

Export Versus FDI and the Communication of Complex Information*

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Abstract

Traditional proximity-concentration models of the decision to serve foreign markets through exports or FDI sales tend to overemphasize physical transport costs and market size while underemphasizing the cost of transmitting information. I augment those models with the importance of interacting with customers and communicating complex information within firms and use these characteristics to predict the location of production. Goods and services requiring direct communication with consumers are more likely to be produced in the destination market. Activities requiring complex within firm communication are more likely to occur at the multinational's headquarters for export, especially when the destination market has weak 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 approach developed in this paper performs well for both manufacturing and service industries and is robust to a variety of specifications.

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1 Introduction

The export versus FDI literature is dominated by models of the proximity-concentration tradeoff. In these models, the decision to produce in the firm's home country for export or in the destination market through a foreign affiliate is based on a tradeoff between the gains to scale achieved by concentrating production at the firm's headquarters and the benefits of producing near the final consumers to avoid transport costs.¹ This framework, while theoretically appealing, has led to an empirical focus on physical transport costs rather than the costs associated with communicating complex information across borders. While physical transport costs and distance still matter, increases in the trade of knowledge-based services highlight the need to pay greater attention to the transmission of information when studying firm production location decisions.

Firm communication can be divided into two categories: the communication of information within the firm (during production) and the communication of information from the firm to the outside customer (during delivery or sales). Consider the path that a product follows from idea to production to consumption in a foreign market. During this process, a design originates at the firm's headquarters, output is produced either at the headquarters or at a foreign affiliate, and the final product is then transferred to the customer, either by the headquarters or by the foreign affiliate. When a firm chooses to locate production at its headquarters for export, it is simplifying the within firm transmission of information between the design and production stages, however, it is complicating transmission to the final customer, which must happen across borders. When the firm chooses to produce at a foreign affiliate in the destination market it is complicating the within firm transmission of information which happens between the headquarters and its affiliate, but simplifying communication with the customer, which occurs between the affiliate and a customer residing in the same location. The relative importance of these two types of communication (within firm and between the firm and its customer) determines whether the firm will serve a given market through exports or affiliate sales.

Looking at the difference between manufacturing and services provides a clear way to illustrate this concept. US exports of services have been increasing rapidly in the last decade (see Figure 1). Much of this trade has been in complex, information-intensive services such as business and finance (see Table 1). These services differ from traditional manufacturing

¹Examples include Krugman (1983), Horstmann and Markusen (1992), Brainard (1993 and 1997) and Helpman, Melitz, and Yeaple (2004)

exports in meaningful ways. Communicating with customers is about twice as important for services as for manufacturing (See Table 2. Details about how these importance scores were constructed will follow in Section 4). Service producers also rely on FDI sales relative to exports to a much greater extent than manufacturing firms (see Figure 1). I show that because services require much more interaction with consumers than manufactures, the difference in the importance of this type of communication 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 affiliate sales is highly intuitive but has never been shown in the economic literature on the export versus FDI decision. Note that although this approach was motivated by observations about trade in services, it does a good job of explaining trade and affiliate sales in both manufactures and services.

If communicating with consumers were the only factor 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 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 has an effect that is opposite to that of communication with customers, offsetting some of the impact of the need for consumer interaction. More nonroutine activities are noncodifiable, and thus it is difficult to successfully transfer these processes to teams in another country and to specify clear quality standards for these more abstract tasks than for more routine activities. Thus their production is less likely to be offshored to foreign affiliates. This is true for both manufacturing and service industries. When a headquarters firm tasks an affiliate with complex and potentially problematic assembly procedure, the parent must communicate more complex information to the affiliate. This is in contrast to a more routine good or service (such as data entry or the assembly of simple and easily inspectable goods like plain tee shirts or reams of paper), for which clear quality standards can be fully specified in advance.² This is consistent with recent work by Keller and Yeaple (2009) who show that headquarters services cannot always be transferred costlessly from parents to affiliates, especially in knowledge-intensive industries. I introduce this possibility into a Helpman, Meltiz and Yeaple (2004) framework to explain how the level of routineness of tasks determines how easily they can be offshored.

I operationalize these two types of information transmission using data on the specific

²Intellectual property concerns may also factor into this decision, as nonroutine goods likely have a higher innovational content than routine goods, and thus are more vulnerable to intellectual property rights violations or information leakage when they are produced abroad, especially if the foreign affiliate is in a country with weak institutions.

work activities or tasks required for production in each industry. The data on these tasks are collected by the Department of Labor and allow for empirical identification of the role that work activities play in determining patterns of trade and investment. When each industry is defined by the importance of communication and complexity in its production, the differences between manufactures and services become clear. On average, the importance of communicating with customers is twice as high for services as for manufactures. Scores for complex activities, 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 2 summarizes the key task dimensions that I will use in this paper. Table 3 lists the service industries used in this study. Business, professional and technical services make up most of the sample.

