Nunn measure of input sophistication and our measure of intermediation may be capturing different aspects of product contractibility both of which interact with country governance in shaping whether trade occurs within the boundary of the firm.

6. Conclusions

The literature on firms and international trade has focused attention on issues of contracting and the boundaries of the firm. This research speaks to policy issues surrounding the growth of outsourcing, offshoring and international production networks.

Our results provide evidence on the role of country governance and product contractibility in determining intra-firm trade. We find evidence of selection: the decision to establish a foreign affiliate in a country differs from the choice of how much to source from the affiliate once it is established. While affiliates are more likely to be situated in countries that are larger and have better governance, once affiliates exist, the share of intra-firm trade is negatively related to both country size and country governance quality.

Our findings both complement and extend the existing empirical literature on intra-firm trade. Our results confirm the role of industry capital intensity and country capital abundance in influencing intra-firm trade. Our results also point to the role of other interactions between country and product characteristics and their interactions.

¹¹According to Nunn (2007), relationship specific inputs are those that are not traded on organized exchanges as measured by Rauch (1999).

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Country/Territory	Total Imports (millions)	Related-Party Import Share	Country/Territory	Total Imports (millions)	Related-Party Import Share	Country/Territory	Total Imports (millions)	Related-Party Import Share
Brunei	387	0.000	United Arab Emirates	937	0.073	Bosnia-Herzegovna	18	0.296
Lesotho	140	0.000	India	10,680	0.077	Kuwait	2,499	0.307
Equatorial Guinea	155	0.000	Nicaragua	597	0.078	Italy	24,790	0.312
Palau	14	0.001	Qatar	491	0.078	Portugal	1,571	0.321
Turkmenistan	28	0.001	Bulgaria	231	0.081	Bolivia	184	0.327
Micronesia	14	0.002	Guyana	127	0.083	Czech Republic	1,069	0.334
Republic of Yemen	151	0.002	Belarus	104	0.086	Thailand	16,300	0.340
Mozambique	24	0.003	Cyprus	23	0.086	St Lucia	22	0.342
Botswana	41	0.003	Ecuador	2,267	0.089	Norway	5,540	0.353
Swaziland	53	0.005	Turkey	3,027	0.095	Nigeria	9,680	0.364
Oman	257	0.006	Kenya	109	0.097	Maldives	94	0.368
Uzbekistan	35	0.007	Panama	297	0.105	Iraq	4,393	0.372
Mauritius	286	0.008	Ghana	206	0.114	New Zealand	2,055	0.379
Algeria	2,690	0.008	Guatemala	2,603	0.122	Morocco	456	0.380
Cambodia	824	0.009	Lithuania	132	0.123	Gabon	2,038	0.403
Faroe Islands	31	0.011	Netherlands Antilles	721	0.126	France	29,430	0.410
Madagascar	158	0.011	Ivory Coast	367	0.136	Belgium	9,844	0.415
Namibia	42	0.015	Sri Lanka	2,002	0.137	Iceland	260	0.416
Bermuda	39	0.015	Hong Kong	11,350	0.140	Slovakia	242	0.421
Bangladesh	2,416	0.019	Tanzania	35	0.142	Bahamas	273	0.434
Ethiopia	29	0.023	Congo (Kinshasa)	212	0.145	Canada	229,100	0.440
Burma (Myanmar)	468	0.024	Barbados	38	0.145	Denmark	2,953	0.451
Macedonia (Skopje)	138	0.025	South Africa	4,204	0.151	El Salvador	1,925	0.456
Cameroon	146	0.027	Venezuela	17,430	0.151	Dominican Republic	4,378	0.459
Uganda	29	0.031	Greece	602	0.157	Jamaica	632	0.475
Peru	1,985	0.032	Georgia	24	0.160	United Kingdom	42,840	0.488
British Virgin Islands	31	0.032	Argentina	3,095	0.163	St Kitts and Nevis	37	0.493
Nepal	229	0.032	Bahrain	338	0.164	Philippines	13,940	0.496
Uruguay	309	0.033	Ukraine	872	0.166	Austria	3,118	0.506
Pakistan	2,164	0.035	Zambia	18	0.173	Honduras	3,091	0.519
Haiti	297	0.035	Chile	3,258	0.179	Suriname	135	0.523
Macao	1,265	0.036	China	99,580	0.181	Switzerland	10,090	0.536
Fiji	146	0.036	Malawi	68	0.189	Netherlands	9,679	0.536
Angola	3,343	0.036	Tunisia	91	0.200	Saudi Arabia	14,330	0.549
Estonia	542	0.038	Romania	471	0.215	Korea, South	39,830	0.554
Mongolia	117	0.039	Taiwan	40,380	0.216	Luxembourg	331	0.575
Iran	169	0.043	Croatia	141	0.218	Finland	3,238	0.617
Paraguay	42	0.045	Indonesia	10,320	0.228	Malaysia	25,450	0.645
Papua New Guinea	37	0.046	Colombia	6,681	0.228	Germany	58,350	0.647
Jordan	73	0.046	Aruba	1,222	0.229	Mexico	134,700	0.661
Azerbaijan	20	0.046	French Polynesia	44	0.231	Malta	462	0.675
Lebanon	76	0.050	Spain	5,674	0.241	Costa Rica	3,555	0.692
Vietnam	827	0.053	Slovenia	314	0.242	Hungary	2,711	0.694
Moldova	105	0.060	Israel	12,950	0.248	Sweden	9,570	0.700
Armenia	23	0.063	Kazakhstan	432	0.253	Singapore	19,110	0.727
Zimbabwe	113	0.065	Trinidad and Tobago	2,179	0.253	Japan	145,700	0.743
Greenland	16	0.066	Russia	7,761	0.266	Ireland	16,370	0.761
Grenada	27	0.066	Congo (Brazzaville)	508	0.272	Guinea	88	0.882
Syria	150	0.068	Poland	1,040	0.275	Liechtenstein	293	0.886
Latvia	295	0.068	Monaco	23	0.275	Liberia	45	0.888
Egypt	925	0.070	Australia	6,213	0.290	New Caledonia	31	0.972
Belize	91	0.073	Brazil	13,730	0.293			

