Export Versus FDI: A Task-Based Framework for Comparing Manufacturing and Services *

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Abstract

This paper shows that standard predictors of the export versus FDI decision hold for manufacturing but not for service industries. I develop an alternative model which decomposes each industry into the tasks required for production and uses these tasks to predict the location of production for that industry. Industries requiring direct communication with consumers are more likely to be produced in the destination market. Production of more nonroutine activities is more likely to occur at the multinational's headquarters for export, especially when the destination market has weak contract-enforcing institutions. These predictions are tested using firm-level data from the Bureau of Economic Analysis US Direct Investment Abroad Benchmark Survey of Multinationals combined with task-level data from the Department of Labor's Occupational Information Network. The task-based approach developed in this paper performs well for both manufacturing and service industries, has greater explanatory power than alternative proximity concentration or comparative advantage explanations, and is robust to a variety of specifications. Differences in task intensities can explain 40 percent of the difference in export to FDI ratios between the manufacturing and service sectors.

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1 Introduction

Manufacturing and service firms do not serve foreign markets in the same way. In manufacturing, exports and sales through FDI comprise roughly equal shares of total foreign sales by US multinationals. Yet service producers overwhelmingly rely on investment rather than exports (see Figure 1). In this paper, I show that standard predictors of the export versus FDI decision such as distance and market size cannot explain this difference across sectors. I augment the Helpman, Melitz and Yeaple (2004) model with the potential for imperfect contracts and miscommunication and propose a new set of measures that capture the relative cost of contracting out production to foreign affiliates through FDI or shipping final products cross-border through exports. This approach is significant for both manufacturing and service industries and can explain 40 percent of the difference in export to FDI ratios across the two sectors.

In the export versus FDI literature, the decision to produce at home for export or in the destination market through FDI is based on a tradeoff between the gains to scale achieved by concentrating production in the home country for export and the benefits of producing near the final consumers to avoid marginal transport costs. I show that this tradeoff, while robust for goods, is not a significant determinant of the export to FDI ratio in services. Instead, I use a measure of the relative costs of FDI and exporting that breaks industries down into an even finer level of detail: tasks. A task is a specific activity (such as making decisions, communicating with customers, operating machinery, etc.) that must be performed in the production of a given industry's output. Certain activities are more difficult to export across borders or to offshore to foreign affiliates for production. In particular, tasks requiring direct communication with consumers are more likely to be performed in the destination market where consumers are located. Communicating with customers is about twice as important for services as for manufacturing (see Table 1). I show that because services require much more interaction with consumers than manufactures, the difference in the importance of this task can explain much of the difference in export to FDI ratios across the two sectors. This relationship between the need for consumer interaction and higher relative FDI is highly intuitive but has never been shown in the economic literature on the export versus FDI decision.

If communicating with consumers were the only task that mattered for the export versus FDI decision, we would expect to see nearly all services provided through investment. Figure 1 shows that about 30 percent of of sales of services to foreign markets are through exports.

Controlling for standard determinants of trade and investment, I show that the level of complexity of production tasks has an effect that is opposite to that of communication intensity, offsetting some of the impact of the need for consumer interaction. More nonroutine activities are more difficult to completely contract for and thus their production is less likely to be offshored to foreign affiliates, especially if the foreign affiliate is in a country with weak contract enforcing institutions. I introduce a model of incomplete contracts into a Helpman, Meltiz and Yeaple framework to explain how the level of routineness of tasks determines how easily they can be offshored. Interactions of tasks with the contracting environment and language of the destination market capture country-industry level variation in these effects. Because more non-routine tasks require judgment, creativity, decision making, and otherwise do not follow explicitly defined rules (Autor, Levy and Murnane 2003) they are much more difficult to specify in complete contracts and thus offshoring the production of nonroutine tasks exposes the firm to a higher level of contracting risk. This risk is higher in countries with weak contract-enforcing institutions.

When each industry is defined by the series of tasks used in its production, the differences between manufactures and services become clear. On average, the importance of working with the public is twice as high for services as for manufactures. Scores for nonroutine tasks, such as creative thinking, are 44 percent higher. In general, manufacturing industries are comprised of relatively more manual and routine tasks, while service production requires relatively more nonroutine, cognitive, and communication tasks. Table 1 summarizes the key task dimensions that I will use in this paper and Table 2 provides detail on a broader range of tasks. The data on these tasks that is collected by the Department of Labor allows for empirical identification of the role tasks play in determining patterns of trade and investment. The service industries used in this study are listed in Table 4. Business, professional and technical services make up most of the sample.

The results show that the task contracting model I propose is robust for both manufacturing and services, even after controlling for distance, market size, tax rates, education levels, and standard measures of endowment-based comparative advantage. The intensity with which an industry uses communication and nonroutine tasks is a significant determinant of the location of multinational production. The relationship between task intensity and the export to FDI ratio is similar for manufacturing and service industries, suggesting that the difference in task compositions across sectors presented in Table 1 can explain the difference in trade and investment outcomes presented in Figure 1. I decompose the difference in export-FDI ratios between the two sectors into the share attributable to the different characteristics of the sectors (X's) and the share attributable to the different relationships between these characteristics and the export to FDI ratio (coefficients). Of the total difference, 40 percent can be explained by the differential task characteristics across industries.

2 Related Literature

This paper is motivated by a broad literature on the organization of multinational activities. However, for the empirical exercise, I focus on one specific aspect of this organization: the decision to serve foreign markets through exports or FDI. When US firms sell goods to foreign consumers they have three options: (1) produce at home for export, (2) open up an affiliate in the destination market and produce locally, or (3) fragment production such that firm ownership, production, and consumption each occur in one or more different locations. Option (2) is broadly referred to as horizontal FDI and option (3), which includes licensing, franchising and subcontracting, as vertical FDI. While evidence of both vertical and horizontal motives for FDI have been well documented (see for example, Krugman (1983), Helpman (1984), Markusen (1984), and Markusen and Maskus (2002)), focusing on the subset of horizontal FDI sales relative to exports of final goods allows for sharp predictions to be made about the determinants of trade relative to investment in final goods. Krugman (1983) developed a model in which firms trade off proximity to consumers (FDI) against the gains to scale achieved by concentrating production in one location for export. Brainard (1993 and 1997) refined this proximity-concentration model and found strong empirical support for its predictions. Helpman, Melitz, and Yeaple (2004) introduced firm-level heterogeneity and found that the impact of heterogeneity is similar in magnitude to that of the proximity-concentration effect.

Despite the growing importance of services in international trade (see Figure 1), nearly all empirical research focuses on trade in manufactures. [1] To my knowledge, no papers have examined the decision of service firms serve foreign markets though exports or FDI. This paucity of research on services trade would not be problematic if we could be certain that trade and investment in services were determined by the same factors as trade and investment in manufactures. However, Figure 1 suggests that this is not the case. This paper exploits those differences in the task composition of manufacturing and service industries to explain the different ways in which manufacturing and service firms serve foreign markets. The result

[1] See Freund and Weinhold (2002), Amiti and Wei (2005), Jensen and Kletzer (2005), or Hanson and Xiang (2008) for examples of research on international trade in services

is a framework that is robust for both manufacturing and services, and that can explain much of the difference in patterns of trade and investment across the two sectors.

3 Theoretical Framework

In this section, I present a model of horizontal FDI in which US multinationals trade off the costs of exporting and the costs of FDI when deciding how to serve foreign markets. The basic framework follows a Helpman, Melitz and Yeaple (2004) model of heterogeneous firms. I extend Helpman, Melitz and Yeaple by explicitly modeling trade and investment costs through the use of task-based contracting. [2] Because tasks differ in their level of complexity, the potential for contract failure and miscommunication is a source of variation between country-industry pairs. This model generates predictions about how characteristics of the tasks embodied in each industry interacted with characteristics of the trading countries determine the extent of trade and investment costs, and thus the relative magnitudes of exports versus FDI. The task-based framework of this model is particularly useful for the study of trade and investment in services as well as goods.