The results show that the two forms of information transmission that I focus on are important for both manufacturing and services and their effects are larger in magnitude than those of distance, industry concentration, tax rates, wages, education levels, and standard measures of endowment-based comparative advantage. The intensity with which an industry uses communication with customers and nonroutine production tasks is a significant determinant of the location of multinational production. The relationship between communication and complexity and the export to FDI ratio is similar for manufacturing and service industries, suggesting that the difference in the importance of these activities across sectors presented in Table 2 can explain the difference in trade and investment outcomes presented in Figure 1.

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 affiliate production in final goods. Krugman (1983), Horstmann and Markusen (1992), and Brainard (1993 and 1997) develop and test models in which firms trade off the proximity to consumers achieved by FDI against the gains to scale achieved by concentrating production in one location for export. Helpman, Melitz, and Yeaple (2004) introduce firm-level heterogeneity and find 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.³ To my knowledge, no papers have examined the decision of service firms to serve foreign markets through 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 followed the same patterns as trade and investment in manufactures. However, Figure 1 suggests that this is not the case. This paper exploits the differences in the importance of communication and complexity of manufacturing and service industries to explain the different ways in which manufacturing and service firms serve foreign markets. The result is an empirical 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 Empirical Specification

3.1 Primary Specification

Helpman, Melitz and Yeaple (2004) show how heterogeneous firms trade off the costs of exporting and the costs of FDI when deciding how to serve foreign markets. My analysis follows from their theoretical framework but in the empirical implementation I augment this framework with different types of trade and investment costs.

Each firm observes its productivity level, and then decides whether or not to serve foreign markets and, if so, whether to use exporting or FDI sales. The firm will choose to export if or produce the task abroad through FDI depending on which strategy results in greater profits. The expected ratio of exports to FDI sales in an industry can be expressed as a function of

³See 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

trade costs, relative productivity, wages, and fixed costs, resulting in the empirical estimation equation.

I reinterpret this model empirically by including communication costs, rather than just traditional trade and transport costs. These costs result from the communication of information, both within the firm and between the firm and its customers. When a firm chooses to produce at its headquarters for export, it is simplifying the within firm transmission of information, however, it is complicating transmission to the final customer, which must happen across borders. When the firm chooses to produce at a foreign affiliate in the destination market it is complicating the within firm transmission of information which happens between the headquarters and its affiliate, but simplifying communication with the customer, which occurs between the affiliate and a customer residing in the same location. The relative importance of these two types of communication (within firm and between the firm and its customer) determine whether the firm will serve a given market through exports or FDI sales.

I estimate the following equation:

$$\ln \frac{X_{zi}}{I_{zi}} = \beta_1 \ln \frac{w_i}{w_{us}} + \beta_2 \tau_{zi} + \beta_3 k + \beta_4 \delta_z + \beta_5 \delta_i + \beta_6 (\delta_z * \delta_i) + \varepsilon_{zi} \quad (1)$$

Where τ_{zi} is the physical transport cost, k captures the productivity dispersion of firms in the industry, δ_z is a vector of industry level controls capturing the importance of various types of communication and complexity, δ_i is a vector of country level controls, and $\delta_z * \delta_i$ interacts country and industry characteristics.

We should see more exports relative to FDI sales for countries with weak institutions and those that are linguistically distant. Industries that are intensive in their use of more nonroutine activities require more complex communication within the firm and are thus more likely to be exported, especially when the destination country has weak contract-enforcing institutions. Industries that rely more heavily on interaction with consumers are more likely to be sold through FDI.

3.2 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 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). I use the difference between the top marginal corporate tax rate in the US and in the destination market as the necessary exclusion restriction. It is well documented that tax rates affect the location of multinational affiliates.⁴ However, the primary purpose of tax-motivated FDI is not to serve local markets in the host country, but rather for vertical or export platform FDI. In the results section of this paper, I show that the relative tax rate of the destination country impacts the likelihood of the log export to FDI ratio being well defined and non-zero, but does not impact the magnitude of this ratio, using the definition of horizontal exports and FDI described above. As robustness checks, I also use common religion, which is one of the exclusion restrictions proposed by Helpman, Melitz and Rubinstein (2008), and a dummy variable indicating whether or not each country has a Bilateral Investment Treaty (BIT) with the US as the exclusion restrictions and obtain similar results which are not reported here.

The log of the export to FDI ratio could be undefined either because exports equal zero, FDI sales equal zero, or both. Thus I separately control for all three cases in which the export to FDI sales ratio may be undefined.

Define indicator variables T_{zi}^x , T_{zi}^I , and T_{zi}^{xI} to equal 1, respectively, if exports are nonzero, FDI is nonzero, or if the US has both non-zero exports and non-zero FDI sales to country i in industry z . Thus the two stage estimator is:

⁴See for example Grubert and Mutti (1991) or Desai, Foley and Hines (2002).