Table 1: U.S. Imports and Related-Party Share By Country, 2000

20 Lowest Related-party Import Shares (NAICS 6-digit)	Total Imports (millions\$)	Related-	
		Party Imports (millions\$)	Related-Party Import Share
Motor Homes	119	1	0.004
Rubber & Plastic Footwear	584	10	0.018
Primary Smelting & Refining of Copper	2,396	66	0.027
Missile/Space Veh Parts & Auziliary Equip, NESOI	224	7	0.033
Cut Stone & Stone Products	1,281	44	0.034
Other Footwear	4,164	151	0.036
Folding Paperboard Boxes	385	16	0.041
Jewelers' Material & Lapidary Work	13,228	582	0.044
Canvas & Related Products	234	11	0.048
Prefabricated Wood Buildings	104	6	0.053
Dried and Dehydrated Foods	161	9	0.056
Spices & Extracts	501	29	0.058
Women's Footwear (Exc Athletic)	6,012	349	0.058
Women's/Girl's Dresses	2,104	126	0.060
Fur & Leather Apparel	1,973	121	0.061
Men's Footwear (Exc Athletic)	3,590	230	0.064
Hats & Caps	923	63	0.068
Wines	2,706	204	0.075
Softwood Veneer & Plywood	271	21	0.077
Miscellaneous Wood Products	1,765	140	0.079
<hr/>			
20 Highest Related-Party Import Shares (NAICS 6-digit)			
Prepared Flour Mixes & Dough	123	89	0.722
Electromedical Apparatus	3,129	2,262	0.723
Automatic Environmental Controls	619	450	0.727
Motor Vehicle Gasoline engines & Engine Parts	10,262	7,504	0.731
Sanitary Paper Products	736	538	0.731
Telephone Apparatus	13,041	9,552	0.732
Motor Vehicle Electrical & Electronic Equip, Nesoi	7,337	5,374	0.732
Medicinal & Botonical Drugs & Vitamins	17,400	12,823	0.737
Carbon Paper & Inked Ribbon	314	233	0.741
Pharmaceutical Preparations	10,131	7,591	0.749
Motor Vehicle Air-Conditioning	1,225	919	0.750
Bottled Water	200	151	0.755
Tires & Tire Parts (Excl Retreadings)	4,720	3,587	0.760
Computer Storage Devices	16,283	12,683	0.779
Pesticides & Other Agricultural Chemicals	500	401	0.802
Photo Films, Papers, Plates & Chemicals	2,485	2,026	0.815

