

# INTRA-FIRM TRADE\*

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## Abstract

This paper examines the determinants of intra-firm activity in U.S. international trade. We document the importance of intra-firm trade, both firm participation and value of shipments, across countries and industries over time for both imports and exports. We create a new measure of product contractibility based on the nature of firms importing the product. To study the determinants of intra-firm trade, we use a new detailed country-product import dataset and draw on testable hypotheses from recent theoretical work combining incomplete contracts, organizational form and international trade. Our results show important roles for product contractibility, country governance quality and their interaction in determining intra-firm trade shares.

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## 1. Introduction

Research into multinational firms has recently been extended to incorporate elements of contract theory. Motivated by substantial increases in firms' cross-border production networks and rapidly rising trade volumes, this emerging literature addresses firms' decisions to source components in-house versus at arm's length in conjunction with their choices over whether to locate production at home or abroad.<sup>1</sup> In general, 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.<sup>2</sup> At heart, this literature seeks to understand the factors that govern intra-firm trade.

This paper provides the first empirical examination of the determinants of intra-firm trade across both a large number of countries and detailed product categories. We focus on testable predictions from the existing theoretical literature, paying special attention to the interaction of product and country attributes, for example the interaction of product contractibility with the quality of countries' contracting environment.

Our analysis of intra-firm trade takes advantage of a unique new dataset that tracks U.S. international trade at the transaction level. These data are derived from the customs documents that accompany every import and export shipment that crosses the U.S. border. For each import (export) shipment, we are able to observe the identity of the importing (exporting) firm, the Harmonized System product classification and date of shipment, the value and quantity shipped, the source (destination) country, the transport mode, and whether the transaction takes place at "arm's length" or between "related parties". We provide a detailed summary of these data in the form of tabulations of the share intra-firm trade by country, industry and year for 1993 and 2000 for both exports and imports. We also extend the existing publicly available summaries of these data by reporting on a new dimension of related-party trade, namely the share of firms trading intra-firm by country, industry and year.

The main contribution of this paper is our examination of the product and country characteristics 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. In practice, the ability of firms to write such contracts depends upon many factors, including product, firm and country characteristics. Using the richness of transaction-level trade data, we introduce a new measure of the products' revealed contractibility that is based on the types of firms importing each product. This measure assumes that products for which contracting is easier are more likely to be imported by retailers or wholesalers. Formally, it is defined as a weighted average of the retail and wholesale employment shares of each firm importing the product, using the firms' importance in a product market in value terms as weights.

Our regression results both complement and extend the existing empirical literature on intra-firm trade. As in Antràs (2003), we find a positive relationship between product physical capital intensity, country capital abundance and intra-firm trade. Our results suggest caution in interpreting this relationship, however, as its significance depends upon the inclusion or absence of product or country fixed effects. Taking advantage of the the level of detail available in the transaction data, we find strong links between product and country characteristics and intra-firm trade, in particular the revealed contractibility of the product and the contracting

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<sup>1</sup>See the literature survey by Helpman (2006).

<sup>2</sup>Markusen (2002) surveys relevant topics in the earlier literature.

environment of the country. We find that increases in product contractibility are associated with substantial declines in the share of country-product intra-firm trade. Similarly, increases in country governance quality, i.e. the contracting environment, lead to more intensive arm's-length shipments. Both these results follow naturally from the predictions of existing theory models. Of perhaps greater interest is the importance of the interaction of product contractibility and country governance. Intra-firm trade shares are relatively higher for products with low contractibility in countries with poor contracting environments. On the other hand, the intensity of related-party trade varies little in response to variation in country governance quality for high contractibility products.

The paper is organized as follows: Section 2 describes the motivating theoretical literature and related empirical work on intra-firm trade, in Section 3 we introduce the trade data, the share of intra-firm trade value and fraction of firms trading with related parties are detailed in Section 4 by country and industry for both imports and exports, Section 5 discusses the new product measure of contractibility, Section 6 presents the empirical results on the determinants of intra-firm trade, In Section 7 we discuss the results in light of the theory and Section 8 concludes.

## 2. Motivating theory and prior empirical research

An early paper addressing the contracting costs of multinationals is Antràs (2003) who develops a Helpman-Krugman general equilibrium model of trade with an incomplete-contracting, property-rights view of the boundaries of the firm. In the model, transactions costs of using the market are increasing in the capital intensity of the input and as a result in general equilibrium the firm will outsource labor intensive activities. The argument for the importance of capital-intensity in intra-firm trade is driven by the assumption that it is easier for final-goods producers to share investment costs (and solve the supplier underinvestment problem) with suppliers for investments in physical capital than for investments in labor.

When combined with variation in countries' capital abundance, and thus comparative advantage, Antràs (2003) predicts that capital-intensive imports to the U.S. are more likely to be produced inside the firm and sourced from capital-abundant countries. Antràs (2003) is unusual in that he combines empirical work with the development of the theory. He reports results for 23 aggregate industries that demonstrate a positive correlation between industry capital intensity and their share of intra-firm imports. Similarly, regressions on 28 countries exhibit a positive correlation between capital abundance and country-level intra-firm import shares.

Antràs and Helpman (2004) combine a model of firms with heterogeneous productivity making investment decisions with relationship specificity in a North-South world with incomplete contracts. In the model, higher firm productivity and greater intensity of headquarters services in final goods production increases likelihood that a firm will import intermediates from subsidiaries in the South. While most of their results focus on the organizational choice of firms within sectors, they show that relatively more final-good producers rely on imported intermediates in sectors with higher productivity dispersion. In sectors with integration and outsourcing, higher productivity dispersion leads to more final goods producers importing intra-firm. Both results suggest that intra-firm trade should be increasing in productivity dispersion within the sector.

In Grossman and Helpman (2002), increased competition in an industry leads to more integration as specialized input producers need a greater per unit cost advantage. In less competitive markets, the decision to integrate or outsource depends on relative fixed costs. Grossman and

Helpman (2003, 2005) consider the choice to outsource or produce inside the firm. In Grossman and Helpman (2003), an increase in industry size favors outsourcing over integration, similarly an improvement in the contracting environment leads to more outsourcing. In Grossman and Helpman (2005), increases in the contracting environment in the South may raise or lower the level of outsourcing in the South.<sup>3</sup>

These theoretical models suggest several empirical hypotheses that we can take to the data. From Antràs (2003), we test whether product capital intensity and country capital abundance are positively related to intra-firm trade shares. Antràs and Helpman (2004) suggest a positive relationship between industry productivity dispersion and intra-firm trade while Grossman and Helpman (2003, 2005) emphasize the role of the contract enforcement environment in the country.

### *2.1. Related empirical research*

While multinationals have been the focus of a large empirical literature, relatively few studies have addressed issues related to contracting, organizational structure and intra-firm trade. As mentioned above, Antràs (2003) finds support for the importance of capital intensity and capital abundance in intra-firm trade. However, due to limitations of the data, he has a very small sample of aggregate industries and countries and must consider industry and country effects in separate specifications. Two additional results from Antràs (2003) are worth mentioning: first he finds no effect of country size (log population) on intra-firm trade shares, as predicted by his model, and across industries R&D intensity has large, positive, and significant effects on intra-firm trade. We build on the work in Antràs (2003) by considering the role of physical capital in intra-firm trade for a large number of countries and for more detailed product categories. In addition, we estimate a single specification with product-country intra-firm trade shares as our dependent variable and test for the importance of the interaction between product capital intensity and country capital abundance.

Nunn (2006) and Levchenko (2004) consider the role of a country's ability to enforce contracts, i.e. institutional quality, as a determinant of comparative advantage. Their focus is on the link between contracting enforcement/institutional quality and the pattern of trade across industries. Industries are classified according to their use of exchange-traded inputs (Nunn 2006) or a Herfindahl index of intermediate input use (Levchenko 2004) while both studies use variables from World Bank country governance data to proxy for contract enforcement and institutional quality. We employ a similar measure of country governance quality, i.e. the ability to enforce contracts, and consider the effects on share of intra-firm trade across countries and products. At the product level we create a new measure of contractibility based on the share of imports controlled by wholesale and retail firms in the U.S..

While they do not consider contracting motives for intra-firm trade, Hanson, Mataloni and Slaughter (2005) examine factors affecting the share of imported intermediates by foreign affiliates of U.S. multinationals in total foreign affiliate sales, i.e. exports from U.S. parents to their affiliates for further processing. Looking across countries within firm-industry pairs, they find demand for imported inputs by foreign affiliates is higher in countries with lower trade costs,

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<sup>3</sup>Other papers that discuss contracting issues, outsourcing and offshoring include McLaren (2000) on the link between market thickness and organizational form, Grossman and Helpman (2004) on the role of firm variation within an industry, Feenstra and Spencer (2005) on the determinants of contractual versus generic outsourcing where the former requires a relationship-specific investment as opposed to the latter which occurs in the market and Antràs (2005) on links between changes in the organizational form of the firm and product life cycles.

lower wages for less-skilled labor and lower corporate income tax rates.