Stage 1:

$$\rho_{zi}^x = Pr(T_{zi}^x = 1 | \text{observed variables}) = \Phi(\gamma_0 + \gamma_1) \quad (2)$$

$$\rho_{zi}^I = Pr(T_{Izi} = 1 | \text{observed variables}) = \Phi(\gamma_0 + \gamma_1) \quad (3)$$

$$\rho_{zi}^{xI} = Pr(T_{zi}^{xI} = 1 | \text{observed variables}) = \Phi(\gamma_0 + \gamma_1) \quad (4)$$

Stage 2:

$$\ln \frac{X_{zi}}{I_{zi}} = \beta_1 \ln \frac{w_i}{w_{us}} + \beta_2 \tau_{zi} + \beta_3 k_z + \beta_4 \delta_z + \beta_5 \delta_i + \beta_6 (\delta_z * \delta_i) + \beta_7 \hat{\rho}_{zi}^x + \beta_8 \hat{\rho}_{zi}^I + \beta_9 \hat{\rho}_{zi}^{xI} + e_{zi} \quad (5)$$

Where γ_1 is the vector of independent variables and $\hat{\rho}_{zi}^x$, $\hat{\rho}_{zi}^I$, and $\hat{\rho}_{zi}^{xI}$ are the predicted values from stage 1.

I use the OLS model given by equation (1) as my primary specification and present the results using the 2-stage estimator in the robustness checks section.

4 Measures of Communication and Complexity

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. Nonroutine 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 words when communicated from a headquarters firm to its affiliate. I use this routine-nonroutine dichotomy to capture the codifiability of information and the ease with which it can be transmitted within a firm. I use the importance of communicating with customers to capture the transmission of information between firms and consumers. 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 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 subjective rankings of the offshorability of service occupations. Autor, Levy and Murnane (2003) use O*NET's predecessor, the Dictionary of Occupational Titles (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

$$M_{sz} = \sum_c \alpha_{zc} \ell_{sc} \quad (6)$$

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 .⁵ Summing over occupations in a given industry results in an index of the un-scaled importance score for 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 :

$$I_{sz} = \frac{M_{sz}}{\sum_s M_{sz}} \quad (7)$$

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 clas-

⁵ 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.

sification of each firm. Thus (7) can be used as a component of the industry characteristics vector δ_z in regression equation (1).⁶

I use the O*NET measure “working with the public” as a proxy for the importance of communicating with consumers. To capture the level of task complexity, 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 also use the O*NET measures “handling objects”, “operating machines (other than vehicles)”, and “general physical activities” to proxy routine manual activities and obtain coefficients with the opposite sign of the non-routine task measures.

As an additional robustness check, I also use 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

5.1 FDI Data

The Bureau of Economic Analysis collects firm-level data on US multinational company operations in both goods-producing and service-producing industries in its annual and benchmark surveys of US 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

⁶I also test equation (3) using the raw importance scores, M_{sz} , instead of the scaled I_{sz} and obtain qualitatively similar results.

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.

5.2 Export Data

Data on exports of manufactures are taken from the US Census data compiled by Rob Feenstra. I subtract out the value of all affiliated exports using information on intrafirm trade from the BEA surveys of direct investment abroad, resulting in data on only unaffiliated exports. Because the model addresses horizontal rather than vertical FDI, it is these unaffiliated transactions that I want to compare to local sales by multinational affiliates.

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. Because of the time dimension of these data, year fixed effects will be included in all regressions. Table 3 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 confidential 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 1 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 US 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 US.

5.3 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. 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. I then construct a dummy variable which equals one if the country's contracting institutions relative to their overall institutional quality is above the median and zero if it is not. Thus what I am measuring is whether or not a country has high quality contracting institutions relative to the overall institutional environment. As a robustness check, I also use the overall measure of institutional quality for each country.

5.4 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. Data on industry concentration, defined as the share of sales accounted for by the eight largest firms in an industry, are from the 2002 US Economic Census. Wages relative to the US 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 US Census 2004 American Community Survey. Data on common religion between the US and its trading partners is from Helpman, Melitz and Rubinstein (2008). I use data on Bilateral Investment Treaties (BITs) from the United Nations Conference on Trade and Development (UNCTAD). 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 Results

Table 5 shows the results of estimations using the preferred specification given in Equation (1) on the sets of goods and services industries, both separately and together. All results are presented using beta coefficients, which have been standardized to represent the change in the log export to FDI ratio that results from a one standard deviation change in each independent variable.

The results for standard variables used to explain the export versus FDI decisions are broadly consistent with previous studies, though in many instances they are not significant. The coefficient on physical distance is negative and significant for manufactures. Because the dependant variable is the log of the ratio of exports to FDI sales, a negative coefficient implies greater affiliate sales relative to exports. Beta coefficients are reported, thus this coefficient suggests that a one standard deviation increase in the distance between countries

decreases the log export to FDI ratio by 0.101 standard deviations for the set of manufacturing industries. For services, the coefficient is also negative, but not statistically significant.

I measure industry concentration using the share of total US sales accounted for by the 8 largest firms in the industry from the 2002 US Economic Census. The coefficient on this measure is not significant for either manufacturing or services.

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) and was one of the measures that they propose to proxy for the level of dispersion of productivity among firms in an industry. 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.