Table 2: U.S. Related Party Trade by 6-Digiti NAICS Industry, 2000

Chapter Description	Intermediation	Chapter Description	Intermediation
87 Non-Railway vehicles	0.012	51 Wool, woven fabric	0.223
27 Mineral fuels, oils, waxes	0.019	62 Apparel, not knitted or crochete	0.232
1 Live animals	0.023	33 Oils; perfumery	0.234
88 Aircraft, spacecraft	0.024	22 Beverages, spirits	0.241
86 Railway locomotives	0.025	79 Zinc and articles thereof	0.242
30 Pharmaceutical products	0.027	69 Ceramic products	0.247
26 Ores, slag and ash	0.030	36 Explosives	0.247
89 Ships, boats, etc.	0.034	96 Misc. manufactured articles	0.259
37 Photographic goods	0.043	21 Misc. edible preparations	0.262
75 Nickel and articles thereof	0.050	80 Tin and articles thereof	0.274
31 Fertilisers	0.056	54 Man-made filaments	0.282
97 Works of art, antiques	0.068	63 Other made up textile articles	0.291
85 Electrical machinery	0.084	56 Wadding, yarns, ropes, cables	0.293
47 Pulp of wood	0.088	68 Stone, plaster, cement	0.295
38 Misc. chemical products	0.090	15 Animal, vegetable fats and oils	0.297
28 Inorganic chemicals+Z77	0.094	11 Milling industry products	0.301
90 Instruments	0.095	42 Leather; saddlery and harness	0.314
76 Aluminum and articles thereof	0.100	91 Clocks and watches	0.322
48 Paper; articles of paper pulp	0.101	50 Silk	0.327
84 Nuclear reactors, machinery	0.102	92 Musical instruments	0.327
25 Salt; earths and stone	0.106	66 Umbrella, walking-sticks	0.334
24 Tobacco	0.108	16 Preparations of meat, fish	0.339
40 Rubber and articles thereof	0.118	2 Meat	0.341
49 Printed books, newspapers	0.122	8 Fruit and nuts	0.345
17 Sugars	0.123	41 Raw hides, skins, leather	0.345
23 Residues from food industries	0.130	58 Woven fabrics; tapestries	0.369
71 Pearls, precious metals, coin	0.135	93 Arms and ammunition	0.373
29 Organic chemicals	0.135	55 Man-made staple fibres	0.373
64 Footwear, gaiters	0.136	13 Gums, resins	0.374
70 Glass and glassware	0.141	46 Straw; basketware	0.379
32 Tanning or dyeing extracts	0.162	57 Carpets, floor coverings	0.384
35 Starches, glues, enzymes	0.168	45 Cork articles	0.409
10 Cereals	0.172	14 Vegetable products	0.414
81 Other base metals	0.173	65 Headgear and parts thereof	0.415
18 Cocoa	0.175	5 Animal products	0.433
94 Furniture; prefab buildings	0.179	4 Dairy produce; honey	0.433
12 Oil seeds, grains, plants	0.181	67 Feathers and down articles	0.440
74 Copper and articles thereof	0.186	20 Vegetables, fruit, nuts	0.447
39 Plastics and articles thereof	0.192	43 Furskins and artificial fur	0.454
72 Iron and steel	0.193	7 Vegetables	0.460
34 Soap, waxes, candles	0.195	60 Knitted or crocheted fabrics	0.465
83 Misc. articles of base metal	0.196	3 Fish, crustaceans	0.469
95 Toys, games	0.199	9 Coffee, tea, spices	0.474
61 Knitted or crocheted apparel	0.207	19 Cereals, flour, milk	0.482
59 Textile fabrics	0.211	53 Vegetable textile fibres	0.500
82 Tools, implements, cutlery	0.212	6 Trees and plants	0.516
44 Wood articles; wood charcoal	0.213	52 Cotton	0.529
73 Articles of iron or steel	0.214	78 Lead and articles thereof	0.631