This model begins with a continuum of goods and services producing industries, $z \in (0, 1)$. Each of these industries is comprised of a discrete number of tasks, $s \in (1, 2, ..., S_z)$, which must be performed to produce the final good or service. The key characteristics of each industry can be represented by the specific tasks involved in producing the final good or service as well as the importance of each of these tasks in that industry. Tasks are defined by their specific characteristics (e.g. decision-making, communicating with customers, handling objects, etc.). Tasks can be performed anywhere, however, due to limitations on the nature of trade data, tasks can only be traded when they are bundled together as goods and services, z. Because each of the tasks, s, contained in z must be performed to complete the product, firms are modeled as having a Leontief production function

$$q(z) = min[\alpha_{1z}s_1, \alpha_{2z}s_2, ..., \alpha_{S_z}s_S] \tag{1}$$

where α_{sz} is the importance of each task in industry z and $q(z)$ is the output of z. Note that z can be either a final or intermediate good or service.

[2] Grossman and Rossi-Hansberg (2006) develop a model of trade in tasks in which production consists of a series of value-added tasks that can be performed in any location. My framework differs from theirs in that I focus on a horizontal FDI decision in which final products are produced at home or abroad according to their task characteristics, rather than a vertical model of the fragmentation of production tasks across countries

Costs Associated with Task Performance

The difference in task compositions across industries leads to differences in the costs of trade and FDI. Because US multinational headquarters decide whether to produce each good or service at home for export or offshore its production to a local affiliate, FDI can be conceived of as contracting out production to the destination market. Therefore the successful fulfillment of contractual obligations is a key component of FDI, and any risk that contractual obligations will not be completed raises the cost of FDI. Breakdowns in communication, both within firm and between the producer and the final consumer, are also costly. I model both of these types of costs: (1) costs relating to contract failure and (2) costs related to communication failure.

Under contract failure, a worker will fail to perform an assigned task if the cost of complying is greater than the cost of shirking. Because the cost of shirking is increasing in the likelihood that the contract will be enforced, shirking is less likely to occur in countries with stronger contract-enforcing institutions. Because routine tasks can be clearly described in writing (see Autor, Levy and Murnane (2003)), shirking is less likely to occur in industries with a greater share of routine to nonroutine tasks. Contracts are enforced with a probability of $e^{-\theta_{zi}}$ where $0 < \theta_{zi} < 1$ measures the quality of contracts in country i and industry z. Thus $e^{-\theta_{zi}}$ is the share of production expected to be completed successfully if the tasks embodied in z are performed in country i. θ_{zi} can be further decomposed into:

$$\theta_{zi} = \theta_z + \theta_i + (\theta_z * \theta_i) \tag{2}$$

θ_z captures the task-requirements of industry z, such as importance of nonroutine tasks, θ_i captures the country-specific contracting environment, and $(\theta_z * \theta_i)$ interacts country and task characteristics (e.g. contract enforcement institutions should be more important for relatively more nonroutine task-intensive industries). This specification is similar to Kremer (1993) and Costinot (2008), except that in this case the success probability is a function of institutions and task intensities. Anderson and Marcouiller (2002), show that institutions matter for the likelihood that a shipment will reach its intended destination, functioning like an iceberg-style transport cost on exports. Acemoglu, Antras, and Helpman (2007) demonstrate that the quality of contracting institutions affects the level of investment in a Grossman Hart (1986) framework. I will allow for both of these roles of institutions (protecting shipments and enforcing contracts). Because the probability of contract failure is different for exporting than for FDI, let θ_{zi}^x denote the risk parameter for exporting and let θ^I_{zi} denote the risk parameter for FDI.

Along the communication task dimension, the risk is that miscommunication between producers and consumers will prevent transactions from occurring, effectively imposing transport costs on the export of communication-intensive goods and services. Each z will be completed with no communication problems with a probability of $e^{-\delta_{zi}}$, where

$$\delta_{zi} = \delta_z + \delta_i + (\delta_z * \delta_i) \tag{3}$$

δ_z captures the task-requirements of industry z, such as importance of communication with consumers, δ_i captures country-specific characteristics such as the language spoken in the country, and $(\delta_z * \delta_i)$ interacts country and task characteristics (e.g. the language spoken in a country should matter differently for tasks associated with answering customer service telephone calls than for tasks associated with assembling automobiles). Because the probability of communication failure is different for exporting than for FDI, let δ^x_{zi} denote the risk parameter for exporting and let δ^I_{zi} denote the risk parameter for FDI. In addition to the costs of potential contract failure or miscommunication, a standard iceberg-style trade cost, τ_{zi}, is applied to US exports of z to country i. $e^{-\tau_{zi}}$ represents the share of the good or service that survives transport. Each firm will choose trade or investment for each destination market based on whether expected profits, as a function of country and industry characteristics, are larger for exporting or for FDI.

Consumers have CES preferences with elasticity of substitution $\sigma_z > 1$. A firm's profits from exporting can be written as

$$\pi_x = [e^{-(\tau_{zi}+\delta^x_{zi}+\theta^x_{zi})} w_{us} a_{us}(z)]^{1-\sigma_z} B_i - f_x \tag{4}$$

Additional profits from locating production abroad for foreign consumption (FDI) are given by:

$$\pi_I = [e^{-(\delta^I_{zi}+\theta^I_{zi})} w_i a_i(z)]^{1-\sigma_z} B_i - f_I \tag{5}$$

where a_{us} is the labor required to produce one unit of z in the US, a_i is the labor required to produce one unit of z in country i, w_i and w_{us} are the wages in each country, $B_i = (1-\gamma)A^i/\gamma^{1-\sigma}$ is income share spent on z, f_x is the fixed cost of exporting, f_I is the fixed cost of FDI and $f_X < f_I$. a is drawn randomly by each firm from a pareto distribution, $G(z)$ and thus firms can be ordered from least productive to most productive. Each firm observes its productivity draw, and then decides whether or not to serve foreign markets and, if so, whether to use exporting or FDI sales. Relative profits of each production location depend on trade costs, relative productivity, a_i, wages, fixed costs, and risks associated with communication and contracting. These profit equations are very similar to those of Helpman, Melitz and Yeaple (2004) but incorporate the task-based trade costs.

From these profit equations, the cutoff for exporting can be written as:

$$[e^{-(\tau_{zi}+\delta^x_{zi}+\theta^x_{zi})}w_{us}a_{us}(z)]^{1-\sigma_z}B_i = f_{xi} \tag{6}$$

and the cutoff for FDI can be written as:

$$[(w_i e^{-(\delta^I_{zi}+\theta^I_{zi})})^{1-\sigma_z} - (w_{us}e^{-(\tau_{zi}+\delta^x_{zi}+\theta^x_{zi})})^{1-\sigma_z}](a_i(z))^{1-\sigma_z}B_i = (f_{Ii} - f_{xi}) \tag{7}$$

The firm will choose to export if $\pi_{xz} - \pi_{Iz} > 0$ and produce the task abroad through FDI if $\pi_{xz} - \pi_{Iz} < 0$. Thus the ratio of exports, X_{zi}, to FDI, I_{zi} is

$$\frac{X_{zi}}{I_{zi}} = (\frac{w_{us}e^{-(\tau_{zi}+\delta^x_{zi}+\theta^x_{zi})}}{w_i e^{-(\delta^I_{zi}+\theta^I_{zi})}})^{1-\sigma_z}[\frac{V_s(a_{us}(z))}{V_s(a_i(z))} - 1] \tag{8}$$

where $V(a) = \int_0^a y^{1-\sigma}dG(y)$ is the distribution of productivity. V is pareto with shape parameter $k-(\sigma-1)$. This distribution implies that $V(a_{us})/V(a_i) = (a_{us}/a_i)^{k-(\sigma-1)}$. Plugging in using the cutoff values for FDI and exporting to get a_{us} and a_i, this condition becomes

$$\frac{X_{zi}}{I_{zi}} = (\frac{w_{us}e^{-(\tau_{zi}+\delta^x_{zi}+\theta^x_{zi})}}{w_i e^{-(\delta^I_{zi}+\theta^I_{zi})}})^{1-\sigma_z}[\frac{f_I - f_x}{f_x}\frac{1}{(w_{us}e^{-(\tau_{zi}+\delta_{zi}+\theta_{zi})})^{\sigma_z-1}(w_i e^{-(\delta_{zi}+\theta_{zi})})^{1-\sigma_z} - 1}]^{\frac{k-(\sigma_z-1)}{\sigma_z-1}} \tag{9}$$

Linearizing this equation produces the primary regression specification:

$$\ln\frac{X_{zi}}{I_{zi}} = \beta_1 ln\frac{w_i}{w_{us}} + \beta_2\delta_{zi} + \beta_3\theta_{zi} + \beta_4\tau_{zi} + \beta_5 f_x + \beta_6 f_I + \beta_7 k \tag{10}$$

Where δ_{zi} denotes the net difference between δ^x_{zi} and δ^I_{zi} and θ_{zi} denotes the net difference between θ^x_{zi} and θ^I_{zi}.