Our work is also related to a larger literature on the importance of imported intermediates in overall trade. Feenstra and Hanson (1996), Campa and Goldberg (1997), Hummels, Ishii and Yi (2001), and Yeats (2001) all emphasize an increasing role for intermediates, as opposed to final goods, in world trade in recent decades. Some or all of these papers have been cited as explicit motivation for the theoretical work on contracting and organizational form. While trade in intermediate goods provides much of the theoretical motivation for our analysis, we consider trade in every product category.

### 3. Data

At the heart of our empirical analysis is the Linked/Longitudinal Firm Trade Transaction Database (LFTTD) which links individual trade transactions to firms in the United States.<sup>4</sup> This dataset has two components. The first, foreign trade data assembled by the U.S. Census Bureau and U.S. Customs, captures all U.S. international trade transactions between 1992 and 2000 inclusive. For each flow of goods across a U.S. border, this dataset records the product classification, the value and quantity shipped, the date of the shipment, the destination (or source) country, the transport mode, and whether the transaction takes place at “arm’s length” or between “related parties”. “Related-party”, or intra-firm, trade refers to shipments between U.S. companies and their foreign subsidiaries as well as trade between U.S. subsidiaries of foreign companies and their affiliates abroad. For export transactions, firms are “related” if either party owns, directly or indirectly, 10 percent or more of the other party (see Section 30.7(v) of the Foreign Trade Statistics Regulations). This definition of related party corresponds exactly to that used by the Bureau of Economic Analysis in their annual surveys of multinational activity. For imports, firms are “related” if either owns, controls or holds voting power equivalent to 6 percent of the outstanding voting stock or shares of the other organization (see Section 402(e) of the Tariff Act of 1930).<sup>5</sup>

The second component of the LFTTD is the Longitudinal Business Database (LBD) of the U.S. Census Bureau, which records annual employment, industry (4-digit 1987 Standard Industrial Classification SIC4), and survival information for most U.S. establishments.<sup>6</sup> Employment information for each establishment is collected in March of every year and we aggregate the establishment data up to the level of the firm. Matching the annual information in the LBD to the transaction-level trade data yields the LFTTD. Products in the LFTTD are tracked according to ten-digit Harmonized System (HS) categories. There are 8572 categories for exported products and 22305 categories for imported products.

For our empirical work we integrate several datasets into the LFTTD. First, from the Longitudinal Research Database, we generate industry-level (4-digit 1987 Standard Industrial Classification SIC4) measures of log capital per work, share of skilled workers and a measure of the dispersion of productivity across single-product plants within the industry, the log standard deviation of labor productivity at single-product plants.<sup>7</sup> These industry-level measures are then

<sup>4</sup>See Bernard et al. (2005) for a description of the LFTTD and its construction.

<sup>5</sup>The 6 percent threshold for imports is lower than that used by the Bureau of Economic Analysis and will result in somewhat higher measured amounts of intra-firm trade.

<sup>6</sup>This dataset excludes the U.S. Postal Service and firms in agriculture, forestry and fishing, railroads, education, public administration and several smaller sectors. See Jarmin and Miranda (2002) for an extensive discussion of the LBD and its construction.

<sup>7</sup>We use the dispersion at single product plants to minimize problems of productivity measurement when plants

matched to the 10-digit HS products based on the concordance in Feenstra, Romalis and Schott (2002). We add country characteristics from several sources: measures of openness to FDI and trade from the Heritage Foundation/WSJ (2006); measures of population, capital abundance, and human capital abundance from Hall and Jones (1999); and a single composite index of country governance created by factor analysis from six measures of governance tabulated by the World Bank (Kaufman, Kraay and Zoido-Lobaton 2004).<sup>8</sup>

#### 4. Intra-firm imports and exports

This section documents the extent of U.S. intra-firm trade by trading partner and industry for 1993 and 2000. Though the U.S. Census Bureau publishes summaries of related-party trade annually on its website, the results reported here are more detailed in two important respects.<sup>9</sup> First, we provide information on firm participation in related-party trade, a new dimension of the data. Second, we report related-party trade for a substantially larger set of countries and industries than is available in the Census summaries. This greater level of detail confirms the perception that intra-firm trade varies widely across industries and countries as well as over time.

##### 4.1. *By Country*

We begin our analysis of intra-firm trade by considering variation in related-party imports and exports across countries in 1993 and 2000. The data are summarized in Table 1, which divides countries across two panels. Countries are included in the table if they meet two criteria. First, transactions with the country must satisfy Census disclosure requirements. Second, we exclude countries where fewer than 100 firms either import from or export to the country, respectively. As a result of these screens, related-party import and export data are not available for the same set of countries. As indicated in the table, we summarize related-party imports for 54 source countries and related-party exports for 68 destination countries.

##### 4.1.1. *Imports*

Cells in the first two columns of each panel of Table 1 document the share of firms importing from the noted country that report positive related-party imports from that country in 1993 and 2000. On average, the share of firms engaging in intra-firm trade was relatively constant over time, increasing from 18 percent in 1993 to 19 percent in 2000. The second two columns of each panel of the table report the share of total import value from each country that takes place between related parties. Between 1993 and 2000, the average country share of intra-firm importing increased from 31 to 38 percent.<sup>10</sup>

As indicated in the table, there is a wide range of exposure to intra-firm trade across countries. Imports from Bangladesh are almost entirely arms-length transactions, with just 4 percent of firms trading with related parties and just 2 percent of the total value of imports taking

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produce in more than one sector, see Bernard, Redding and Schott (2006).

<sup>8</sup>See the data Appendix for details on the construction of the governance factor.

<sup>9</sup>The Census summaries are available at See <http://www.census.gov/foreign-trade/www/>. We note here that although our intra-firm statistics are based on the same underlying transaction data, they differ slightly from those provided on the Census website due to the screenings discussed below.

<sup>10</sup>Note that firms that report related party imports may also be conducting arms-length import transactions from the same country.

place inside the firm. In contrast imports from Japan and Ireland are dominated by intra-firm transactions. In 2000, 78 percent of the value of imports from Ireland, up substantially from 1993, and 77 percent of the imports from Japan were conducted by multinationals trading with related foreign divisions. While the LFFTD data does not reveal the ownership nationality of the importing firm, anecdotal 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 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. The share of firms importing from related parties varies far less across countries, from 4 percent in Bangladesh to 44 percent in Japan.

In general, countries with low shares of intra-firm exports to the U.S. are less developed while high income countries in the OECD generally report above average intra-firm imports to the United States. Imports from China, the fastest growing sources of U.S. imports over the period, were still largely conducted at arms-length. The intra-firm import share for China increased from 11 percent in 1993 to 19 percent in 2000.

Table 1 also reveals substantial variation in the growth of intra-firm trade over time. Forty of the 54 countries for which data are available experienced rising shares of intra-firm imports between 1993 and 2000. Some countries experienced dramatic changes: the intra-firm import shares of Hungary, Morocco, El Salvador and the Czech Republic, for example, each rose by more than 25 percentage points, with Hungary's share of intra-firm imports reaching 70 percent in 2000. Luxembourg, Finland and Belgium, on the other hand, experienced declining shares of intra-firm activity between 1993 and 2000.

#### 4.1.2. Exports

The second half of each column of Table 1 reports an analogous breakdown of related-party exports. As is well known, U.S. exports are less likely to be conducted between related parties than are U.S. imports. For the average destination country in 2000, 12 percent of the exporting firms are trading, at least in part, with a related party, and 17 percent of all exports are conducted inside the firm.<sup>11</sup>

As with imports, there is substantial variation in destination countries' exposure to intra-firm trade. Exports to Egypt from the United States consist almost entirely of arms-length transactions: 7 percent of firms exporting to Egypt report trading with related parties and just 4 percent of the total value of exports is done within firms. The relatively large flow of exports to Canada, by contrast, takes place largely between related parties: in 2000, 59 percent of the value of exports to Canada were intra-firm, up from 54 percent in 1993. As with imports, the share of firms exporting to related parties varies less across countries than the share of value.

Changes in destination countries' related-party exports over time are also more muted than for imports. Half the countries in the sample, 33 out of 68, experienced rising shares of intra-firm exports over the sample period. The most dramatic changes are for Hungary and Poland, which saw their intra-firm export shares rise by 19 and 12 percentage points respectively. The growth of these countries' related party exports (and imports) is likely due to their opening up as destinations for foreign direct investment during the 1990s. France, the Netherlands and the United Kingdom are among countries with substantial declines in the share of related-party exports.

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<sup>11</sup>Here, as well, firms that report related-party exports may also be conducting arms-length export transactions to the same country.

While intra-firm trade is positively and significantly correlated across imports and exports in both 1993 and 2000, changes in these shares over time exhibit very little comovement. Figure 1, for example, displays the relationship between the change in the intra-firm export and import value shares over the sample period. This lack of correlation indicates that factors beyond country characteristics are likely influential in determining changes in their exposure to related-party trade. We return to this issue below.