Table 3: Intermediation Index by HS2 Industry, 1997

	(1)	(2)	(3)	(4)
	Intra-Firm Trade Dummy	Share of Intra-Firm Trade	Intra-Firm Trade Dummy	Share of Intra-Firm Trade
Intermediation	-0.715 *** (0.050)	-0.165 *** (0.019)	-0.719 *** (0.050)	-0.235 *** (0.025)
Governance	0.154 *** (0.014)	-0.031 *** (0.007)	0.103 *** (0.019)	-0.031 *** (0.009)
x Intermediation	-0.058 (0.039)	0.084 *** (0.015)	-0.056 (0.039)	0.090 *** (0.017)
Capital Intensity	-0.005 (0.021)	0.059 *** (0.007)	-0.005 (0.020)	0.056 *** (0.008)
Log capital abundance	0.213 *** (0.016)	0.067 *** (0.006)	0.173 *** (0.017)	0.068 *** (0.007)
x Capital intensity	0.068 *** (0.016)	0.005 (0.004)	0.072 *** (0.015)	0.010 ** (0.005)
Skill Intensity	1.336 *** (0.192)	0.196 *** (0.051)	1.348 *** (0.192)	0.324 *** (0.067)
Log human capital abundance	-0.105 ** (0.044)	-0.066 *** (0.022)	-0.044 (0.046)	-0.059 ** (0.023)
x Skill intensity	-0.415 (0.407)	-1.063 *** (0.152)	-0.460 (0.411)	-1.142 *** (0.174)
HQ Intensity	-0.103 (0.196)	0.043 (0.065)	-0.099 (0.196)	0.016 (0.071)
Log population	0.152 *** (0.008)	-0.034 *** (0.002)	0.145 *** (0.009)	-0.033 *** (0.003)
FDI protection	0.13 *** (0.015)	-0.017 *** (0.005)	0.154 *** (0.014)	0.039 *** (0.007)
Trade protection	-0.098 *** (0.011)	0.017 *** (0.004)	-0.092 *** (0.011)	-0.023 *** (0.005)
US Phone Call Cost	-	-	-0.050 *** (0.003)	-
Lambda	-	-	-	0.150 *** (0.029)
Sample	Full	Positive Intra-firm Trade	Full	Positive Intra-firm Trade
Estimation	Probit	OLS	Heckman First-Stage	Heckman Second-Stage
R-squared		0.079		
Observations	180,774	92,656	180,774	92,656

Note: In constructing the interaction terms, we subtract the sample mean from each variable entering the interaction term, so that the main effects of each variable can be interpreted as the effect at the sample mean. Columns 1 and 3 include all country-product pairs with positive imports. Robust standard errors adjusted for clustering at the four-digit SIC level are reported below coefficient estimates. ***, **, and * indicate significance at the 1, 5, and 10 percent levels respectively.

Table 4: Determinants of Intra-Firm Imports, HS10-Country 1997

	(1)	(2)	(3)	(4)
Intermediation	-0.165 *** (0.019)	-0.156 *** (0.019)		
Governance	-0.031 *** (0.007)		-0.033 *** (0.008)	
x Intermediation	0.084 *** (0.015)	0.074 *** (0.016)	0.097 *** (0.016)	0.086 *** (0.016)
Capital Intensity	0.059 *** (0.007)	0.055 *** (0.007)		
Log capital abundance	0.067 *** (0.006)		0.052 *** (0.006)	
x Capital intensity	0.005 (0.004)	-0.003 (0.006)	-0.001 (0.005)	-0.007 (0.007)
Skill Intensity	0.196 *** (0.051)	0.192 *** (0.051)		
Log human capital abundance	-0.066 *** (0.022)		-0.055 *** (0.021)	
x Skill intensity	-1.063 *** (0.152)	-1.297 *** (0.181)	-1.175 *** (0.155)	-1.45 *** (0.192)
HQ Intensity	0.043 (0.065)	0.068 (0.061)		
Log population	-0.034 *** (0.002)		-0.045 *** (0.002)	
FDI protection	-0.017 *** (0.005)		-0.017 *** (0.005)	
Trade protection	0.017 *** (0.004)		0.021 *** (0.004)	
Estimation	OLS	OLS	OLS	OLS
Sample	Positive Intra-firm Trade	Positive Intra-firm Trade	Positive Intra-firm Trade	Positive Intra-firm Trade
Fixed Effects	None	Country	Product	Country and Product
Observations	92,656	92656	92656	92656
R-squared	0.079	0.154	0.300	0.368