The regressions in Table 5 also control for GDP, which is a proxy for market size. The coefficient on GDP is not significant for manufacturing or services. Similarly, GDP per capita has no impact on the the export versus FDI decision. However, per capita GDP is also correlated with a number of other factors, such as institutions and wages, that will be discussed later in this paper.

One 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.⁷ I measure the relative wage in a number of different ways. The results presented in Table 5 show the average wage in the destination market relative to the average wage in the US. These results suggest that relative wages are not driving the export to FDI ratio. In other specifications not reported here, I also use the measure of high to low skilled wages proposed by Grogger and Hanson (2008) as well as the manufacturing wage relative to the service wage in the destination country. None of these relative wage measures are significant predictors of the export versus investment decision for either manufacturing or service industries.

Tax rates are another factor that have been shown to impact different types of FDI. The variable *Tax difference* is defined as the US top marginal corporate tax rate minus the top marginal corporate tax rate in the destination market. The value of this variable will be higher when tax rates in the destination market are lower, so it can be interpreted as a tax

⁷See for example Yeaple (2003) and Carr, Markusen and Maskus (2001).

benefit in the foreign country. Table 5 shows that *tax difference* is not significantly associated with the log of the export to FDI sales ratio. As with wages, the most likely explanation is that low corporate tax rates are primarily a motive for vertical or export platform FDI, rather than FDI for the purpose of selling to local markets.

The coefficient on the dummy variable for good contracting institutions is negative and significant for manufactures and services. The coefficient on linguistic distance is positive and significant for both manufactures and services. Together these results suggest that firms prefer FDI relative to exports in countries that are linguistically similar and that have strong contract enforcing institutions.

6.1 The Role of Communication

The negative coefficient on *communication* in Table 5 suggests that industries that require a higher degree of interaction with consumers are more likely to be sold through FDI than through exports. Because communication with customers is much more important for services than for manufactures, this relationship is important for explaining why service firms use FDI rather than exports to a greater extent than do manufacturing firms. For the full sample of industries, a one standard deviation increase in the importance of communicating with customers reduces the export to FDI ratio by about 0.17 standard deviations. The standard deviation of the export to FDI sales ratio in the data is about 1.8, so this corresponds to a change in ratio of exports to FDI of about -0.3. Considering that the mean export to FDI ratio in the data is about 1.5, this is an economically significant result. This effect is larger in magnitude than that of distance, gdp, tax rates, wages, institutions, or education. The 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 affiliate sales rather than exporting is new to the empirical literature. Note that communication intensity is not acting as a prohibitive transport cost that renders certain services untradable, as all industries in this dataset exhibit nonzero trade volumes. Thus communication intensity is having an impact on the volume of exports relative to FDI sales.

6.2 The Role of Complexity

The importance of nonroutine tasks in an industry is positively correlated with the educational level of workers in that industry (see Table 4). Therefore I control for the average

educational level of workers in each industry. Industries requiring higher educational levels are more likely to produce in the US for export rather than offshore production through FDI, which is consistent with a US comparative advantage in high-skilled activities. However, this relationship is not statistically significant. Moreover, nonroutine task intensity is significant even when education is controlled for, suggesting that complexity plays a role in the production location decision that is distinct from educational content. For the full sample of industries, a one standard deviation increase in the nonroutine intensity leads to a 0.12 standard deviation increase in the export to FDI ratio. This corresponds to a change in the export to FDI ratio of about 0.22. This effect is larger in magnitude than that of distance, gdp, tax rates, wages, institutions, or education.

To summarize the results, exports are more common when selling to countries that are linguistically distant or have weak contract enforcing institutions. FDI sales are relatively more common in industries with more heterogeneity of firm-level productivity and when selling to countries that are more physically distant. In all specifications, the need to communicate with consumers is associated with greater FDI sales relative to exports. More nonroutine activities are more likely to be exported rather than sold through foreign affiliates.

6.3 Fixed Effects Model

The results discussed so far do not control for industry or country fixed effects because they include the task measures, which are time-invariant industry characteristics, and distance, which is a time-invariant country characteristic. To control for other unobservables, Table 6 includes both country and industry fixed effects and examines the interaction between the task measures and relevant country characteristics. The coefficient on the interaction of complexity with contract enforcing institutions is negative and significant for services. Thus, while nonroutine activities are more likely to be sold through exports rather than FDI, this result can be partially offset if the destination country has strong contract enforcing institutions. The relationship has the same sign for manufactures, but is not statistically significant.