I estimate a reduced form version of equation (11), where δ_{zi} and θ_{zi} are stacked in one vector, along with other country and industry characteristics, denoted by δ_{zi}, and replaced by Equation (3):

$$\ln\frac{X_{zi}}{I_{zi}} = \beta_1 ln\frac{w_i}{w_{us}} + \beta_2\tau_{zi} + \beta_3 k + \beta_4\delta_z + \beta_5\delta_i + \beta_6(\delta_z * \delta_i) + \varepsilon_{zi} \tag{11}$$

This specification is similar to Brainard (1997) and Helpman, Melitz and Yeaple (2004). But in addition to the proximity-concentration trade off, communication risk and contract risk must also be balanced to make exporting more profitable than incurring the cost of opening a new plant in the final consumption market. We should see more exports relative to FDI for countries with weak institutions and those that are linguistically distant. More nonroutine tasks are more vulnerable to contract risk and are thus more likely to be exported, especially when the destination country has weak contract-enforcing institutions. Communication-intensive tasks are associated with greater risk at the time and location of delivery to consumers and thus are more likely to be sold through FDI. So while the analytical result is similar to previous models of the trade versus investment decision for goods, the empirical implications are different.

4 Construction of Task Intensities

Autor, Levy and Murnane (2003) divide the set of all possible job tasks that workers perform into two basic categories: routine and nonroutine. Routine tasks are those that can be accomplished by following a set of specific, well-defined rules. Non-routine tasks require more complicated activities like creative problem solving and decision making. These tasks are sufficiently complex that they can not be completely specified in computer code and executed by machines as emphasized by Autor, Levy and Murnane, nor can they be fully described in a written contract. I use this routine-nonroutine dichotomy and add another dimension, communication, which captures tasks that require interaction with customers. This activity has the largest average difference in importance between manufacturing and service industries. It also offers a meaningful measure of a characteristic that has often been cited as a intuitive explanation for why some activities are more offshorable than others, namely the extent to which producers and consumers must be in the same location at the time of delivery (Blinder 2007).

The Department of Labor's Occupational Information Network (O*NET) includes data on the importance of these and other tasks in about 800 occupations. To match the relevant task measures to the industry-level trade and investment data, I aggregate the the raw O*NET scores up to the industry level, weight them by share in total task composition of each industry and merge them with trade data to get an index of the intensity of each task in each industry. Industries can then be defined by a vector of tasks, each weighted by its importance in that industry. O*NET lists 277 different skills, abilities, work activities, etc. Blinder

(2007) and Jensen and Kletzer (2007) use this data to construct indices of the offshorability of service occupations. Bacolod, Blum, and Strange (2007) use O*NET's predecessor, the Dictionary of Occupational Titles (DOT), to estimate the impact of agglomeration on the hedonic prices of worker skills. Autor, Levy and Murnane (2003) use the DOT to classify the extent to which industries and occupations are comprised of routine versus nonroutine tasks.

I combine data on the task requirements of occupations from O*NET with data on services and manufactures trade from the BEA to create an index of task intensity in each industry which will serve as a measure of trade costs in the export versus FDI framework described above. The importance score of each task, s in each industry, z is

$$M_{sz} = \sum_{c} \alpha_{zc} \ell_{sc} \tag{12}$$

where s indexes tasks, c indexes occupations, and z indexes industries. Thus α_{zc} is the share of occupation c used in the production of industry z, and ℓ_{sc} is an index of the importance of task s for occupation c.[3] Summing over occupations in a given industry results in an index of the un-scaled importance score for each each task in that industry. Each raw score is then divided by the sum of scores for each task in each industry, resulting in an input intensity measure for each task, s, in each industry, z:

$$I_{sz} = \frac{M_{sz}}{\sum_s M_{sz}} \tag{13}$$

Occupations are matched to industries using the Bureau of Labor Statistics Occupational Employment Statistics. These intensities are then matched to the BEA data on multinational firms. BEA collects data at the level of the firm and then reports the primary industry classification of each firm. Thus (13) can be used as a component of the industry characteristics vector δ_z in regression equation (11).

I took two different approaches to distilling the O*NET data into a simple measure of each task characteristic. The first approach is similar to Autor, Levy and Murnane (2003) and consists of identifying an individual task measure that most closely proxies each desired characteristic. Under this approach, I use the O*NET measure "working with the public" as

[3] ℓ_{sc} corresponds to the 0-100 score O*NET reports to measure the importance of each task in each occupation. These scores are constructed from surveys of individuals in those occupations and are normalized to a 0-100 scale by analysts at the Department of Labor. Due to the subjective nature of the surveys, one unit of importance for given task can not be directly compared to one unit of another task. This is a limitation of the data and motivates the use of relative intensity scores rather than the raw scores reported by O*NET.

a proxy for the importance of communicating with consumers. To capture the level of task complexity (which corresponds to Autor, Levy and Murnane's "non-routine cognitive" category), I use the O*NET measure of "creative thinking". As a robustness check, I replicate the regressions using "making decisions and solving problems" and "communicating inside the organization" as alternate measures of non-routine task intensity. I use the O*NET measures "handling objects", "operating machines (other than vehicles)", and "general physical activities" to proxy routine manual activities.

The second approach uses principal components analysis to distill a large number of tasks down to their core elements. I create one measure of non-routine intensity using the primary component among creativity, problem solving, giving consultation or advice, developing objectives, communicating internally, and working with computers. The routine manual component is drawn from the tasks handling objects, operating machines and general physical activities. No principal components were constructed for communication because working directly with the public is the single O*NET task that corresponds directly to that concept. All empirical results are robust to the use of individual task proxies or principal component measures.

5 Data

FDI Data

The Bureau of Economic Analysis collects firm-level data on U.S. multinational company operations in both goods-producing and service- producing industries in its benchmark surveys of U.S. direct investment abroad. I use data on local sales by foreign affiliates from these surveys as a measure of sales through FDI. The information on manufacturing firms contained in this dataset has been used in previous studies (see for example Hanson, Mataloni, and Slaughter 2005 or Desai, Foley and Hines 2001), however the data on service trade and investment are not frequently exploited. I restrict my sample to the years in which the Benchmark surveys were conducted. These include 1982, 1989, 1994, 1999, and 2004. The BEA surveys cover 54 manufacturing industries and 33 service industries, classified according to BEA versions of 3-digit SIC codes. For this paper, I aggregated the affiliate firm level data up to the industry level, defined by the primary industry of the affiliate, to be matched with industry level export data.

Export Data

Data on exports of manufactures are taken from the dataset compiled by Feenstra and available at the NBER website. These data were converted from 4-digit SIC codes to 3-digit BEA SIC-based codes using concordance tables provided by Raymond Mataloni. Data on exports of services were taken from BEA's survey of selected services transactions with unaffiliated foreign persons. This survey provides information on both the general product categories that are being traded and on the primary industry of the exporting firm, as reported by the firm itself. These classifications are highly correlated (e.g. we observe firms in the legal industry exporting legal services and firms in the advertising industry exporting advertising services). I use the industry of the exporting firm, rather than the product category, to classify service exports, as these codes are also used in the FDI data. Data from this survey are available annually beginning in 1992, resulting in a final dataset containing three years (1994, 1999, and 2004), 54 manufacturing industries, 32 service industries, and 88 countries. Table 4 lists service industries in descending order of their export to FDI ratios.