#### 4.2. *By Industry*

Table 2 summarizes variation in related-party imports and exports across industries in 1993 and 2000, using two-digit Harmonized System “chapters” to define industries. As with Table 1, industries are reported across two panels. Also as above, industries are included in the table if they satisfy Census disclosure requirements and if at least 100 firms import or export in the industry, respectively. As a result of these screens, related-party import and export data are not available for the same set of countries. As indicated in the table, we summarize related-party trade for 77 import industries and 75 export industries.

##### 4.2.1. *Imports*

Across industries, the average share of firms engaging in related-party imports remained relatively constant, decreasing from 19 percent in 1993 to 17 percent in 2000. The average industry share of intra-firm imports also changed little, increasing from 31 percent in 1993 to 33 percent in 2000.<sup>12</sup>

As with the country-level data, industries vary widely in the extent to which their trade takes place within firms. Imports of cotton (HS 52), wool (HS 51), knitted fabrics (HS 60-62), coffee (HS 9), and footwear (HS 64) consist almost entirely of arms-length transactions. In footwear, for example, just 12 percent of firms transact with related parties, and intra-firm imports account for a relatively small 5 percent of total imports. Imports of vehicles (HS 87), instruments (HS 90) and pharmaceuticals (HS 30), on the other hand, are dominated by intra-firm transactions. In each of these industries, more than 75 percent of all imports are between related parties. In general, the data in Table 2 suggest low shares of intra-firm imports are associated with raw materials, early-stage products such as hides (HS 41) and silk (HS 42), or labor-intensive goods such as apparel and footwear. High shares of intra-firm imports are reported in capital- and technology-intensive industries such as nuclear reactors (HS 84), electrical machinery (HS 85) and organic chemicals (HS 29).

Of the 77 industries for which import data are available, 43 experience rising shares of intra-firm imports over the sample period, with these increases averaging 6.5 percentage points. For the 27 exhibiting declining intra-firm import shares, the average decrease was 6.4 percentage points.

##### 4.2.2. *Exports*

The average share of firms engaging in related-party exports across industries declined slightly over the sample period, from 17 percent in 1993 to 14 percent in 2000. The average industry share of intra-firm exports also fell moderately, from 30 percent in 1993 to 26 percent in 2000.

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<sup>12</sup>Firms that report related party imports may also be conducting arms-length import transactions in the same industry.



Industries exhibit substantial variation in their shares of intra-firm exports. Exports of cotton (HS 52), various food products (HS 2-10), and pulp wood (HS 47) have intra-firm export value shares below 10 percent. Only 6 percent of firms exporting pulp wood transact with related parties, and intra-firm exports in the industry comprise just 8 percent of total exports. As with imports, exports of more capital- and skill-intensive goods such as vehicles, photographic goods and pharmaceuticals are dominated by intra-firm transactions.

Table 2 reveals large changes in industries' intra-firm exports over time. In contrast with imports, however, these changes are more likely to be negative. Of the 75 industries for which export data are available, 47 exhibit declining shares of intra-firm exports, with an average decline of 9.4 percentage points. The 28 industries that experienced increases saw their average share of intra-firm exports rise by 7.2 percentage points. As with the country-level data, import and export shares are significantly correlated across industries but, as demonstrated in Figure 2, not across time. This lack of correlation indicates that industry characteristics alone are unlikely to account for all of the variation in industries' intra-firm trade.

## 5. Measuring contractibility

The theoretical literature on international trade, contract theory, and the structure of the firm discussed above and summarized in Helpman (2006) focuses on the ability of the firm to write a contract for the production of specialized inputs. In practice, the ability of firms to write such contracts depends upon many factors related to the input, the firms involved, and the institutional setting in which contracting takes place. Existing empirical research has focused on several proxies for measuring products' contractibility. Antràs (2003), for example, relies on an interaction of goods' capital intensity and countries' capital abundance. Nunn (2006), by contrast, measures industry contract intensity as the share of inputs that are neither sold on an organized exchange nor have a reference price.

Here, we create a measure of contractibility based on the types of firms that import the product. Our measure assumes that products for which contracting is easier are more likely to be imported by retailers or wholesalers. This measure takes advantage of the fact that the LFFTD records the primary industry and employment of each establishment of a firm. We use these data to compute the share of employment at each firm that is engaged in wholesaling or retailing. We define the contractibility of a product to be a weighted average of the retail and wholesale employment shares of each firm importing the product, using the firms' importance in a product market in value terms as weights,

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

The first term in the contractibility measure is the share of firm  $f$ 's total employment ( $EMP_f$ ) engaged retail and wholesale sectors ( $RW_f$ ). The second term is the import share of firm  $f$  in product market  $p$ , with  $M_{pf}$  and  $M_f$  representing firm  $f$ 's imports of product  $p$  and total U.S. imports of product  $p$ , respectively. Contractibility ranges between zero and unity: if no firms importing product  $p$  have any retail or wholesale establishments then  $C_p = 0$ . On the other hand, if product  $p$  is imported exclusively by pure retailing or wholesaling firms, then  $C_p = 1$ .

Table 3 reports the contractibility measure for 77 HS2 industries in 1997, the midpoint of our sample. The first column of the table sorts industries according to contractibility, from high to low, while the second column sorts industries according to their two-digit HS chapter. Across

industries, contractibility averages 0.45, ranging from 0.16 in pharmaceuticals (HS 30) to 0.88 in straw (HS 46), with an interquartile range of 0.32 to 0.58. Agricultural goods and relatively labor intensive industries such as apparel and footwear generally have the highest measured contractibility, while most “sophisticated” products such as pharmaceuticals, chemicals and photographic goods have the lowest measures of contractibility.

Contractibility is inversely related to industries’s exposure to intra-firm trade across HS2 industries. This relationship can be seen visually in Figure 3, which reports a scatter of industries’ contractibility versus their share of intra-party imports for 1997. The figure makes clear that contractibility and intra-firm import shares are not synonymous: industries with low contractibility display a wide range of intra-firm trade shares, from a low of 10 percent for pearls (HS 71) to a high of 83 percent for photographic equipment (HS 37).<sup>13</sup>

## 6. Determinants of intra-firm trade

In this section we formally examine the theoretical implications of intra-firm trade models using the import data available in the LFTTD.<sup>14</sup> As indicated above, these models predict that intra-firm imports are influenced by a number of product and country characteristics, as well as interactions of these characteristics. To test these predictions, we combine the data available in the LFTTD with additional datasets measuring these characteristics.

As discussed previously, our empirical work focuses on testing the implications of the new models of contract theory and international trade. Antràs (2003) emphasizes the role of capital-intensity and capital abundance in related-party trade. His model predicts industries that are more capital-intensive and countries that are more capital-abundant will have higher shares of intra-firm imports in U.S. imports. In addition he predicts no relationship between intra-firm import shares and country size (log population). For country capital abundance and population, we follow Antràs (2003) and use the measures from Hall and Jones (1999).

Unfortunately, product characteristics such as capital intensity are not available for ten-digit HS products, i.e., the product classification at which we observe U.S. imports and exports. As a result, we concord HS product codes to more aggregate four-digit Standard Industry Classification (SIC) industries and assign all products within a particular industry the characteristic of that industry. We obtain four-digit SIC industry characteristics from the 1997 U.S. Census of Manufactures. To measure a four-digit SIC’s capital intensity, we use the average capital intensity of all plants in that industry.

Antràs and Helpman (2004) predict that industries with increased dispersion of productivity across firms will be more likely to undertake FDI. For our measure of product dispersion we use the log variance of labor productivity across single-product plants within SIC4 industries from the 1997 Census of Manufactures.<sup>15</sup>

Grossman and Helpman (2003, 2005) emphasize the contracting environment in the country in the choice between outsourcing and integration. We use a single composite index of countries’

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<sup>13</sup>Products’ contractibility is relatively stable over time. The correlation of the contractability index in 1993 and 2000 is 0.93, significant at the 1 percent level.

<sup>14</sup>The theoretical models described above all consider final goods producers in the U.S. (North) potentially importing from affiliates abroad (usually the South). An examination of product and country characteristics in shaping related party exports from the U.S. would require extensions of the theoretical frameworks. We plan to examine the determinants of intra-firm exports in future work.

<sup>15</sup>We use the dispersion at single product plants to minimize problems of productivity measurement when plants produce in more than one sector, see Bernard, Redding and Schott (2006).

governance quality for 1996 created by factor analysis from six measures of governance tabulated by Kaufman, Kraay and Zoido-Lobaton (2004) for the World Bank.<sup>16</sup> Our comparable product-level variable is the contractibility index, which, as noted above, can be computed for every HS10 product.