Because institutional quality is correlated with the overall level of development, one might be concerned that this result is picking up the effect of higher demand for more complex services in richer countries. If greater demand is needed to justify incurring the fixed costs of FDI, then we might expect to see more FDI sales relative to exports of complex services in rich countries where demand for these services is higher. To address this, I control for the

the interaction between routineness and per capita GDP in columns 4 through 6 of Table 6. Indeed, the coefficient on the interaction of GDP per capita and nonroutine intensity is negative. However, this interaction is only significant for manufactured goods. The statistically significant relationship between institutions and nonroutineness still holds for services. These results suggest that demand matters more for goods and that institutions matter more for complex services. Why is this the case? Think about the export versus FDI tradeoff in terms of communication of complex information in both the production and the delivery of output. With exporting, this information is communicated from the US headquarters, which handles both design and production, to customers in another country. With FDI, the design information is communicated from the headquarters to a foreign affiliate, who produces the good or service and must also communicate with the consumer, moving a greater share of the knowledge process to the destination country. Thus it is not surprising that the institutions of that country matter more for FDI sales than for exports. What is perhaps surprising is that this relationship is significant for services but not for manufactures. However, this more crucial role for institutions in services rather than goods is consistent with previous work that has been done on trade in services. Both manufactured goods and services may have a high knowledge content. However, the intangible nature of services often makes them unobservable up to the point of consumption. Thus it is much more difficult to monitor the quality of services than of goods. For this reason, the types of institutions required to protect producers of services must be more sophisticated than those used to monitor goods (Quah 1999, VanWelsum 2003).

It is also possible that the propensity of US firms to export nonroutine tasks reflects a US comparative advantage in more complex activities. Table 5 addresses this in part by controlling for the skill intensity of each industry. But I also explore this explanation using interaction terms in Table 6. To further identify the role of tasks separately from a comparative advantage story, I include controls for traditional endowment-based comparative advantage. 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. I am unaware of a measure that directly captures a country's endowment of nonroutine factors, so I use skilled labor endowment instead. The importance of institutions interacted with routineness still holds for services even when controlling for skilled labor as a more traditional form of endowment based comparative advantage.

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

These results support the framework in which differences in trade and investment patterns between goods and services can be explained at least in part by their differential use of complex production activities and communication with customers. 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. To isolate the average effects of communication and nonroutine intensity, I use coefficients from the preferred specification presented in column 3 of Table 5. The coefficient on communicating with customers implies that a 1 standard deviation increase in the communication intensity score of an industry will lead to a 0.17 standard deviation decrease in the share of exports relative to FDI sales in that industry. The average service industry has a communication intensity that is about 4 standard deviations above that of the average manufacturing industry. Holding all else constant, we would expect the export to FDI ratio in the average service industry to be about 0.69 standard deviations lower than that of the average manufacturing industry.

The coefficient on nonroutine task-intensity from Table 5 implies that a 1 standard deviation increase in the nonroutine task intensity of an industry will lead to a 0.12 standard deviation increase in the share of exports relative to FDI sales in that industry. On average, the nonroutine intensity of services is 1.4 standard deviations higher than that of manufactures. Holding all else constant, this corresponds to an export-FDI ratio that is about 0.17 standard deviations higher for services than for manufacturing. Together, these two measures would predict that the export to FDI ratio for service industries is about one half of a standard deviation below that of manufactures. The standard deviation of the export to FDI ratio is about 1.8 and the mean value for a manufacturing industry is 1.4. Thus, based purely on the importance of communication and nonroutine tasks, we would expect the mean ratio of exports to FDI sales for services to be about 0.5. In the data, the average ratio of exports to FDI sales for services is 0.59. So communication and complexity can explain a large amount of the difference between the ratio of exports to FDI in services versus manufactures.

7 Robustness Checks

7.1 Two-Stage Selection Model

As discussed in Section 3, the OLS results may be biased because they do not account for selection into exporting and FDI sales. Thus I also present the results using the two stage selection model described by equations (2) through (5). I use the variable *tax difference* as the necessary exclusion restriction. *Tax difference* is defined as the US top marginal corporate tax rate minus the top marginal corporate tax rate in the destination market. Table 5 shows that *tax difference* is not associated with the log of the export to FDI sales ratio, however, the first stage results presented in Tables 7 and 8 show that, as expected, the coefficient on *tax difference* is positively and significantly associated with the existence of exports and FDI sales, making it a useful exclusion restriction. We would expect the difference in tax rates to determine whether an export and/or FDI relationship exists at all, but then have little impact on the relative volume of horizontally motivated trade and investment because tax motives are much stronger for vertical and export platform FDI and within firm trade than for horizontal FDI and arms length exports.⁸

Tables 7 and 8 present the first stage results and Table 9 presents the second stage. It could be the case that exports equal zero, FDI sales equal zero, or both exports and FDI sales equal zero. I break these results down and control for all three possibilities separately. The variable *fdi dum* is a dummy that equals 1 if only FDI sales equal 0, *x dum* equals 1 if only exports equal 0, and *x & I dum* equals 1 if both exports and FDI sales equal 0. In the stage two results, the coefficient on the selection term for FDI sales, $\hat{\rho}^I$, is significant for services but not for manufactures, highlighting the importance of the selection model for service FDI. However, the coefficient on the selection terms for both exports and the export to FDI ratio, $\hat{\rho}^x$ and $\hat{\rho}^{Ix}$, are significant for manufactures but not for services. The main results on the importance of communication and routineness still hold, even when controlling for this source of bias.