There are a few key differences between the public versions of the BEA services trade data and the proprietary BEA survey data I use for this paper. Based on BEA definitions, service exports reported in the public data occur when "the residents of one country sell services to the residents of another country." (Nephew et al. 2005). This could occur in the US (e.g. a foreign resident travels to the US to purchase services) or abroad (a company located in the US provides services to an individual or company located in another country). These exports can be within firm or unaffiliated. Table 3 gives the values of these exports by major category in 2004. They include services that are classified by BEA as "other private services". These do not include travel, transportation, retail, or wholesale services. The largest categories are financial and business services, the latter of which includes information, management, telecommunications, legal, accounting, engineering, advertising, and other similar services. For this paper, I use firm-level data from BEA's survey of selected services transactions with unaffiliated foreign persons, which is one component of the aggregate public data (compiled by BEA from several different sources). This survey covers a subset of other private service and only includes exports by U.S. companies to unaffiliated persons abroad. Therefore my analysis is not complicated either by intrafirm trade or by service exports sold to foreign citizens traveling to the U.S.

Institutional Quality Data

I use an index of regulation and enforcement from the World Bank's Doing Business

Database to proxy for the level of institutional quality. This index is based on surveys of local experts, including lawyers, business consultants, accountants, freight forwarders, government officials and other professionals routinely administering or advising on legal and regulatory requirements. The index includes an overall measure of business institutions, as well as separate measures for ten specific areas: starting a business, protecting investors, dealing with construction permits, paying taxes, employing workers, trading across borders, registering property, getting credit, closing a business, and enforcing contracts. Countries are ranked based on their strength on each of these dimensions. Each country's score for each dimension is its rank from 1 to 181. The overall score for a country is the simple average of that country's scores on each of the ten dimensions. I normalize these rankings to fall between 0 and 100, with 100 representing the highest level of institutional quality. For the baseline specification, I use the difference between the contracting institutions score and the overall score to isolate the specific role of contract enforcement apart from the overall business environment. As a robustness check, I also use the overall measure of institutional quality for each country.

Other Data

The great circle distance between capital cities proxies for transport costs. GDP is used to capture market size. Data on firm-level sales by industry from Compustat are used to construct a measure of productivity dispersion for each industry in the sample. Relative wages in manufacturing and services are constructed using data from Freeman and Oostendorp (2000). As a robustness check, I also use a ratio of high to low skill wages from Grogger and Hanson (2008), which defines low-skill wages as the income level at the 20th percentile and high-skill wages as the income level at the 80th percentile. Data on corporate tax rates are from the University of Michigan World Tax Database. I use data on the educational level of industries from the Department of Labor's O*NET database. O*NET assigns each occupation a score of 1 to 5 to indicate the level of education and training required for that occupation. I aggregate those occupational level scores up to the industry level using the same occupation shares for each industry described by equation (12) in Section 4. The linguistic distance between countries based on language trees from Fearon (2003) is used to capture the effect of language. The more nodes on these trees that two languages have in common, the more likely they are to trace their roots to a recent common ancestor language. In this sense, the number of common nodes (out of a possible total of 15) that two languages share can be used to measure their linguistic similarity. Fearon (2003) also provides information on the linguistic composition of countries. Combining the information on language trees with the linguistic composition of countries results in a linguistic distance measure for each country, which is bounded by 0 and 1 and increasing in linguistic distance. For correlations between these and other variables, see Table 4.

6 Empirical Specification

Two-Stage Estimator

Helpman, Melitz, and Rubinstein (2008) demonstrate that standard gravity models suffer from bias because they do not account for the empirical fact that not all countries trade all goods with all other countries. Ignoring these zero-valued observations results in selection bias, as trade volumes are only observed for those countries that choose to trade with each other.

Figure 2 shows the share of country-industry pairs for which the US has zero exports, zero FDI sales, or an undefined or zero-valued export to FDI ratio in the manufacturing and service sectors. These patterns suggest that zero-valued observations are an even greater concern for the study of services than manufacturing. Correcting for selection into service exports or FDI is especially important if the biases are more systematic than in manufacturing, which could be the case if the task characteristics of certain service industries make them nontradable or if individual countries have restrictions barring service-sector FDI or trade.

I correct for selection into exporting and FDI sales using the non- parametric two-stage estimator proposed by Helpman, Melitz, and Rubinstein (2008). This estimator has the advantage of controlling both for the endogenous number of firms engaged in export and FDI and for bias due to correlation between the error term and the independent variables, which is generated by the selection of country-industry pairs into non-zero exports and FDI (e.g. a Heckman (1979) selection correction), but without the normality assumptions required by a similar parametric estimator. A disadvantage of the non-parametric functional form is that it does not allow for decomposition of the two types of bias. However, because the goal of this paper is to get unbiased estimates of the determinants of the export-FDI ratio, rather than to decompose the potential sources of bias, I am less concerned with this limitation. I also follow Helpman, Melitz and Rubinstein in using an index of common religion as the necessary exclusion restriction. They show that this measure only impacts the probability of trade, not the volume and I confirm that it holds for the probability of existence (but not volume) of the export-FDI ratio.

The log of the export to FDI ratio could be undefined either because exports equal zero, FDI sales equal zero, or both. However, positive selection into the sample of export-FDI observations occurs only if both exports and FDI sales are strictly positive. Therefore, I do not distinguish between the source of an undefined log export-FDI ratio and estimate the likelihood that both exports and FDI sales exist based on observables in the first stage, and then control for this selection in the second stage. Define indicator variable T_{zi} to equal 1 if the log of the export to FDI ratio exists, that is, if US has both non-zero exports and non-zero FDI sales to country i in industry z. Thus the two stage estimator is:

Stage 1:

$$\rho_{zi} = Pr(T_{ij} = 1 | \text{ observed variables }) = \Phi(\gamma_0 + \gamma_1) \tag{14}$$

Stage 2:

$$\ln \frac{X_{zi}}{I_{zi}} = \beta_1 ln \frac{w_i}{w_{us}} + \beta_2 \tau_{zi} + \beta_3 k_z + \beta_4 \delta_z + \beta_5 \delta_i + \beta_6 (\delta_z * \delta_i) + \beta_7 \hat{\rho}_{zi} + e_{zi} \tag{15}$$

Where γ_1 is the vector of independent variables and $\hat{\rho}_{zi}$ is the predicted value from stage 1.

I estimate equation (15) several times: using the specification listed above, including separate controls for zero-valued exports and zero-valued FDI sales, and without any corrections for selection bias. The coefficients and significance on each of the task measures are not changed much with inclusion of bias controls.

7 Results

Testing the Proximity-Concentration Story

Table 6 gives the results of a proximity-concentration model of the export versus FDI decision run on separate samples of manufacturing and service industries. The results for manufacturing industries are consistent with previous papers on the export-FDI trade off. Consistent with a proximity explanation, the coefficient on physical distance is negative and significant for manufactures. The coefficient on GDP, which can be interpreted as a measure of market size, is also negative for the sample of manufactures. Taken together, these results suggest that firms are more likely to serve foreign markets though FDI sales when those markets are far away (making transport of exports more costly) and when those markets are large (making it easier to recover the fixed costs of setting up a local affiliate branch). Table 6 also shows that these results do not hold for service industries, suggesting that a distance-market size tradeoff is not driving the decision of service firms to serve foreign markets through FDI or export.

The variable *dispersion* is the standard deviation of sales by firms in each industry. It was constructed using total sales information on US firms from the Compustat database. This variable captures the degree of firm level heterogeneity within an industry that was emphasized by Helpman, Melitz, and Yeaple (2004). Consistent with their results, I find that greater firm-level heterogeneity significantly increases FDI relative to exports in an industry. This result holds for both manufacturing and service industries.

Another possible explanation for production location decisions is that firms prefer to locate production in countries with lower relative labor costs. This is generally thought of as a motive for vertical FDI, but may be relevant here to the extent that firms engage in both vertical and horizontal FDI (see for example Yeaple 2003 and Carr, Markusen and Maskus 2001). I measure the relative wage in a number of different ways. The results presented in Table 6 show the average wage in service industries relative to the average wage in manufacturing industries for country i. The results in Table 6 suggest the wage ratio is not driving the export to FDI ratio in service or manufacturing industries. In other specifications not reported here, I also use the measure of high to low skilled wages proposed by Grogger and Hanson (2008) and either the destination country manufacturing wage relative to the US manufacturing wage and the destination country service wage relative to the US service wage. None of these relative wage measures are significant predictors of the export versus investment decision for either manufacturing or service industries.