Theoretical work on the determinants of FDI enjoys a long history and encompasses a wide range of potential explanatory variables. We focus on a subset of additional explanatory variables in our empirical analysis. Markusen (2002) surveys the knowledge-capital model which predicts that FDI is increasing differences in relative skilled labor abundance between home and host countries. For country skill abundance, we again follow Antràs (2003) and use the measures from Hall and Jones (1999). As with capital intensity, product-level measures of skill intensity are not readily available. Instead we use skill intensity as measured by the average share of non-production workers in total employment for SIC4 industries concorded to the HS10 products. Finally, we consider measures of both country trade openness and FDI openness which are expected to be associated with increased levels of intra-firm trade and thus intra-firm imports to the U.S., see Hanson, Mataloni and Slaughter (2005).

We estimate the relationship between intra-firm trade and product and country characteristics via the following set of cross-sectional OLS regressions, first across products, next across countries, and finally for product-country groups,

$$IF_p = c + \alpha X_p + \epsilon_p \quad (2)$$

$$IF_c = c + \beta Z_c + \epsilon_c \quad (3)$$

$$IF_{pc} = c + \alpha X_p + \beta Z_c + d_i + \epsilon_{pc} \quad (4)$$

$$IF_{pc} = c + \alpha X_p + \beta Z_c + \gamma X Z_{pc} + d_i + \epsilon_{pc}. \quad (5)$$

$IF_p$  is the share of intra-firm import value in total imports in product  $p$  in 1997,  $IF_c$  is the share of intra-firm import value in total imports from country  $c$ , and  $IF_{pc}$  is the share of intra-firm import value in total imports from country  $c$  in product  $p$ .  $X_p$  is a vector of product characteristics,  $Z_c$  is a vector of country characteristics,  $X Z_{pc}$  is a set of interactions between country and product variables and  $d_i$  indicates a set of fixed effects (product or country).

### 6.1. Product

In the first four columns of Table 4, we report univariate product-level regressions for each of the product characteristics. The dependent variable in each case is the share of intra-firm import value in total imports for the HS10 product in 1997. After matching with the industry characteristics from the Census of Manufactures, there are a total of 11,442 products in the import data.

The results conform closely to the predictions of the theoretical frameworks for all four characteristics. Contractibility is strongly and significantly negatively correlated with intra-firm trade (column 1). More contractible products are less likely to be imported from related parties. Conversely, both industry capital and skill intensity are positively and significantly correlated with intra-firm trade. Finally the univariate relationship between productivity dispersion and intra-firm trade is positive. Industries with greater productivity dispersion have higher amounts of intra-firm trade.

Column 5 of the table reports a multivariate specification with all four characteristics. The sign and significance of contractibility, capital intensity, and skill intensity are all unchanged,

<sup>16</sup>See the data Appendix for details on the construction of the governance factor.

although the point estimates are reduced in each case. Dispersion is not longer significant and the point estimate is negative and close to zero. In spite of the detailed nature of the dependent variable the four characteristics are able to explain a substantial fraction of the variance of intra-firm trade shares.

### 6.2. *Country*

In Table 5, we consider the role of country characteristics in explaining intra-firm trade. The dependent variable in each case is the share of intra-firm import value in total imports for each source country in 1997. After matching with the six country characteristics, we are left with 102 countries in the sample.

Columns 1-6 report univariate regressions for each country variable. Again the theoretical predictions are largely true to form as both capital and skill abundance are positively correlated with countries' intra-firm export share to the U.S.. The indicator of good governance is also strongly positively and significantly correlated with intra-firm import shares as are both trade and FDI openness (lower numbers are associated with increased openness for both of the Heritage/WSJ measures). Country size as measured by log population is not correlated with intra-firm import shares. Of the characteristics, country governance is notable in that it has a large positive coefficient and it can explain more than one third of the cross-country variance in intra-firm import shares. While the theoretical models disagree about the predicted sign for country governance, the positive coefficient is somewhat surprising. Generally arms-length relationships would be expected to increase as contract enforcement improves.

In columns 7-10, we consider several multivariate specifications. First, in column 7, we include both capital and skill abundance; both remain positive and significant (capital at the 5 percent level). After adding the country governance measure (columns 8-10), neither physical nor human capital remain significant and the point estimates, while positive, are greatly reduced. The governance factor continues to be positive and significant, but only at the 10 percent level, suggesting a substantial amount of colinearity in the independent variables.

### 6.3. *Product-country*

In Table 6 we exploit the product and country dimensions of the data. The dependent variable is the share of intra-firm import value in total imports for the product-country pair in 1997. The resulting data contains 75,799 product-country pairs. Product-country pairs with no trade are not included in the regressions.<sup>17</sup>

Columns 1-3 contain specifications with all the available product characteristics and subsets of the country variables; column 4 includes all available variables. The results for the product characteristics are robust to the inclusion of different sets of country variables. Contractibility is negatively and significantly associated with intra-firm trade in each specification while physical capital intensity is positive and significant in each case. Skill intensity however, while positive, is not significant in any of the specifications. Interestingly, productivity dispersion is once again positive and significant.

The coefficients on the country characteristics show greater differences from the earlier results. Physical capital abundance is positive and significant in each regression while human capital abundance is now negative and often significant. Log population enters with a negative

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<sup>17</sup>We are implicitly conditioning on observed trade flows. For a discussion of the importance of considering the zero-trade cells, see Helpman, Melitz and Rubinstein (2006).

and significant coefficient. The country governance indicator is negative in every case, and significant once we control for FDI openness. Increased FDI openness remains positively correlated with intra-firm trade, however, trade openness is now significantly, negatively correlated with intra-firm trade shares.

In columns 5 and 6 we add country and product fixed effects respectively. The inclusion of the fixed effects leaves the magnitude and significance of the variables largely unchanged. Lower contractibility, higher physical capital intensity and increased productivity dispersion are all positively related to the share of intra-firm trade in product-country imports. Across countries, greater physical capital abundance and increased openness to FDI increase intra-firm import shares while greater skill abundance, larger population size, increased governance quality and trade openness are associated with lower intra-firm shares.

In Table 7, we add interaction terms for physical capital, skill and contractibility to the specifications in Table 6. The capital interaction is the product of industry log capital intensity and country log capital abundance; the skill interaction is the product of industry skill intensity and country log skill abundance; the contractibility interaction is the product of HS10 product contractibility and country governance.

The inclusion of the interaction effects does not change the sign or significance of the contractibility measure or the governance indicator, both remain negative and significant, although the magnitude of the estimates increases. The interaction term however is positive and significant. Using the estimates from column 4, we find that intra-firm shares are highest for products with low contractibility in countries with weak governance.<sup>18</sup> The role of country governance is extremely important for products with low contractibility. Moving from one standard deviation below the mean to one standard deviation above the mean in the governance indicator increases the intra-firm share by 9 percentage points for a product with a low contractibility measure of 0.2. Intra-firm shares are lowest when product contractibility is high and country governance is weak; however for these more contractible products the effect of increasing country governance quality is small. For a product with a contractibility of 0.8, a comparable rise in the governance measure decreases the intra-firm share by less than a percentage point.

The addition of the capital interaction term changes both the sign and significance of the capital intensity variable (now negative and insignificant) while the coefficient on country capital abundance is unchanged. The interaction term is positive and significant at the 10 percent once all the country controls are included. Using the point estimates and the range of value for industry capital intensity and country capital abundance, we can examine the net effects on intra-firm trade shares.<sup>19</sup> Intra-firm shares are increasing in both intensity and abundance. For the least capital intensive products, moving from the least capital-intensive country to the most raises the intra-firm trade share by 27 percentage points. The comparable increase for the most capital-intensive product is 47 percentage points.<sup>20</sup>

The inclusion of the interaction effects dramatically increases the positive coefficient on skill intensity and reverses the sign (to positive) on country skill abundance. The interaction term itself is large, negative, and significant. We use the coefficients from column 4, the range of skill intensity across products (0.06 - 0.83) and the range of log skill abundance across countries

<sup>18</sup>Contractability is distributed between zero and one inclusive, while the country governance factor is a  $N(0,1)$  and ranges from -2.5 to 2.5.

<sup>19</sup>Country log capital abundance ranges from 5.75 to 11.58; industry log capital intensity ranges from 1.73 to 6.87.

<sup>20</sup>Given the large standard errors on the estimated coefficients, these point estimates should be viewed with caution.

(0.05 - 1.2) to examine the nature of the relationship between skill and intra-firm trade. For products with high skill intensity, intra-firm trade shares are sharply decreasing in country skill abundance. In contrast for products with low skill intensity, increases in country skill abundance are associated with modest increases in intra-firm trade shares.

The final two columns of Table 7 incorporate country and product fixed effects respectively. The capital intensity and capital interaction terms continue to be unstable across specifications. All other terms retain their sign, magnitude and significance.

## 7. Discussion

This paper breaks new ground by bringing the new theoretical literature on incomplete contracts, firm structure and international trade to detailed country-product data on U.S. imports and exports. The results emphasize the importance both country and product characteristics and their interactions in intra-firm trade. Indeed, we find that running cross-sectional country or product regressions alone can yield misleading results.