7.2 Affiliated Versus Unaffiliated Exports

All of the specifications discussed so far use unaffiliated exports as the alternative to sales by foreign affiliates to their local market. The intuition for doing so is that unaffiliated

⁸As a robustness check, I also ran the two-stage model using common religion as the exclusion restriction, as was suggested by Helpman, Melitz and Rubinstein (2008) and obtained similar results. Similar results were also obtained using the existence of bilateral investment treaties as the exclusion restriction.

exports are more likely than affiliated exports to capture the sale of goods and services for consumption rather than for use by firms as intermediate inputs in products that will eventually be reexported. I also take this approach because disaggregate data on affiliated service exports are not available. However, it is possible that not including affiliated exports leaves out some sales that are consumed in the country of interest. This would be the case if US firms sell to foreign distributors that they own, which then sell to the local market. Leaving these sales out of the analysis could bias the results if, for example, sales through affiliated distributors were more common in larger countries. About 30 percent of US exports of goods are affiliated, so any bias that may exist could be non-trivial in magnitude.

To address this concern, I re-ran the primary specification using all exports, rather than just unaffiliated exports. As mentioned above, data on affiliated exports of services are not available, so these results only include the sample of manufactured goods. The results of this exercise are reported in Table 10. They are both qualitatively and quantitatively similar to the results that use only unaffiliated exports.

7.3 Excluding Rarely Traded Services

For certain services, such as health care, automotive repair, etc, direct interaction between producers and consumers is so important that exports are almost never observed. To make sure that these extreme cases are not driving the results, I rerun my preferred specification excluding observations in which the export to FDI ratio is less than 0.01. The results of this exercise are presented in Table 11. The communication and nonroutine task intensity measures are statistically significant, even with this restricted sample.

7.4 Other Robustness Checks

As mentioned previously, I also ran the regressions using a principal components measure of nonroutine task intensity. The results were unchanged. Similar results were also obtained using the importance of problem solving and making decisions rather than creativity as the measure of nonroutine task intensity.

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, in results not reported in this paper 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.

8 Conclusion

Manufacturing and service producing firms use exports and FDI in different proportions. To explain the difference across sectors, I focus on two empirically 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 variable captures a hidden cost of FDI: the difficulty of offshoring nonroutine activities to foreign affiliates. Industries that are more intensive in their use of nonroutine tasks are more likely to be produced at home for export rather than produced at foreign affiliates. Because services are more nonroutine 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 a large portion of the difference in export to FDI ratios across the sectors.

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Table 1: US Exports of “Other Private Services”

Service Category	2004 US Exports (\$M)	2004 Share of US Service Exports
Financial services	36,389	24%
Education and Training	13,634	9%
Insurance	7,314	5%
Telecommunications	4,651	3%
Business/professional		
Computer and information	8,693	6%
Research and development	9,563	6%
Management and consulting	16,372	11%
Other business/professional	26,304	18%
Other services	26,349	18%
Total	149,269	100%

Constructed using publicly available data from www.bea.gov

Table 2: Mean Task Intensities for Manufacturing and Service Industries

Task	Goods		Services		Difference	
	raw	scaled	raw	scaled	raw	scaled
1 Communicating with customers	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 3: Service Industries Ranked from Highest to Lowest Export/FDI Ratio

Rank	Industry
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 4: Correlations

	ln x	ln fdi	ln x/fdi	ln dist	ln gdp	inst	lang
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

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

Table 5: Export Versus FDI Model

Model :	1	2	3
Sample:	goods	services	gds+svc
N:	3766	1766	5532
Depvar:	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)
tax difference	0.025 (1.42)	-0.022 (-0.95)	0.008 (0.68)
ln distance	-0.101*** (-5.64)	-0.039 (-1.44)	-0.072*** (-5.31)
concentration	0.077 (1.00)	-0.035 (-1.55)	-0.012 (-1.21)
dispersion	-0.231*** (-4.16)	-0.214* (-1.87)	-0.185*** (-3.14)
ln gdp	-0.027 (-0.81)	-0.013 (-0.43)	-0.011 (-0.50)
ln gdp per capita	0.123** (2.22)	-0.111 (-1.37)	0.045 (0.96)
rel wage	-0.130* (-1.42)	-0.043 (-0.58)	-0.092 (-1.48)
lang distance	0.223*** (9.37)	0.111*** (6.06)	0.168*** (10.80)
institutions dummy	-0.126*** (-7.23)	-0.022* (-1.71)	-0.069*** (-4.18)
edu (industry)	0.091 (0.88)	0.050 (0.40)	0.062 (0.81)
communication	-0.230*** (-4.46)	-0.051** (-1.98)	-0.169*** (-2.88)
nonroutine	0.186** (2.15)	0.039** (2.01)	0.118** (2.12)
R-sq	0.163	0.119	0.256

Notes: Standardized beta coefficients reported. Standard errors clustered by industry. T-statistics in parentheses. *,** and *** indicate significance at the 10, 5, and 1 percent levels, respectively