Differences in corporate tax rates between the US and the destination country are not significantly associated with the export to FDI ratio. I define this variable as the US top marginal corporate tax rate minus the top marginal corporate tax rate in the destination country. Previous literature has found that tax rates matter for the location of affiliates of US multinationals (Grubert and Mutti 1991, Desai, Foley and Hines 2002). However, these studies do not look at sales to the local market by affiliates of US multinationals. Instead, their results suggest that those tax-driven locations are generally used for production for further export. It is therefore not inconsistent to observe that local sales by affiliates relative to exports from the US are not determined by differences in corporate tax rates.

The Role of Communication Tasks

Table 7 shows the results of the task-based model using communication and nonroutine tasks separately. Table 8 shows the results including communication and nonroutine tasks in the same regression. The negative coefficient on *communication* in tables 7 and 8 suggests that industries that require a higher degree of interaction with the public are more likely to be sold though FDI than through exports. Because services use communication tasks much more intensively than manufactures, this relationship is important for explaining why service firms use FDI rather than exports to a greater extent than do manufacturing firms. This result is not surprising, as FDI brings production closer to the final consumers. However, the simple and intuitive relationship between the need to communicate with customers and the propensity to use FDI rather than exporting is new to the literature.

I also interact the communication measure with contracting institutions and linguistic distance. Neither of these interactions has a significant coefficient for the sample of manufacturing industries. For services, the interaction of communication with institutional quality is positive and significant in Table 7. So while the need to communicate with customers generally leads to greater relative FDI sales, if the destination country has strong contracting institutions then communication-intensive services are more likely to be exported. This suggests that the way service firms communicate with customers differs from that of manufacturing firms, and that this difference is related to the need for strong contracting institutions.

The Role of Nonroutine Tasks

The importance of nonroutine tasks in an industry is positively correlated with the educational level of workers in that industry (see Table 5). Therefore I control for the average educational level of workers in each industry using the O*NET education measure described in Section 5. Industries requiring higher educational levels are more likely to produce in the US for export rather than offshore production through FDI. However, nonroutine task intensity is significant even when education is controlled for. In the sample of service industries, the educational level of the industry is not significant when included in the same regression as the task measures, suggesting that nonroutine tasks play a role in the production location decision that is distinct from their educational content.

The importance of nonroutine tasks in an industry significantly increases relative exports. This result is consistent with the contracting model proposed in Section 3. Because nonroutine tasks can not be fully specified in contracts, they are subject to greater risk when their production is contracted out to affiliates in the destination market. Given that services are more nonroutine task intensive than manufactures, this relationship works in the opposite direction of communication intensity in that it increases the relative exports (rather than FDI) of service firms compared to manufacturing firms, offsetting some of the effect of the need to communicate with consumers.

The coefficient on contract enforcement is negative, implying that FDI relative to exports is higher for countries with stronger contract-enforcing institutions. This result is consistent with the contracting model proposed in Section 3. The coefficient on institutions interacted with nonroutine task intensity is also negative. In other words, an increase in the quality of contracting institutions increases relative FDI sales for nonroutine industries to a greater extent than for routine industries. This result also supports the contracting model in which institutions matter more for activities that are more difficult to fully specify in a complete contract.

Taken on its own, the positive relationship between nonroutine tasks and exporting could potentially be explained by a US endowment-based comparative advantage in non-routine cognitive tasks. However, interactions of routinization with both contract enforcing institutions and linguistic distance are significant. To the extent that a country's institutions and language are not associated with a relative abundance of the factors used intensively in the production of nonroutine tasks, then the significance of these interactions can be taken as evidence for a contracting model over a comparative advantage model. To further identify the role of tasks separately from a comparative advantage story, I include controls for traditional endowment-based comparative advantage. These controls are interactions between the non-routine task intensity of each industry with the skill abundance of each country (see Table 9). Following Romalis (2004), this comparative advantage story can be tested by interacting each country's relative endowment of a given factor with the relative intensity with which this factor is used in each industry. Because I do not have data on endowments of tasks by country, I use the skill level of the workforce from Hall and Jones (1999) to proxy for endowment of factors used in the production of nonroutine task-intensive goods and services. Nonroutine tasks are associated with higher skilled labor. If the location of these tasks was determined by traditional sources of comparative advantage, we would expect them to be produced in more skill-abundant countries. However, Table 9 shows that the skill interactions are not significant and the coefficients on nonroutine task intensity, both alone and interacted with institutions or linguistic distance, are still significant even when skill interactions are controlled for. To the extent that institutions can be considered an input into the production of more nonroutine goods and services, the institution-nonroutine interactions may still be interpreted as evidence of comparative advantage. However, this is more likely to be the case for overall institutional quality rather than contract enforcement. The definition of contracting institutions as the strength of contract enforcement relative to the overall business environment isolates this channel and provides support for the contracting model, which is still significant even traditional comparative advantage controls are included.

Table 10 shows the results of a similar exercise using a different definition of comparative advantage controls. Rather than interacting task intensity with relative skill endowment, this exercise uses standard interactions of relative skill endowment with relative skill intensity and relative capital endowment with relative capital intensity following Romalis (2004). The data on industry level intensities come from the NBER Manufacturing Database and are not available for service industries. However, Table 10 shows that these comparative advantage measures are not significant when the nonroutine task interactions are also included for the sample of manufacturing industries. It may seem surprising that the intensity-endowment interactions are not significant. However, we would expect the results to be weaker than in Romalis, given that this exercise only uses one exporter (the US) and compares the relative importance of the ways in which the US serves each market, not the standard exercise of looking at who specializes in what given a large set of potential producing countries and industries. The key result is still that for the export to FDI decision of US firms already serving foreign markets in a given industry, task intensities are more significant than measures of comparative advantage.

To ensure that the results are not being driven by the specific measure of nonroutine tasks used in this specification, I reran the regressions using the principal component measure of nonroutine task intensity. Table 11 shows that similar results are obtained when principal components are used in place of individual task measures.

The Role of Language

The coefficient on linguistic distance is positive and significant, suggesting that linguistic distance imposes a cost on FDI that is greater than the cost it imposes on exports. The coefficient on the interaction between the non-routine tasks and linguistic distance is negative. So firms are more likely to sell nonroutine task intensive goods through a local affiliate rather than exporting when the destination market is linguistically distant, a result that is consistent with the theoretical model. More complex tasks are generally more amenable to exporting than to FDI, however, the increased complexity leads to a greater translation cost (more is "lost in translation") of exports when countries are linguistically distant, above and beyond exports of more routine industries to linguistically distant countries or exports of nonroutine goods to linguistically similar countries. A plot of the linguistic distance to export ratio by industry shows that this result is driven by highly interactive services such as advertising in countries that are linguistically distant from the US. However, the result still holds even when advertising is excluded from the sample.

Country and Industry Fixed Effects

The above regressions do not include country or industry fixed effects in order to examine variation in the industry-specific task measures and the country-specific language and institutions measures. Table 9 shows the results of a series of regressions which include both country and industry fixed effects and examine variation in the interactions between linguistic distance and the task measures. Again, the general results from Tables 7 and 8 still hold. More nonroutine task intensive industries are more likely to be sold through FDI in countries with stronger contract enforcing institutions. The role of delivery intensity is independent of contracting institutions and linguistic distance.

Explaining Differences in Trade and Investment Patterns between Manufacturing and Service Industries

These results support the model in which differences in trade and investment patterns between goods and services can be explained at least in part by their differential task compositions. In this section, I use a Oaxaca-Blinder decomposition to quantify how much of the difference can be explained the different task intensities across sectors. This method, developed by Blinder (1973) and Oaxaca (1973) separates the difference in predicted values for two groups in to the shares that are attributable to the difference in the levels of each variable (endowments) across groups, the difference in the coefficients across groups, and the difference in interactions between endowments and coefficients.