Throughout the analysis, we find a strong role for the contractibility of the product and the contracting environment of the country. In our preferred specification (column 4 in Table 7), increases in product contractibility are associated with substantial decreases in the share of intra-firm trade. Similarly, increases in country governance quality, i.e. the contracting environment, lead to more arm's-length shipments. Both these results follow naturally from the predictions of the theory models. Of perhaps greater interest is the importance of the interaction of product contractibility and country governance. Intra-firm trade shares are relatively higher for products with low contractibility in countries with poor contracting environments. Intra-firm trade shares vary little in response to variation in country governance quality for high contractibility products.

Our results largely confirm the positive relationship between physical capital intensity, country capital abundance and higher intra-firm trade shares predicted by Antràs (2003). However, a degree of caution is needed as the significance of the coefficients in our preferred specification is marginal at best and weaken further when product or country fixed effects are included.

Considering other hypotheses from the theoretical literature, we confirm that industries with greater productivity dispersion have higher intra-firm trade shares, as predicted by Antràs and Helpman (2004). Country size as measured by log population, however, is significantly negatively associated with intra-firm trade shares in all the product-country specifications in contrast to the prediction in Antràs (2003).

Nowhere is the interaction of product and country characteristics more important in the effects of skill intensity and human capital abundance. While skill-intensive products typically have greater intra-firm trade shares, the relationship is reversed for exports from the most skill-abundant countries. Intra-firm trade shares are low for less-skill intensive products in skill-scarce countries as well as for skill-intensive products in skill-abundant countries. High levels of intra-firm shares are found for skill-intensive products from skill-scarce countries. These findings suggest a need for more work on the role of skills and incomplete contracts in trade.

## 8. Conclusions

To be completed

**References**

- Antràs, Pol. 2003. Firms, Contracts, and Trade Structure. *Quarterly Journal of Economics*, 118, 1375-1418.
- Antràs, Pol. 2005. Incomplete Contracts and the Product Cycle. *American Economic Review*, vol. 95 no. 4, 1054-1073.
- Antràs, Pol and Elhanan Helpman. 2004. Global Sourcing. *Journal of Political Economy* 112, 552-580.
- Bernard, Andrew B., J. Bradford Jensen and Peter K. Schott. 2005. Importers, Exporters, and Multinationals: A Portrait of Firms in the U.S. that Trade Goods. *NBER Working Paper*, 11404.
- Bernard, Andrew B., Stephen Redding and Peter K. Schott. 2006. Products and Productivity. Tuck School of Business mimeo.
- Borga, Maria and William J. Zeile. 2004. International Fragmentation of Production and Intrafirm Trade of U.S. Multinational Companies. Bureau of Economic Analysis Working Paper WP2004-02.
- Feenstra, Robert C. and Gordon H. Hanson. 1996. Globalization, Outsourcing, and Wage Inequality. *American Economic Review* 86, 240-245.
- Feenstra, Robert C. and Gordon H. Hanson. 2005. Ownership and Control in Outsourcing to China: Estimating the Property-Rights Theory of the Firm. *Quarterly Journal of Economics* 120, 729—761.
- Feenstra, Robert C., John Romalis and Peter K. Schott. 2002. U.S. Imports, Exports and Tariff Data, 1989 to 2001. NBER Working Paper 9387.
- Feenstra, Robert C., and Barbara J. Spencer. 2005. Contractual versus Generic Outsourcing: the Role of Proximity. NBER Working Paper 11885.
- Grossman, Gene M. and Elhanan Helpman. 2002. Integration versus Outsourcing in Industry Equilibrium. *Quarterly Journal of Economics* 117, 85-120.
- Grossman, Gene M. and Elhanan Helpman. 2003. Outsourcing versus FDI in Industry Equilibrium. *Journal of the European Economic Association 1 (Papers and Proceedings)*, 317-327.
- Grossman, Gene M. and Elhanan Helpman. 2004. Managerial Incentives and the International Organization of Production. *Journal of International Economics* 63, 237-262.
- Grossman, Gene M. and Elhanan Helpman. 2005. Outsourcing in a Global Economy. *Review of Economic Studies* 72, 135-159.
- Grossman, Gene M., Elhanan Helpman and Adam Szeidl. 2005. “Complementarities Between Outsourcing and Foreign Sourcing,” *American Economic Review (Papers and Proceedings)* 95, 19-24..
- Hall, Robert E. and Charles I. Jones. 1999. Why Do Some Countries Produce So Much More Output per Worker than Others? *Quarterly Journal of Economics*, 114, 83-116.

- Hanson, Gordon H., Raymond J. Mataloni, Jr. and Matthew J. Slaughter. 2005. Vertical Production Networks in Multinational Firms. *Review of Economics and Statistics*. vol. 87 no. 4 664-678.
- Hart, Oliver. 1995. *Firms, Contracts, and Financial Structure* (Oxford: Oxford University Press).
- Hart, Oliver and John Moore. 1990. "Property Rights and the Nature of the Firm," *Journal of Political Economy* 98, 1119-1158.
- Helpman, Elhanan. 2006. Trade, FDI, and the Organization of Firms. National Bureau of Economic Research Working Paper # 12091.
- Helpman, Elhanan, Marc J. Melitz, and Yona Rubinstein. 2006. Trading Partners and Trading Volumes. Harvard University mimeo.
- Jarmin, Ron S and Javier Miranda. 2002. The Longitudinal Business Database. Economic Studies 02-17, US Census.
- Kaufman, D., A Kraay, and P Zoido-Lobaton. 2004. Governance Matters. World Bank, Washington, DC.
- Markusen, James R. 2002. *Multinational Firms and The Theory of International Trade*. MIT Press, Cambridge, MA.
- McLaren, John. 2000. "Globalization" and Vertical Structure. *American Economic Review*. Vol. 90 no. 5, 1239-1254.
- Nunn, Nathan. 2006. Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade. *Quarterly Journal of Economics*, forthcoming.



## A Appendix

### *A1. The country governance factor*

We create a univariate measure of governance at the country level from six World Bank measures (see Kaufman, Kraay and Zoido-Lobaton 2004). The six measures are voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and corruption and are available every other year from 1996-2004. Factor analysis on the pooled data reveals that the six measures are largely driven by a single underlying factor with an eigenvalue of 4.96 (all other factors have eigenvalues below 0.1). Pairwise correlations of the factor with each of the six variables range from 0.83 to 0.97. We use the calculated factor in 1996 as our measure of country-level governance.<sup>21</sup>

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<sup>21</sup>Results from the factor analysis are available upon request.

Country	Imports				Exports				Country	Imports				Exports			
	RP Firms (%)		RP Trade (%)		RP Firms (%)		RP Trade (%)			RP Firms (%)		RP Trade (%)		RP Firms (%)		RP Trade (%)	
	1993	2000	1993	2000	1993	2000	1993	2000		1993	2000	1993	2000	1993	2000	1993	2000
Angola	.	.	.	.	47	22	53	26	Korea, South	13	12	32	57	12	11	10	11
Argentina	10	11	16	13	13	15	16	22	Kuwait	.	.	.	.	6	5	3	7
Australia	21	19	28	26	20	15	35	27	Luxembourg	51	43	81	52	24	13	7	19
Austria	27	29	51	50	16	11	21	19	Macao	7	5	12	4	.	.	.	.
Bahamas	.	.	.	.	9	35	28	28	Malaysia	22	24	66	69	21	15	43	37
Bangladesh	4	4	1	2	.	.	.	.	Mexico	34	29	63	68	27	23	44	37
Barbados	.	.	.	.	8	9	7	9	Morocco	18	22	20	50	.	.	.	.
Belgium	27	26	47	39	23	18	38	32	Netherlands	28	28	41	58	24	17	50	35
Bolivia	.	.	.	.	11	14	10	16	Netherlands Ant	.	.	.	.	6	10	8	13
Brazil	17	19	22	31	18	16	24	20	New Zealand	13	11	23	39	16	11	21	15
Canada	27	23	58	65	25	23	54	59	Nigeria	.	.	.	.	25	14	27	6
Chile	6	9	7	11	13	12	14	14	Norway	25	27	29	35	15	8	13	11
China	7	7	11	19	13	13	4	11	Pakistan	5	5	2	3	7	7	4	7
Colombia	12	13	12	25	11	12	16	14	Panama	.	.	.	.	10	7	16	11
Costa Rica	20	26	53	64	13	11	24	27	Peru	.	.	.	.	9	9	17	11
Czech Rep	20	21	10	37	12	12	16	9	Philippines	13	13	41	51	19	12	32	36
Denmark	24	27	39	46	14	9	23	13	Poland	17	14	10	21	10	13	3	15
Dominican Rep	22	21	30	38	12	11	17	18	Portugal	13	13	10	34	12	8	12	18
Ecuador	.	.	.	.	9	10	14	14	Puerto Rico	.	.	.	.	16	10	25	18
Egypt	.	.	.	.	9	7	3	4	Russia	.	.	.	.	14	11	15	23
El Salvador	15	22	19	49	7	8	7	8	Saudi Arabia	.	.	.	.	14	11	7	8
Finland	33	32	67	58	13	9	9	13	Singapore	27	27	80	73	20	15	43	31
France	23	25	40	42	21	15	40	24	Slovenia	22	29	14	27	.	.	.	.
Greece	8	9	11	9	9	9	7	10	South Africa	10	14	7	14	12	13	11	14
Guatemala	11	7	14	11	7	7	9	6	Spain	12	15	23	25	18	12	24	12
Haiti	.	.	.	.	17	7	16	8	Sri Lanka	8	7	8	14	.	.	.	.
Honduras	14	29	30	53	13	14	20	23	Sweden	39	36	75	75	16	10	19	11
Hong Kong	11	8	14	15	16	10	20	17	Switzerland	30	31	59	61	16	10	9	11
Hungary	18	31	18	70	13	13	8	27	Taiwan	9	9	19	23	12	10	11	14
India	6	7	5	6	11	11	7	10	Thailand	9	11	30	38	16	14	27	33
Indonesia	7	8	12	25	15	11	7	9	T&T	.	.	.	.	14	9	14	5
Ireland	23	29	62	78	23	15	37	29	Turkey	6	7	4	5	9	8	11	9
Israel	19	18	24	19	9	8	9	11	UAE	.	.	.	.	11	7	13	7
Italy	12	18	21	31	17	11	22	21	United Kingdom	26	25	48	53	24	15	45	23
Jamaica	.	.	.	.	11	6	10	8	Uruguay	.	.	.	.	8	10	8	10
Japan	46	44	78	77	28	19	35	35	Venezuela	15	20	16	16	13	11	15	12