Note: Column (1) repeats the results from column (2) in Table 5. In constructing the interaction terms, we subtract the sample mean from each variable entering the interaction term, so that the main effects of each variable can be interpreted as the effect at the sample mean. Robust standard errors adjusted for clustering at the four-digit SIC level are reported below coefficient estimates. ***, **, and * indicate significance at the 1, 5, and 10 percent levels respectively.

Table 5: Determinants of Intra-Firm Imports - Fixed Effects, HS10-Country 1997

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intermediation	-0.235 *** (0.025)	-0.214 *** (0.027)	-0.235 *** (0.027)	-0.208 *** (0.026)	-0.243 *** (0.028)	-0.212 *** (0.023)	-0.206 *** (0.023)
Governance	-0.031 *** (0.009)	-0.023 *** (0.010)	-0.048 *** (0.008)	-0.043 *** (0.008)	-0.059 *** (0.008)	-0.031 *** (0.009)	-0.029 *** (0.009)
x Intermediation	0.09 *** (0.017)	0.069 *** (0.017)	0.107 *** (0.014)	0.094 *** (0.014)	0.107 *** (0.019)	0.089 *** (0.017)	0.066 *** (0.015)
Capital Intensity	0.056 *** (0.008)	0.06 *** (0.009)	0.063 *** (0.012)	0.074 *** (0.013)	0.079 *** (0.018)	0.079 *** (0.010)	0.085 *** (0.010)
Log capital abundance	0.068 *** (0.007)	0.073 *** (0.009)	0.043 *** (0.008)	0.042 *** (0.010)	0.068 *** (0.007)	0.068 *** (0.007)	0.07 *** (0.006)
x Capital intensity	0.01 *** (0.005)	0.011 *** (0.004)	0.027 *** (0.005)	0.025 *** (0.005)	0.006 (0.008)	0.01 *** (0.005)	-0.004 (0.004)
Skill Intensity	0.324 *** (0.067)	0.315 *** (0.084)	0.325 *** (0.063)	0.372 *** (0.073)	0.084 (0.077)	0.198 *** (0.070)	0.188 *** (0.071)
Log human capital abundance	-0.033 (0.003)	-0.034 *** (0.004)	-0.034 *** (0.004)	-0.037 *** (0.004)	-0.034 *** (0.003)	-0.033 *** (0.003)	-0.033 *** (0.003)
x Skill intensity	-1.142 *** (0.174)	-0.968 *** (0.192)	-0.804 *** (0.158)	-0.718 *** (0.182)	-0.982 *** (0.168)	-1.141 *** (0.174)	-0.818 *** (0.201)
HQ Intensity	0.016 (0.071)	0.061 (0.076)	-0.078 (0.109)	-0.049 (0.125)	-0.16 * (0.093)	0.011 (0.072)	0 (0.071)
Log population	-0.059 *** (0.023)	-0.066 *** (0.025)	-0.066 *** (0.026)	-0.075 *** (0.030)	-0.089 *** (0.031)	-0.059 *** (0.023)	-0.068 *** (0.023)
FDI protection	0.039 *** (0.007)	0.038 *** (0.008)	0.031 *** (0.008)	0.029 *** (0.009)	0.041 *** (0.007)	0.039 *** (0.007)	0.039 *** (0.007)
Trade protection	-0.023 *** (0.005)	-0.02 *** (0.005)	-0.037 *** (0.003)	-0.037 *** (0.004)	-0.027 *** (0.005)	-0.023 *** (0.005)	-0.024 *** (0.005)
R&D Intensity					1.230 *** (0.245)		
Nunn measure						0.143 *** (0.044)	0.185 *** (0.044)
x Governance							-0.141 *** (0.021)
Lambda	0.150 ***	0.164 ***	0.093 ***	0.085 ***	0.112 ***	0.144 ***	0.150 ***
Sample	Full	Exclude foreign-intensive industries	Exclude final goods	Exclude both foreign-intensive and final goods	Industries with R&D data	Full	Full
Observations	180774	163005	131424	115546	112337	179790	179790