Table 13 decomposes the baseline specification. The differences in the endowments between manufacturing and service industries account for 40 percent of the total difference in the export to FDI ratios across these two sectors. Of this 40 percent, nearly all of it can be explained by differences in the task intensity measures. Differences in education levels between manufacturing and services only explain 1 percent of the difference in the export to FDI ratio. Of the remaining 60 percent of the total difference, 55 percent is explained by differences in coefficients across the two sectors and 5 percent is explained by the interaction between endowments and coefficients.

To quantify the level of these differences, recall that the task intensities represent the importance score of a given task re-scaled to reflect the share of that task in the sum of total importance scores across all work activities. So the coefficients on task intensities give the percentage change in the export to FDI ratio for a one point increase in the task intensity of an industry. To isolate the average effects of communication and nonroutine intensity, I use coefficients from the specification withouit interaction terms presented in Table 12. The coefficient on communication task-intensity implies that a 1 point increase in the communication intensity score of an industry will lead to a 69 percent decrease in the share of exports relative to FDI sales in that industry. On average, services have a communication intensity that is 1.22 points higher than the delivery intensity of manufactures. Holding all else constant, we would expect the export share in services to be 85 percent lower than in manufactures. The coefficient on nonroutine task-intensity from Table 12 implies that a 1 point increase in nonroutine intensity leads to an 89 percent increase in the share of exports relative to FDI. On average, the non-routine task intensity of services is 0.44 points higher than that of manufactures. Holding all else constant, this corresponds to an export-FDI ratio that is 39 percent higher for services than for manufacturing. Together, these two task measures would predict that the export FDI share for service industries is about 46 percent less than for manufactures. In 2004, the export to FDI ratio in manufacturing industries was 1.04 and the export FDI ratio for services was 0.40, or 62 percent lower than for manufactures. In 1999, the export to FDI ratio was 72 percent lower for services than for manufactures. So these two task variables alone explain about 64 to 74 percent of the difference between the ratio of exports to FDI in services versus manufactures. A portion of the remaining difference can be explained by the role of distance, which significantly decreases the export share for manufactures but not services.

8 Robustness Checks

I also ran the specifications described above on several subsets of the service industries to investigate whether or not a few highly traded services were driving the results. For this exercise, I defined highly tradable services in five different ways: first as those industries in which at least 20 percent of foreign sales occur through exports rather than FDI, second as those industries in which at least 10 percent of foreign sales occur through exports rather than FDI, third as the top five industries ranked by level of exports, fourth as the top ten industries ranked by level of exports, and fifth as the as the top fifteen industries ranked by level of exports. No consistent patterns emerge among more and less traded service industries, suggesting that the results are not being driven by a subset of highly tradable services.

One drawback of using the export to FDI ratio is that it masks the underlying volumes of trade and investment such that an country-industry observation with $2 million in exports and $1 million in FDI sales would be indistinguishable from a country-industry observation with $20 billion in exports and $10 billion in FDI sales. To ensure that the results were not biased by this weighting effect, I re-ran the model using only the smallest third, middle third, and largest third of industry-country observations, defined by total foreign sales. The results for all three of these subsets were consistent with those using the full sample.

9 Conclusion

Manufacturing and service producing firms use exports and FDI in different proportions. In this paper, I demonstrate that market size and distance are significant predictors of the export to FDI ratio for manufactures but not for services. To explain the difference across sectors, I focus on two new sources of the relative costs of FDI and exports. The first of these is the need to communicate with consumers. I provide rigorous empirical support to the intuitive idea that industries requiring greater interaction with consumers are more likely to locate production near those consumers through the use of FDI. Because communicating with consumers is about twice as important for services as for manufactures, this variable can explain why service firms use FDI relative to exports at a much higher rate than manufacturing firms.

The second new variable captures a hidden cost of FDI: the difficulty of contracting nonroutine activities to foreign affiliates. Industries that are more intensive in their use of nonroutine tasks are more likely to produce at home for export rather than offshoring to foreign affiliates. Because services are more nonroutine task intensive than manufactures, this relationship partially offsets the propensity towards FDI in services implied by the role of communicating with consumers. Differences in these two task measures between manufacturing and services can explain 40 percent of the difference in export to FDI ratios across the sectors.

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Table 1: Mean Task Intensities for Manufacturing and Service Industries

	Task	**Goods**		**Services**		**Difference**	
		raw	**scaled**	**raw**	**scaled**	**raw**	**scaled**
1	Working with the public	21.3	1.34	50.3	2.56	29.0	1.22
2	Creative Thinking	35.7	2.19	49.3	2.63	13.6	0.44
3	Problem solving/ decisions	54.4	3.30	66.5	3.51	12.1	0.21
4	Handling objects	62.5	3.67	35.0	1.76	-27.5	-1.91
5	Operating machines	61.0	3.59	31.7	1.65	-29.3	-1.94

Raw scores are unadjusted importance levels of each task reported by O*NET. Scaled scores are the percentage shares of each task in the total task input requirements of a given industry.

Table 2: Mean Task Intensities for Manufacturing and Service Industries

	Task	**Manufacturing**	**Services**	**Difference**
1	Working with the public	1.34	2.56	1.22
2	Working with computers	2.25	3.39	1.13
3	Interpersonal relationships	2.75	3.58	0.83
4	Conflict resolution	1.80	2.56	0.76
5	Administrative tasks	1.85	2.56	0.71
6	Selling	1.28	1.91	0.63
7	Interpreting	2.03	2.61	0.59
8	Developing Objectives	1.74	2.22	0.47
9	Creative Thinking	2.19	2.63	0.44
10	Scheduling	2.03	2.47	0.44
11	Organizing work	2.90	3.32	0.42
12	Caring for others	1.70	2.12	0.42
13	Building teams	1.86	2.26	0.40
14	Updating and using knowledge	2.91	3.27	0.36
15	Communicating inside organization	3.47	3.82	0.36
16	Documenting information	2.82	3.17	0.35
17	Consulting/advice	1.67	2.02	0.34
18	Staffing	0.88	1.17	0.28
19	Monitoring resources	1.50	1.78	0.27
20	Guiding subordinates	1.68	1.90	0.22
21	Coaching	1.83	2.05	0.22
22	Problem solving/decision making	3.30	3.51	0.21
23	Processing information	2.93	3.15	0.21
24	Coordinating others	2.19	2.38	0.19
25	Teaching/training	2.09	2.26	0.18
26	Analyzing data	2.69	2.82	0.13
27	Getting information	4.28	4.14	-0.14
28	Identifying objects	3.66	3.31	-0.35
29	Estimating quantifiable characteristics	2.65	2.27	-0.38
30	Evaluating compliance	3.35	2.90	-0.45
31	Repairing electric equipment	1.51	0.94	-0.57
32	Drafting technical documents	1.54	0.92	-0.62
33	Monitoring processes	3.75	2.89	-0.86
34	Inspecting	3.64	2.22	-1.41
35	General physical activities	3.31	1.79	-1.51
36	Repairing mechanical equipment	2.53	0.88	-1.65
37	Handling objects	3.67	1.76	-1.91
38	Operating machines	3.59	1.65	-1.94

Table 3: US Service Exports*

Service Category	2004 US Exports ($M)	2004 Share of US Service Exports
Financial services	32,666	22%
Education and Training	13,634	9%
Insurance	7,314	5%
Telecommunications	4,651	3%
Business/professional		
Computer and information	8,800	6%
Research and development	8,688	6%
Management and consulting	5,339	4%
Other business/professional	48,962	33%
Other services	18,095	12%
Total	148,149	100%

*constructed using publicly available data from www.bea.gov

Table 4: Service Industries Ranked from Highest to Lowest Export/FDI Ratio

1 Legal services
2 Accounting, auditing, and bookkeeping services
3 Communications (other than telegraph and telephone)
4 Amusement and recreation
5 Research, development, and testing
6 Information retrieval services
7 Educational services
8 Repair Services
9 Engineering, architectural, and surveying services
10 Management and public relations services
11 Telephone and telegraph communications
12 Business services
13 Equipment rental
14 Computer related
15 Other insurance
16 Other services
17 Hotels and other lodging places
18 Computer processing and data preparation
19 Advertising
20 Other finance, including security and commodity br.
21 Health services
22 Real estate
23 Motion pictures, including television tape and film
24 Life insurance
25 Accident and health insurance
26 Depository Institutions
27 Savings institutions and credit unions
28 Holding companies
29 Services to buildings
30 Personnel supply services
31 Automotive rental and leasing
32 Automotive parking, repair, and other services