Note: Table summarizes U.S. related-party imports and exports. The first two columns of each panel report the percent of firms importing from the noted country that report positive related party imports in 1993 and 2000. Second two columns of each panel report the percent of import value from noted country that is between related parties in 1993 and 2000. Final four columns of each panel report analogous numbers vis a vis export destinations and export value. "." denotes data unavailability. The set of countries for which data are available is determined by disclosure screenings (see text).

Table 1: U.S. Related Party Trade By Country, 1993 and 2000

HS Chapter	Imports				Exports				HS Chapter	Imports				Exports			
	RP Firms		RP Trade		RP Firms		RP Trade			RP Firms		RP Trade		RP Firms		RP Trade	
	1993	2000	1993	2000	1993	2000	1993	2000		1993	2000	1993	2000	1993	2000	1993	2000
2 Meat	.	.	.	.	11	10	6	8	48 Paper; articles of paper pulp	24	21	30	38	23	18	30	28
3 Fish, crustaceans	8	5	9	9	16	10	23	7	49 Printed books, newspapers	24	22	23	23	21	15	38	26
4 Dairy produce; honey	.	.	.	.	11	10	14	19	50 Silk	7	8	5	6	.	.	.	.
6 Trees and plants	14	10	23	9	.	.	.	.	51 Wool, woven fabric	8	7	15	8	.	.	.	.
7 Vegetables	15	14	39	23	11	9	15	8	52 Cotton	11	8	9	9	8	9	11	9
8 Fruit and nuts	11	10	30	34	9	7	9	5	53 Vegetable textile fibres	8	8	11	13	.	.	.	.
9 Coffee, tea, spices	7	7	6	7	16	12	37	29	54 Man-made filaments	16	10	47	42	13	13	34	37
10 Cereals	13	10	18	21	12	13	14	18	55 Man-made staple fibres	12	9	21	15	12	11	30	21
11 Milling industry products	.	.	.	.	17	17	14	19	56 Wadding, yarns, ropes, cables	19	18	39	35	20	17	60	44
12 Oil seeds, grains, plants	12	12	13	14	11	8	23	21	57 Carpets, floor coverings	11	9	9	14	11	10	30	15
13 Gums, resins	17	14	28	33	15	14	21	12	58 Woven fabrics; tapestries	11	9	13	13	14	14	25	40
15 Animal, vegetable fats and oils	14	12	21	27	15	13	10	19	59 Textile fabrics	28	23	34	41	15	13	32	34
16 Preparations of meat, fish	11	9	13	5	14	11	19	9	60 Knitted or crocheted fabrics	12	6	21	7	11	11	27	30
17 Sugars	13	14	14	36	15	15	22	24	61 Knitted or crocheted apparel	11	12	10	16	16	14	18	25
18 Cocoa	19	20	30	42	17	18	55	36	62 Apparel, not knitted or crocheted	12	13	12	15	16	16	26	25
19 Cereals, flour, milk	11	11	23	36	16	14	36	48	63 Other made up textile articles	13	11	17	14	14	14	31	27
20 Vegetables, fruit, nuts	9	8	22	24	12	12	22	26	64 Footwear, gaiters	11	12	8	5	13	15	16	31
21 Misc. edible preparations	15	14	37	40	14	14	27	13	65 Headgear and parts thereof	10	11	6	7	15	12	14	19
22 Beverages, spirits	7	7	19	26	10	10	16	14	68 Stone, plaster, cement	11	7	29	22	20	16	41	29
23 Residues from food industries	17	17	19	43	14	12	30	19	69 Ceramic products	11	9	26	23	14	12	21	15
24 Tobacco	20	22	14	32	18	15	37	29	70 Glass and glassware	16	13	39	44	16	13	33	30
25 Salt; earths and stone	20	19	25	40	16	13	15	17	71 Pearls, precious metals, coin	15	17	6	11	14	6	33	7
27 Mineral fuels, oils, waxes	24	31	23	26	17	18	14	16	72 Iron and steel	40	35	48	44	16	14	12	16
28 Inorganic chemicals+Z77	30	31	41	35	21	17	31	22	73 Articles of iron or steel	26	23	40	37	21	17	34	31
29 Organic chemicals	38	34	58	63	30	23	39	40	74 Copper and articles thereof	16	16	24	16	18	15	21	20
30 Pharmaceutical products	28	29	70	75	21	20	41	64	75 Nickel and articles thereof	32	28	78	55	16	14	37	22
31 Fertilisers	28	28	30	58	.	.	.	.	76 Aluminum and articles thereof	22	20	49	49	17	14	30	29
32 Tanning or dyeing extracts	35	33	64	59	22	16	48	36	81 Other base metals	25	24	37	35	19	14	37	26
33 Oils; perfumery	20	20	26	30	23	17	32	26	82 Tools, implements, cutlery	16	16	32	38	26	18	69	50
34 Soap, waxes, candles	29	25	48	41	24	20	48	36	83 Misc. articles of base metal	22	17	31	33	23	15	35	37
35 Starches, glues, enzymes	32	28	66	61	25	21	37	27	84 Nuclear reactors, machinery	33	31	62	61	19	15	43	33
36 Explosives	.	.	.	.	30	27	37	33	85 Electrical machinery	36	33	68	67	20	15	52	34
37 Photographic goods	35	33	82	83	37	22	87	68	87 Non-Railway vehicles	26	25	85	87	13	15	22	71
38 Misc. chemical products	39	36	69	58	22	18	45	34	89 Ships, boats, etc.	.	.	.	.	10	8	27	30
39 Plastics and articles thereof	30	29	52	55	24	20	48	37	90 Instruments	28	27	62	58	19	14	41	27
40 Rubber and articles thereof	36	36	64	68	21	19	41	47	91 Clocks and watches	15	14	40	47	14	9	34	21
41 Raw hides, skins, leather	5	5	8	7	9	9	9	13	92 Musical instruments	11	10	56	54	10	7	12	11
42 Leather; saddlery and harness	12	12	8	11	15	14	17	20	93 Arms and ammunition	17	15	39	51	.	.	.	.
44 Wood articles; wood charcoal	11	11	12	17	11	11	20	14	94 Furniture; prefab buildings	10	9	15	15	14	12	25	28
46 Straw; basketware	4	4	2	3	.	.	.	.	95 Toys, games	10	10	22	22	14	12	23	31
47 Pulp of wood	32	38	32	37	11	6	11	8	96 Misc. manufactured articles	13	13	33	39	20	15	41	25

Note: Table summarizes U.S. related-party imports and exports by two-digit Harmonized System chapters. The first two columns of each panel report the percent of firms importing the noted chapter that report positive related party imports in 1993 and 2000. The second two columns of each panel report the percent of import value in the noted chapter that is between related parties in 1993 and 2000. Final four columns of each panel report analogous numbers vis a vis for exports. "." denotes data unavailability. The set of chapters for which data are available is determined by disclosure screenings (see text).