Note: Column (1) replicates the baseline results from column (4) in Table 5. In constructing the interaction terms, we subtract the sample mean from each variable entering the interaction term, so that the main effects of each variable can be interpreted as the effect at the sample mean. Robust standard errors adjusted for clustering at the four-digit SIC level are reported below coefficient estimates. ***, **, and * indicate significance at the 1, 5, and 10 percent levels respectively.

Table 6: Determinants of Intra-Firm Imports - Robustness, HS10-Country 1997

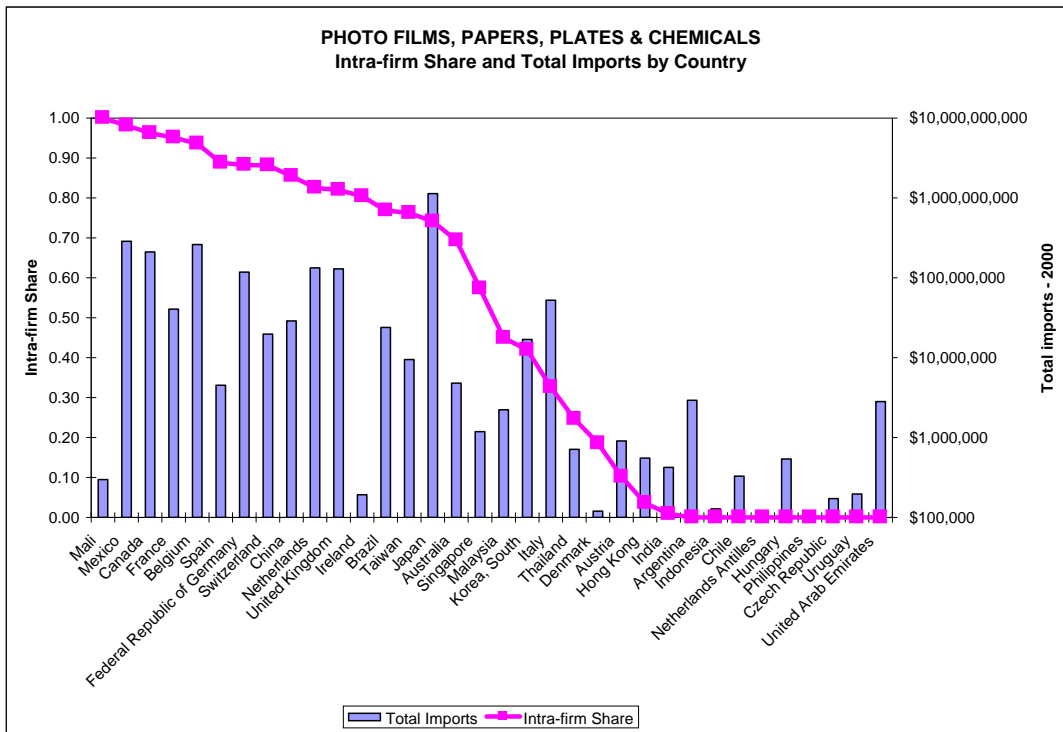


Figure 1: Intra-firm Import Share and Total Imports in 2000, NAICS Industry 325992