Table 6: Export Versus FDI Model with Comparative Advantage Controls

Model :	1	2	3	4	5	6
Sample:	goods	services	gds+svc	goods	services	gds+svc
N:	5384	2454	7838	4803	2161	6964
Depvar:	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)
inst*nonroutine	-0.070 (-0.92)	-0.026* (-1.92)	-0.102*** (-2.97)	-0.120 (-1.43)	-0.078** (-2.18)	-0.156*** (-4.39)
inst*comm	0.026 (0.33)	0.050 (0.78)	0.089 (1.45)	0.035 (0.41)	0.069 (1.02)	0.109* (1.87)
gdppc*nonroutine				-0.273** (-2.03)	-0.082 (-1.00)	-0.134** (-2.05)
gdppc*comm				0.127 (0.85)	-0.160 (-1.16)	-0.086 (-0.75)
skill*nonroutine				0.010 (0.11)	-0.061 (-0.66)	-0.028 (-0.46)
skill*comm				-0.015 (-0.15)	0.070 (0.68)	0.031 (0.44)
Industry FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
R-sq	0.252	0.276	0.352	0.270	0.322	0.382

Notes: Standardized beta coefficients reported. Standard errors clustered by industry T-statistics in parentheses. *,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively

Table 7: Stage 1: Probit model for use as a control in the Table 8

Model :	1	2	3	4	5	6
Sample:	goods	services	gds+svc	goods	services	gds+svc
N:	8750	4900	13650	8750	4900	13650
Depvar:	fdi dum	fdi dum	fdi dum	x dum	x dum	x dum
tax difference	-0.008*** (-3.73)	-0.016*** (-5.49)	-0.011*** (-6.05)	-0.047*** (-6.05)	-0.012*** (-5.77)	-0.025*** (-7.17)
ln distance	0.248*** (5.78)	0.090*** (2.18)	0.186*** (5.90)	0.213*** (6.84)	0.157*** (4.98)	0.184*** (6.71)
concentration	0.014** (2.08)	0.001 (0.67)	0.001 (1.12)	-0.008 (-0.68)	0.001*** (6.93)	0.001*** (6.05)
dispersion	-0.202 (-1.47)	-0.171*** (-3.61)	-0.121*** (-2.80)	0.463 (1.64)	0.014 (0.13)	0.125 (1.15)
ln gdp	-0.461*** (-16.03)	-0.416*** (-12.97)	-0.433*** (-20.62)	-0.142*** (-7.59)	-0.248*** (-10.38)	-0.178*** (-8.05)
ln gdp per capita	-0.342*** (-10.01)	-0.298*** (-7.55)	-0.317*** (-12.62)	-0.313*** (-9.84)	-0.159*** (-4.78)	-0.244*** (-8.75)
lang distance	0.436*** (2.91)	0.821*** (3.49)	0.571*** (4.52)	0.532*** (3.78)	0.260*** (2.19)	0.313*** (3.86)
rel wage	0.284*** (8.41)	0.104* (1.90)	0.216*** (7.41)	0.608*** (11.54)	0.121*** (3.09)	0.372*** (7.58)
institutions dummy	0.239*** (6.32)	0.326*** (5.58)	0.259*** (8.17)	-0.416*** (-5.53)	0.113*** (3.65)	-0.104*** (-2.76)
edu (industry)	-0.952*** (-3.49)	-0.216 (-0.94)	-0.386** (-2.14)	-0.013 (-0.02)	-0.596 (-1.42)	-0.252 (-0.77)
communication	-0.108 (-0.31)	0.341* (1.79)	0.218 (1.38)	0.507 (1.41)	0.054 (0.14)	0.263 (0.85)
nonroutine	0.455 (1.44)	-0.609** (-2.07)	-0.273 (-1.30)	0.720 (1.23)	1.338*** (2.79)	0.983*** (3.30)
R-sq	0.380	0.412	0.374	0.255	0.268	0.315

Notes: Standard errors clustered by industry. T-statistics in parentheses.

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

Table 8: Stage 1 (continued): Probit model for use as a control in the Table 8

Model :	7	8	9
Sample:	goods	services	gds+svc
N:	8750	4900	13650
Depvar:	x & I dum	x & I dum	x & I dum
tax difference	-0.030*** (-4.78)	-0.015*** (-7.08)	-0.020*** (-5.70)
ln distance	0.430*** (5.14)	0.255*** (5.95)	0.332*** (6.75)
concentration	-0.005 (-0.40)	0.001*** (5.12)	0.001*** (4.10)
dispersion	0.438 (1.59)	-0.027 (-0.27)	0.098 (0.91)
ln gdp	-0.159*** (-8.77)	-0.319*** (-13.97)	-0.230*** (-9.05)
ln gdp per capita	-0.437*** (-12.31)	-0.220*** (-6.38)	-0.336*** (-9.20)
lang distance	0.222 (1.20)	0.481*** (2.94)	0.271** (2.20)
rel wage	0.609*** (10.53)	0.143*** (3.08)	0.383*** (6.99)
institutions dummy	-0.082* (-1.67)	0.208*** (4.87)	0.102*** (3.30)
edu (industry)	-0.221 (-0.35)	-0.609 (-1.55)	-0.318 (-0.99)
communication	0.611 (1.54)	0.038 (0.11)	0.201 (0.68)
nonroutine	-0.701 (-1.08)	-1.202*** (-2.68)	-0.950*** (-3.35)
R-sq	0.304	0.341	0.364