Table 2: U.S. Related Party Trade by Industry, 1993 and 2000

HS Chapter	Contractability	HS Chapter	Contractability		
46	Straw; basketware	0.88	3	Fish, crustaceans	0.56
8	Fruit and nuts	0.74	6	Trees and plants	0.65
57	Carpets, floor coverings	0.74	7	Vegetables	0.63
64	Footwear, gaiters	0.73	8	Fruit and nuts	0.74
20	Vegetables, fruit, nuts	0.72	9	Coffee, tea, spices	0.64
42	Leather; saddlery and harness	0.71	10	Cereals	0.33
16	Preparations of meat, fish	0.66	12	Oil seeds, grains, plants	0.42
6	Trees and plants	0.65	13	Gums, resins	0.37
9	Coffee, tea, spices	0.64	15	Animal, vegetable fats and oils	0.40
7	Vegetables	0.63	16	Preparations of meat, fish	0.66
65	Headgear and parts thereof	0.63	17	Sugars	0.50
18	Cocoa	0.62	18	Cocoa	0.62
22	Beverages, spirits	0.62	19	Cereals, flour, milk	0.56
61	Knitted or crocheted apparel	0.62	20	Vegetables, fruit, nuts	0.72
63	Other made up textile articles	0.62	21	Misc. edible preparations	0.55
62	Apparel, not knitted or crocheted	0.61	22	Beverages, spirits	0.62
94	Furniture; prefab buildings	0.61	23	Residues from food industries	0.31
95	Toys, games	0.61	24	Tobacco	0.20
52	Cotton	0.60	25	Salt; earths and stone	0.27
69	Ceramic products	0.58	27	Mineral fuels, oils, waxes	0.20
3	Fish, crustaceans	0.56	28	Inorganic chemicals+Z77	0.28
19	Cereals, flour, milk	0.56	29	Organic chemicals	0.27
53	Vegetable textile fibres	0.56	30	Pharmaceutical products	0.16
60	Knitted or crocheted fabrics	0.56	31	Fertilisers	0.43
92	Musical instruments	0.56	32	Tanning or dyeing extracts	0.29
21	Misc. edible preparations	0.55	33	Oils; perfumery	0.37
91	Clocks and watches	0.55	34	Soap, waxes, candles	0.29
82	Tools, implements, cutlery	0.54	35	Starches, glues, enzymes	0.39
93	Arms and ammunition	0.53	37	Photographic goods	0.17
55	Man-made staple fibres	0.52	38	Misc. chemical products	0.17
96	Misc. manufactured articles	0.52	39	Plastics and articles thereof	0.32
17	Sugars	0.50	40	Rubber and articles thereof	0.34
50	Silk	0.50	41	Raw hides, skins, leather	0.39
54	Man-made filaments	0.50	42	Leather; saddlery and harness	0.71
58	Woven fabrics; tapestries	0.50	44	Wood articles; wood charcoal	0.35
73	Articles of iron or steel	0.50	46	Straw; basketware	0.88
68	Stone, plaster, cement	0.48	47	Pulp of wood	0.23
72	Iron and steel	0.46	48	Paper; articles of paper pulp	0.41
74	Copper and articles thereof	0.45	49	Printed books, newspapers	0.31
31	Fertilisers	0.43	50	Silk	0.50
12	Oil seeds, grains, plants	0.42	51	Wool, woven fabric	0.41
83	Misc. articles of base metal	0.42	52	Cotton	0.60
48	Paper; articles of paper pulp	0.41	53	Vegetable textile fibres	0.56
51	Wool, woven fabric	0.41	54	Man-made filaments	0.50
15	Animal, vegetable fats and oils	0.40	55	Man-made staple fibres	0.52
56	Wadding, yarns, ropes, cables	0.40	56	Wadding, yarns, ropes, cables	0.40
35	Starches, glues, enzymes	0.39	57	Carpets, floor coverings	0.74
41	Raw hides, skins, leather	0.39	58	Woven fabrics; tapestries	0.50
70	Glass and glassware	0.39	59	Textile fabrics	0.32
13	Gums, resins	0.37	60	Knitted or crocheted fabrics	0.56
33	Oils; perfumery	0.37	61	Knitted or crocheted apparel	0.62
44	Wood articles; wood charcoal	0.35	62	Apparel, not knitted or crocheted	0.61
40	Rubber and articles thereof	0.34	63	Other made up textile articles	0.62
10	Cereals	0.33	64	Footwear, gaiters	0.73
84	Nuclear reactors, machinery	0.33	65	Headgear and parts thereof	0.63
90	Instruments	0.33	68	Stone, plaster, cement	0.48
39	Plastics and articles thereof	0.32	69	Ceramic products	0.58
59	Textile fabrics	0.32	70	Glass and glassware	0.39
76	Aluminum and articles thereof	0.32	71	Pearls, precious metals, coin	0.23
23	Residues from food industries	0.31	72	Iron and steel	0.46
49	Printed books, newspapers	0.31	73	Articles of iron or steel	0.50
32	Tanning or dyeing extracts	0.29	74	Copper and articles thereof	0.45
34	Soap, waxes, candles	0.29	75	Nickel and articles thereof	0.23
81	Other base metals	0.29	76	Aluminum and articles thereof	0.32
85	Electrical machinery	0.29	81	Other base metals	0.29
28	Inorganic chemicals+Z77	0.28	82	Tools, implements, cutlery	0.54
87	Non-Railway vehicles	0.28	83	Misc. articles of base metal	0.42
25	Salt; earths and stone	0.27	84	Nuclear reactors, machinery	0.33
29	Organic chemicals	0.27	85	Electrical machinery	0.29
47	Pulp of wood	0.23	87	Non-Railway vehicles	0.28
71	Pearls, precious metals, coin	0.23	90	Instruments	0.33
75	Nickel and articles thereof	0.23	91	Clocks and watches	0.55
24	Tobacco	0.20	92	Musical instruments	0.56
27	Mineral fuels, oils, waxes	0.20	93	Arms and ammunition	0.53
37	Photographic goods	0.17	94	Furniture; prefab buildings	0.61
38	Misc. chemical products	0.17	95	Toys, games	0.61
30	Pharmaceutical products	0.16	96	Misc. manufactured articles	0.52

Note: Table displays average contractability of ten-digit Harmonized System products in 1997 by two-digit HS chapters. First column is sorted by contractability. Second column is sorted by HS chapter.

Table 3: Contractability Index by HS2 Industry, 1997

	(1)	(2)	(3)	(4)	(5)
Contractability	-0.320 *** 0.028				-0.222 *** 0.028
Capital Intensity		0.089 *** 0.006			0.054 *** 0.011
Skill Intensity			0.777 *** 0.092		0.364 *** 0.089
Dispersion				0.079 *** 0.009	-0.006 0.011
R-squared	0.114	0.112	0.086	0.056	0.183
Observations	11442	11442	11442	11442	11442

Note: Dependent variable is the intra-firm share of import value. Standard errors are robust to clustering at the SIC4 level. \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent levels respectively.

Table 4: Determinants of Intra-firm Imports, HS10 Product 1997

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Log capital abundance	0.079 *** 0.010						0.037 ** 0.017	0.022 0.016	0.021 0.016	0.022 0.017
Log human capital abundance		0.441 *** 0.049					0.287 *** 0.087	0.147 0.124	0.147 0.124	0.146 0.129
Log population			-0.005 0.014							-0.001 0.011
Governance				0.130 *** 0.016				0.071 * 0.036	0.070 * 0.036	0.062 * 0.042
FDI openness					-0.097 *** 0.025				-0.005 0.027	0.000 0.024
Trade openness						-0.075 *** 0.018				-0.012 0.023
R-squared	0.292	0.319	0.002	0.343	0.110	0.164	0.343	0.373	0.373	0.376
Observations	102	102	102	102	102	102	102	102	102	102

Note: Dependent variable is the intra-firm share of import value by country. All specifications report robust standard errors. \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent levels respectively.

Table 5: Determinants of Intra-firm Imports, Country 1997

	(1)	(2)	(3)	(4)	(5)	(6)
Contractability	-0.131 *** 0.019	-0.131 *** 0.019	-0.121 *** 0.019	-0.120 *** 0.019	-0.106 *** 0.018	
Capital Intensity	0.033 *** 0.008	0.033 *** 0.008	0.040 *** 0.008	0.040 *** 0.008	0.037 *** 0.008	
Skill Intensity	0.075 0.059	0.077 0.060	0.079 0.061	0.079 0.061	0.068 0.057	
Dispersion	0.024 *** 0.008	0.024 *** 0.008	0.021 *** 0.008	0.021 ** 0.008	0.019 *** 0.007	
Log capital abundance	0.068 *** 0.005	0.073 *** 0.006	0.064 *** 0.006	0.066 *** 0.007		0.054 *** 0.006
Log human capital abundance	-0.155 *** 0.030	-0.138 *** 0.032	-0.050 0.032	-0.062 ** 0.031		-0.059 * 0.033
Log population			-0.034 *** 0.002	-0.033 *** 0.002		-0.045 *** 0.002
Governance		-0.009 0.008	-0.043 *** 0.008	-0.033 *** 0.007		-0.037 *** 0.008
FDI openness			-0.011 * 0.006	-0.013 ** 0.005		-0.013 ** 0.006
Trade openness				0.012 *** 0.004		0.018 *** 0.004
Fixed Effects	none	none	none	none	country	product
R-squared	0.067	0.067	0.081	0.081	0.151	0.196
Observations	75799	75799	75799	75799	75799	75799

Note: Dependent variable is the intra-firm share of import value by HS10-country. Standard errors are robust to clustering at the SIC4 level. \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent levels respectively.