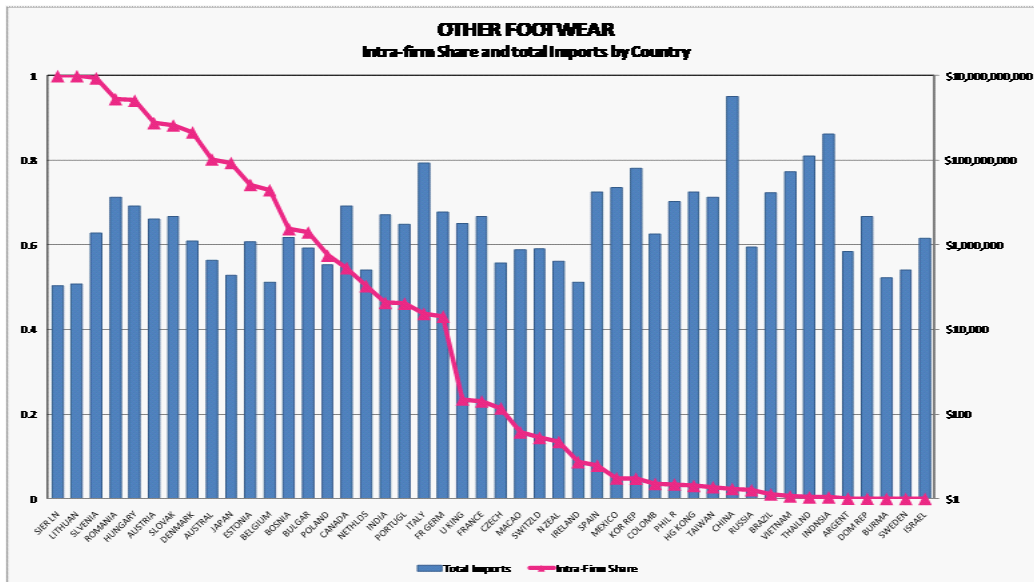


Figure 2: Intra-Firm Import Share and Total Imports in 2000, NAICS Industry 316219

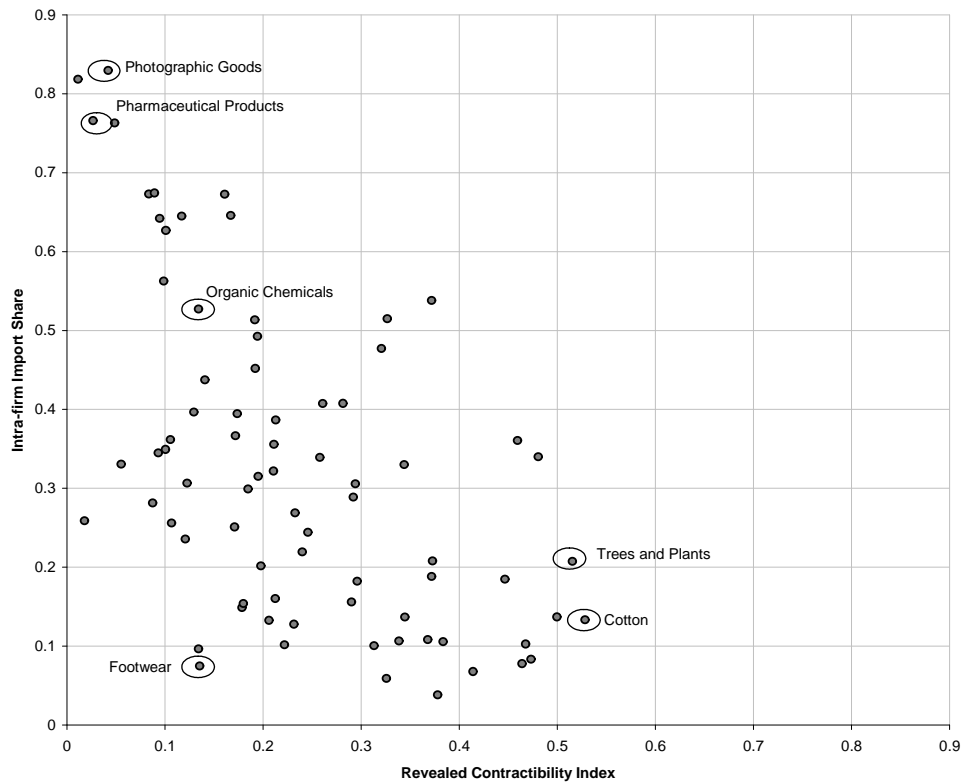


Figure 3: Intra-firm Import Intensity and “Revealed Contractability” by Two-Digit HS Category, 1997