Table 5: Correlations

	ln x	ln fdi	ln x/fdi	ln dist	ln gdp	inst	lang	lit
ln x	1							
ln fdi	0.302	1						
ln x/fdi	0.618	-0.563	1					
ln dist	-0.197	-0.211	0.003	1				
ln gdp	0.332	0.370	-0.017	-0.215	1			
institutions	0.018	-0.008	0.022	-0.304	-0.166	1		
lang dist	-0.069	-0.247	0.144	0.427	-0.223	-0.268	1	
litteracy	0.048	0.160	-0.090	-0.204	0.155	0.294	-0.412	1

	edu	nr	comm
education	1		
nonroutine	0.620	1	
communication	0.277	0.608	1

Table 6: Proximity-Concentration Model of the determinants of the export to FDI ratio, controlling for selection bias, standard errors clustered by country

Model:	1	2
Sample:	goods	svc
N :	5000	3161
Depvar:	ln(x/fdi)	ln(x/fdi)
intcpt	5.953***	-1.698
	(1.110)	(1.769)
dispersion	-0.376***	-0.271***
	(0.041)	(0.043)
ln gdp	-0.064*	-0.015
	(0.029)	(0.043)
ln distance	-0.587***	-0.135
	(0.057)	(0.105)
R-sq	0.069	0.042

*,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively

Table 7: Export-FDI Model, controlling for selection bias, standard errors clustered by country

Model :	1	2	3	4	5	6
Sample:	goods	services	gds+svc	goods	services	gds+svc
N:	4181	2679	6860	4181	2679	6860
Depvar:	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)
intcpt	-6.303***	-8.702**	-4.048***	2.665*	1.093	1.592
	(1.842)	(3.465)	(1.350)	(1.477)	(2.227)	(1.048)
dispersion	-0.396***	-0.292***	-0.341***	-0.472***	-0.314***	-0.376***
	(0.045)	(0.047)	(0.033)	(0.043)	(0.050)	(0.033)
ln gdp	0.045	0.074	0.060**	0.021	0.088*	0.066**
	(0.030)	(0.046)	(0.025)	(0.030)	(0.046)	(0.025)
ln distance	-0.487***	-0.201	-0.374***	-0.481***	-0.196	-0.367***
	(0.059)	(0.189)	(0.055)	(0.058)	(0.189)	(0.055)
lang distance	9.288***	11.263***	6.975***	2.471*	0.600	2.923***
	(1.955)	(3.941)	(1.334)	(1.425)	(1.716)	(0.657)
literacy	0.878*	-2.183**	-0.261	0.849*	-2.165***	-0.173
	(0.482)	(0.790)	(0.420)	(0.485)	(0.757)	(0.419)
rel wage	0.292	-0.41	0.020	0.284	-0.401	0.041
	(0.191)	(0.280)	(0.161)	(0.191)	(0.280)	(0.160)
tax difference	-0.005	0.001	-0.003	-0.004	0.000	-0.003
	(0.007)	(0.010)	(0.006)	(0.007)	(0.010)	(0.006)
institutions	-0.018**	-0.035**	-0.013**	-0.004	-0.016**	-0.011***
	(0.007)	(0.016)	(0.005)	(0.005)	(0.007)	(0.003)
edu (industry)	0.846***	0.231	0.483***	1.653***	0.085	0.609***
	(0.182)	(0.164)	(0.124)	(0.165)	(0.179)	(0.118)
nonroutine	3.080***	2.639**	2.152***			
	(0.670)	(1.075)	(0.429)			
inst*nonroutine	-0.680**	-1.241**	-0.484**			
	(0.332)	(0.577)	(0.209)			
lang*nonroutine	-2.655***	-3.187**	-1.626***			
	(0.872)	(1.405)	(0.549)			
communication				-2.218***	-1.010**	-0.713**
				(0.786)	(0.416)	(0.292)
inst*comm				0.062	0.739**	0.553***
				(0.382)	(0.286)	(0.147)
lang*comm				0.671	0.815	0.071
				(1.038)	(0.711)	(0.372)
R-sq	0.095	0.051	0.235	0.107	0.052	0.235

*,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively

Table 8: Export-FDI Model, controlling for selection bias, standard errors clustered by country

Model :	1	2	3
Sample:	goods	services	gds+svc
N:	4181	2679	6860
Depvar:	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)
dispersion	-0.382***	-0.321***	-0.361***
	(0.043)	(0.050)	(0.033)
ln gdp	-0.042	0.108	0.045
	(0.031)	(0.998)	(0.039)
ln distance	-0.534***	-0.165	-0.397***
	(0.055)	(0.107)	(0.053)
lang distance	7.250***	10.965*	7.678***
	(1.941)	(5.838)	(1.310)
literacy	-0.699	-1.196	-0.745
	(0.575)	(0.877)	(0.488)
rel wage	0.113	-0.273	-0.003
	(0.192)	(0.285)	(0.162)
tax difference	-0.007	0.001	-0.004
	(0.007)	(0.010)	(0.006)
institutions	-0.030***	-0.035*	-0.026***
	(0.006)	(0.020)	(0.004)
edu (industry)	0.548***	0.069	0.305**
	(0.176)	(0.179)	(0.126)
nonroutine	3.792***	3.014**	2.615***
	(0.714)	(1.234)	(0.479)
inst*nonroutine	-1.092***	-0.975*	-0.747***
	(0.310)	(0.593)	(0.216)
lang*nonroutine	-3.129***	-3.400**	-2.702***
	(0.961)	(1.622)	(0.624)
communication	-4.164***	-0.635*	-1.660***
	(0.869)	(0.440)	(0.335)
inst*comm	0.052	-0.178	0.362**
	(0.364)	(0.310)	(0.160)
lang*comm	2.120*	0.374	1.066**
	(1.178)	(0.831)	(0.428)
R-sq	0.145	0.055	0.245

*,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively

Table 9: Export-FDI Model with comparative advantage controls, country and industry fixed effects

Model :	1	2	3	4
Sample:	goods	services	goods	services
N:	5520	3429	5520	3429
Depvar:	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)
inst*nonroutine	-0.007**	-0.004**		
	(0.003)	(0.002)		
lang*nonroutine	-0.584***	-0.485**		
	(0.158)	(0.266)		
skill*nonroutine	-0.127	-0.033		
	(0.140)	(0.099)		
inst*communication			-0.270	-0.210
			(0.414)	(0.325)
lang*communication			0.795	0.032
			(0.880)	(0.740)
skill*communication			0.315	0.066
			(0.262)	(0.252)
R-sq	0.422	0.251	0.418	0.252

*,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively

Table 10: Manufacturing only Export-FDI Model with comparative advantage controls, country and industry fixed effects

Model :	1	2
Sample:	goods	goods
N:	5520	5520
Depvar:	ln(x/fdi)	ln(x/fdi)
inst*nonroutine	0.003***	
	(0.000)	
lang*nonroutine	-0.554***	
	(0.052)	
capital intensity*endowment	0.019	0.009
	(0.056)	(0.057)
skill intensity*endowment	0.082	0.197
	(0.138)	(0.144)
inst*communication		0.499
		(0.213)
lang*communication		1.364
		(0.831)
R-sq	0.421	0.417

*,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively

Table 11: Export-FDI Model, principal components, controlling for selection bias, standard errors clustered by country