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

	(1)	(2)	(3)	(4)	(5)	(6)
Contractability	-0.177 *** 0.023	-0.217 *** 0.023	-0.219 *** 0.023	-0.205 *** 0.024	-0.182 *** 0.024	
Capital Intensity	-0.045 0.037	-0.072 ** 0.035	-0.072 ** 0.035	-0.041 0.039	0.051 0.060	
Skill Intensity	0.711 *** 0.172	0.675 *** 0.170	0.683 *** 0.166	0.742 *** 0.174	0.846 *** 0.185	
Dispersion	0.025 *** 0.008	0.024 *** 0.008	0.024 *** 0.008	0.021 ** 0.009	0.022 *** 0.008	
Log capital abundance	0.031 ** 0.015	0.032 ** 0.014	0.027 * 0.014	0.034 ** 0.016		0.037 ** 0.016
Log human capital abundance	0.018 0.061	0.050 0.060	0.107 * 0.057	0.150 ** 0.061		0.185 *** 0.062
Log population				-0.034 *** 0.003		-0.046 *** 0.002
Governance		-0.039 *** 0.008	-0.055 *** 0.008	-0.062 *** 0.009		-0.066 *** 0.009
FDI openness			-0.042 *** 0.006	-0.014 ** 0.006		-0.013 ** 0.006
Trade openness				0.012 *** 0.004		0.018 *** 0.004
Capital interaction	0.007 ** 0.004	0.010 *** 0.003	0.010 *** 0.003	0.007 * 0.004	-0.002 0.006	0.003 0.004
Skill interaction	-0.733 *** 0.171	-0.683 *** 0.167	-0.695 *** 0.162	-0.761 *** 0.172	-0.893 *** 0.183	-0.869 *** 0.171
Contractability interaction	0.039 *** 0.011	0.073 *** 0.012	0.076 *** 0.012	0.072 *** 0.013	0.065 *** 0.012	0.075 *** 0.014
Fixed Effects	none	none	none	none	country	product
R-squared	0.070	0.071	0.074	0.085	0.156	0.200
Observations	75,799	75,799	75,799	75,799	75,799	75,799

Note: Dependent variable is the intra-firm share of import value by HS10-country. The capital interaction is the product of industry log capital intensity and country log capital abundance; the skill interaction is the product of industry skill intensity and country log skill abundance; the contractability interaction is the product of HS10 product contractability and country governance. Standard errors are robust to clustering at the SIC4 level. \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent levels respectively.

Table 7: Determinants of Intra-firm Imports - with interactions, HS10-Country 1997



	Intermediate Imports (%)	Imports as a Share of Shipments (%)
1992	43	8
1997	34	10
2002	na	na

Notes: First column reports share of manufacturing firm imports of products outside the set of four-digit industries they produce. Second column reports manufacturing firm imports as a share of their shipments.

Table 8: U.S. Imported Intermediate Inputs, 1992 to 2002

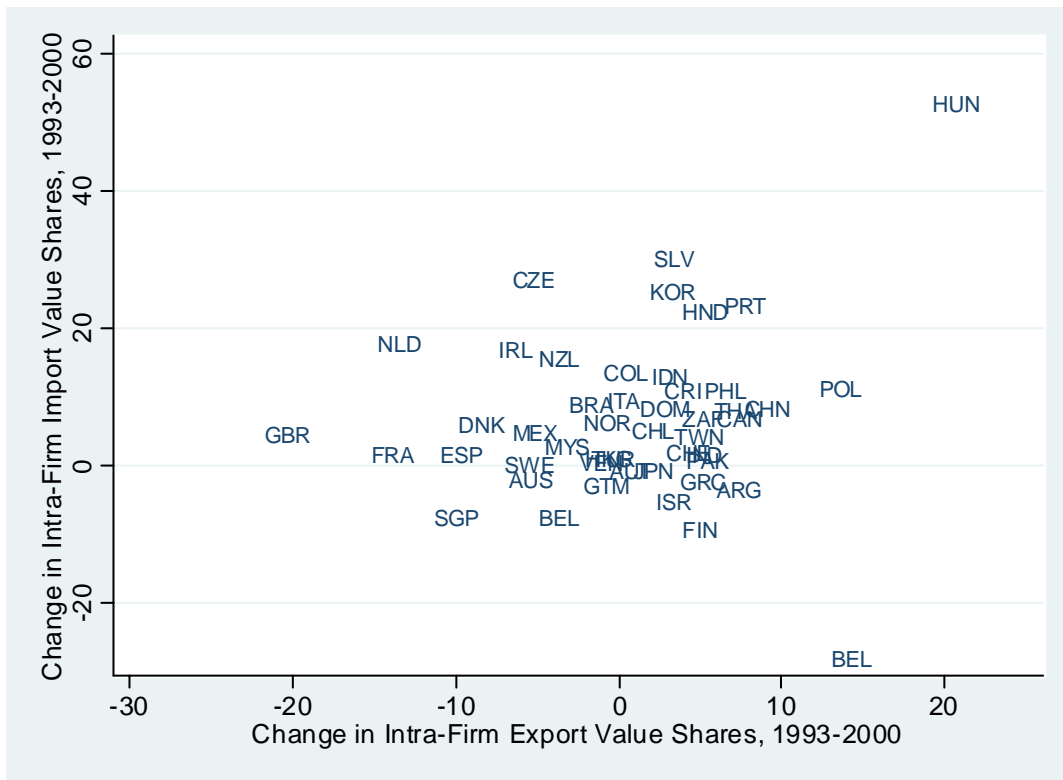


Figure 1: Changes in Intra-firm Export and Import Shares by Country, 1993-2000



Figure 2: Changes in Intra-firm Export and Import Shares by Country, 1993-2000

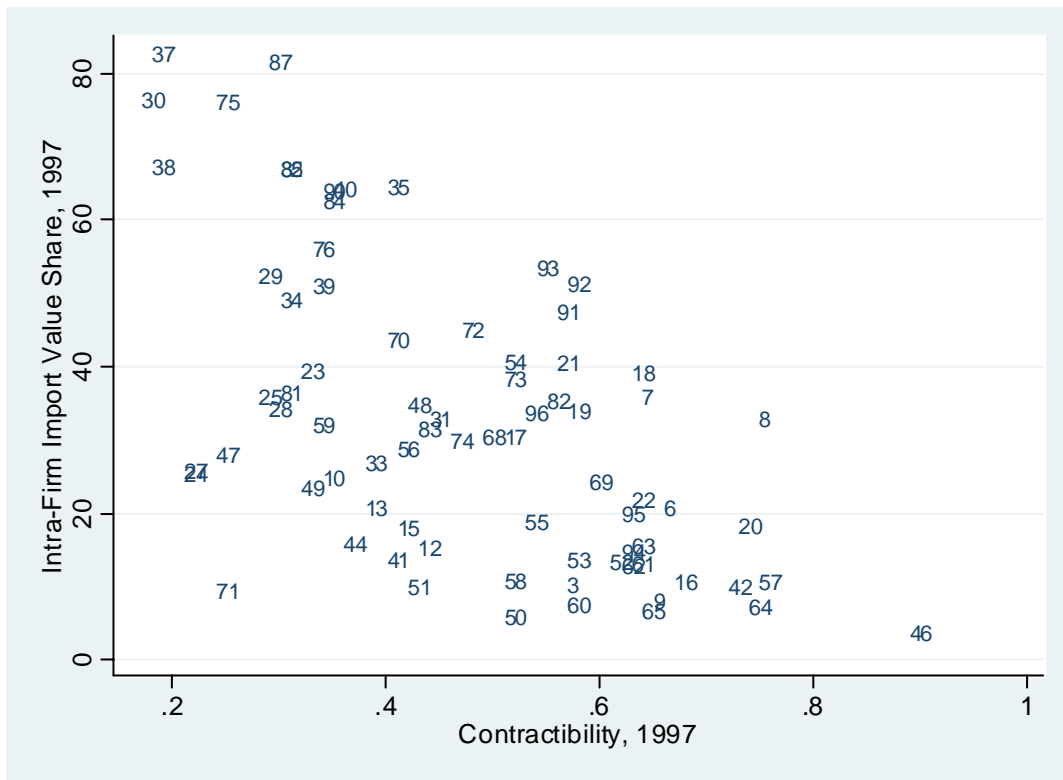


Figure 3: Relationship of Intra-firm Imports to Contractability for HS2 Industries