Notes: Standard errors clustered by industry. T-statistics in parentheses. *, ** and *** indicate significance at the 10, 5, and 1 percent levels, respectively

Table 9: Export-FDI model, second stage controlling for selection bias

Model :	1	2	3
Sample:	goods	services	gds+svc
N:	3766	1766	5532
Depvar:	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)
$\hat{\rho}^f$	-0.102 (-1.35)	0.185* (1.90)	-0.039 (-0.62)
$\hat{\rho}^x$	0.079* (1.81)	0.036 (0.10)	0.021 (0.16)
$\hat{\rho}^{fx}$	-0.098* (-1.93)	-0.165 (-1.01)	0.042 (0.61)
ln distance	-0.075*** (-3.03)	-0.033 (-0.96)	-0.075*** (-4.55)
concentration	0.117 (1.34)	-0.018 (-0.20)	-0.023 (-0.97)
dispersion	-0.263*** (-4.02)	-0.174 (-1.56)	-0.201*** (-3.59)
ln gdp	-0.126* (-1.90)	0.033 (0.46)	-0.024 (-0.47)
ln gdp per capita	0.031 (0.34)	-0.102 (-1.53)	0.057 (0.89)
lang distance	0.240*** (10.00)	0.097*** (4.45)	0.172*** (9.97)
rel wage	-0.069 (-0.96)	-0.018 (-0.27)	-0.113 (-1.07)
institutions dummy	-0.098*** (-3.70)	-0.001** (-2.02)	-0.060*** (-2.96)
edu (industry)	0.045 (0.42)	0.032 (0.27)	0.064 (0.84)
communication	-0.228*** (-4.61)	-0.076*** (-2.59)	-0.187*** (-2.75)
nonroutine	0.203** (2.31)	0.038** (2.26)	0.133** (2.51)
R-sq	0.165	0.122	0.257

Notes: Standardized beta coefficients reported. Standard errors clustered by industry. T-statistics in parentheses. *, ** and *** indicate significance at the 10, 5, and 1 percent levels, respectively

Table 10: Export-FDI model with affiliated and unaffiliated exports

Model :	1
Sample:	goods
N:	3766
Depvar:	ln(x/fdi)
tax difference	0.048 (0.50)
ln distance	-0.110*** (-5.68)
concentration	0.067 (0.64)
dispersion	-0.229*** (-3.95)
ln gdp	0.048 (0.60)
ln gdp per capita	0.251*** (3.56)
lang distance	0.218*** (7.92)
rel wage	-0.267*** (-4.01)
institutions dummy	-0.044 (-1.11)
edu (industry)	0.121 (1.11)
communication	-0.231*** (-4.60)
nonroutine	0.175** (2.02)
R-sq	0.154

Notes: Standardized beta coefficients reported, Standard errors clustered by industry. T-statistics in parentheses. *,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively

Table 11: Export Versus FDI Model, excluding rarely exported services

Model :	1	2	3
Sample:	goods	services	gds+svc
N:	3133	793	3926
Depvar:	ln(x/fdi)	ln(x/fdi)	ln(x/fdi)
tax difference	-0.001 (-0.03)	-0.048 (-1.17)	-0.010 (-0.64)
ln distance	-0.080*** (-3.51)	0.002 (0.04)	-0.062*** (-3.09)
concentration	0.192** (2.48)	-0.052*** (-3.02)	-0.009 (-1.04)
dispersion	-0.183*** (-3.23)	-0.027 (-0.27)	-0.066 (-1.21)
ln gdp	-0.076** (-2.21)	-0.029 (-0.55)	-0.054* (-1.78)
ln gdp per capita	0.119* (1.89)	-0.076 (-1.13)	0.100* (1.95)
lang distance	0.213*** (10.35)	0.084*** (2.72)	0.183*** (9.94)
rel wage	-0.165*** (-2.84)	-0.074 (-1.03)	-0.161*** (-3.38)
institutions dummy	-0.064*** (-2.78)	-0.011** (-2.24)	-0.050** (-2.48)
edu (industry)	-0.049 (-0.45)	0.041 (0.45)	-0.001 (-0.02)
communication	-0.100** (-2.01)	-0.104** (-1.97)	-0.030** (-1.97)
nonroutine	0.175** (2.21)	0.083** (-2.02)	0.078** (2.01)
R-sq	0.093	0.057	0.074

Notes: Standardized beta coefficients reported. Standard errors clustered by industry. T-statistics in parentheses. *, ** and *** indicate significance at the 10, 5, and 1 percent levels, respectively