Model :	1	2	3
Sample:	goods	services	gds + svc
N:	4181	2679	6860
Depvar:	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)
dispersion	-0.429***	-0.349***	-0.368***
	(0.044)	(0.048)	(0.032)
ln GDP	-0.051	0.090	0.066
	(0.030)	(0.091)	(0.060)
ln distance	-0.487***	-0.204	-0.372***
	(0.094)	(0.197)	(0.055)
svc/mfg wage	0.323	-0.392	0.037
	(0.292)	(0.279)	(0.161)
tax difference	-0.005	0.000	-0.003
	(0.007)	(0.010)	(0.006)
literacy	0.950**	-2.113***	-0.229
	(0.484)	(0.759)	(0.420)
lang dist	2.698***	4.782***	3.140***
	(0.333)	(0.867)	(0.246)
institutions	-0.002*	-0.007**	-0.002*
	(0.001)	(0.003)	(0.001)
edu (industry)	1.121***	-0.237***	0.258*
	(0.208)	(0.191)	(0.140)
nonroutine principal component	0.667***	0.944***	0.447***
	(0.152)	(0.205)	(0.081)
inst*nonroutine pc	-0.001	-0.002**	-0.001**
	(0.001)	(0.001)	(0.000)
lang*nonroutine pc	-0.726***	-0.903***	-0.304***
	(0.196)	(0.267)	(0.100)
R-sq	0.088	0.059	0.234

*,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively

Table 12: Average task effects, controlling for selection bias, standard errors clustered by country

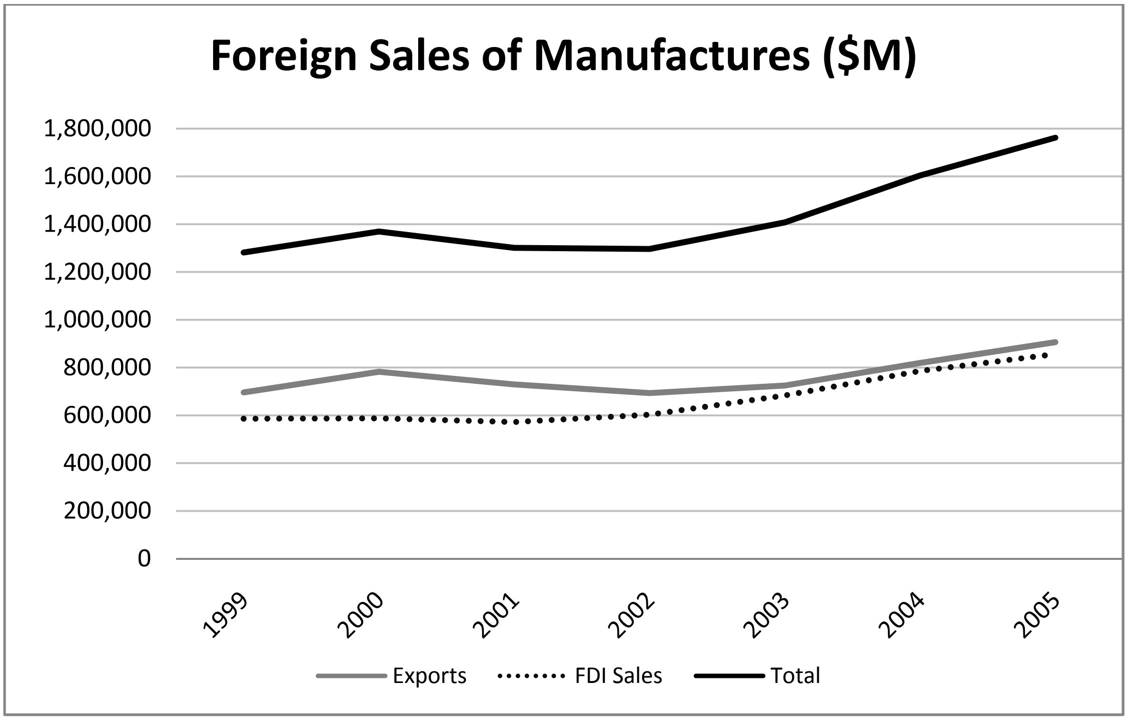
Model:	1	2	3
Sample:	goods	svc	gds+svc
N:	4186	2679	6865
Depvar:	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)
dispersion	-0.400***	-0.294***	-0.340***
	(-0.045)	(0.047)	(0.033)
ln distance	-0.468***	-0.185	-0.377***
	(0.059)	(0.109)	(0.054)
ln gdp	0.05	0.05	0.056**
	(0.03)	(0.045)	(0.025)
relative wage	0.166	-0.131	0.033
	(0.184)	(0.268)	(0.153)
tax difference	-0.004	-0.004	-0.004
	(0.007)	(0.01)	(0.006)
linguistic dist	3.240***	2.915***	3.096***
	(0.278)	(0.429)	(0.237)
institutions	-0.003***	-0.004**	-0.002**
	(0.001)	(0.002)	(0.001)
education	0.844***	0.245	0.480***
	(0.183)	(0.165)	(0.124)
nonroutine	1.035***	0.340***	0.892***
	(0.15)	(0.049)	(0.124)
communication	-1.716***	-0.446**	-0.693***
	(0.162)	(0.129)	(0.096)
R-sq	0.11	0.05	0.08

*,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively

Table 13: Oaxaca-Blinder decomposition of the contribution of individual elements to the total difference in predicted ln(X/FDI) between manufactures and services

Share of difference explained by endowments:	
Country endowments	3%
Dispersion	-4%
Education (industry-level)	1%
Tasks Endowments	4%
Task interactions	36%
TOTAL	**40%**
Share of difference explained by coefficients:	
TOTAL	**55%**
Share of difference explained by endowments*coefficients:	
TOTAL	**5%**

Figure 1: Share of export and FDI sales in manufacturing and service industries



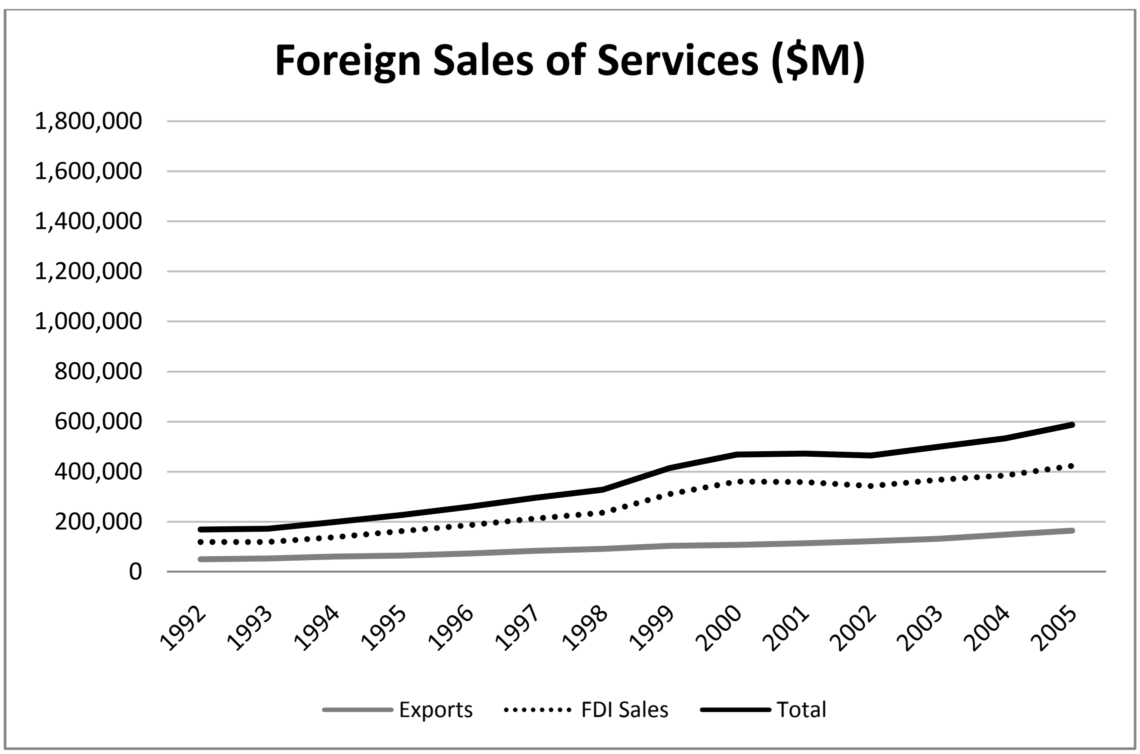


Figure 2: Share of zeros in all possible country-industry pairs