THE DETERMINANTS OF INTRAFIRM TRADE*

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Abstract

How well does the theory of the firm explain the choice between intrafirm vs arms' length trade? Using import data from France we examine firm, country and product determinants of intrafirm imports at both the extensive (sourcing mode choice) and intensive (value of imports for a given mode) margin. By examining the extensive margin we find support for three key predictions of the property-rights approach. Intrafirm imports are more likely: (i) in capital-, skill-, and headquarter services-intensive firms; (ii) in highly productive firms; (iii) from countries with well-functioning judicial institutions. On the other hand, we find that complex inputs are more likely to be sourced within firm boundaries which can be rationalized within the transaction-cost approach. We also find that earlier industry- and product-level findings can be misleading, because some of these are driven by the intensive margin (on which theory is silent), and because of strong hidden within-sector heterogeneity in key covariates.

Keywords: intrafirm trade; outsourcing; firm heterogeneity; incomplete contracts; internationalization strategies; quality of institutions, extensive margin, intensive margin.

JEL Classification: F23, F12, F19

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1 Introduction

Multinational companies (MNCs) are central in international trade. Intrafirm imports alone account for over 40% of US total imports (Zeile, 2003, Bernard et al. 2010). MNCs have therefore become central in public debate too, not least in OECD countries where concerns about the relocation of production facilities to low-wage emerging economies are widespread. Naturally, the pattern of cross-border production networks and FDI flows has also attracted much attention among economists. In particular, substantial research efforts aim to explain why some international transactions are carried out within a firm or at arms' length on markets.

A well-established literature considers explanations based on the importance of intangible assets such as knowledge and reputation.[1] More recently, several contributions have taken on an explicit contract-theoretical approach of multinationals.[2] This rapidly expanding theoretical literature has triggered a series of empirical investigations on US intrafirm trade data (Antràs 2003, Yeaple 2006, Nunn and Trefler 2008, Bernard et al. 2010), which find support for the incomplete-contracts models by Antràs (2003) and Antràs and Helpman (2004; 2008).[3] However, while useful and important first steps, these analyzes are limited to the industry or imported product level, whereas the theory emphasizes the firm as the relevant unit of analysis.

This paper provides an empirical analysis of international sourcing modes at the *firm level*. Using data on imports of manufactured goods by French firms in 1999, we investigate the firm, product and country characteristics that determine the internalization choice. This allows us to assess the predictions of property-rights models of multinationals' organizational choices. In doing so we distinguish two margins of international sourcing: the extensive margin, i.e. the choice between sourcing modes; and the intensive margin, i.e. the transaction value for a given mode.

Two new lessons can be drawn from our analysis.

i) First, key results of property-rights theory find empirical support at the *firm-level*. In partic-

[1] See the surveys in Markusen (1995) and Barba Navaretti and Venables (2004).

[2] See among others McLaren (2000), Antràs (2003), Grossman and Helpman (2002, 2003, 2004, 2005), Antràs and Helpman (2004; 2008), Marin and Verdier (2003, 2008). Good surveys of the literature are found in Helpman (2006), Spencer (2007) and Antràs and Rossi-Hansberg (2008). Some of the most illustrative recent work along this line of research is published in Helpman, Marin and Verdier (2008).

[3] That group of papers also includes Costinot et al. (2010), although that paper tests an alternative theory of the firm based on adaptation and the costs of ex post renegotiation.

ular, we find that the choice of intrafirm sourcing is more likely in capital-, skill- and headquarter-intensive firms. More productive firms are also more likely to engage in intrafirm trade, typically importing higher amounts. These results match the direct predictions of property-rights models of the international firm. In addition, we find that intrafirm imports are more likely to originate from countries with well-functioning judicial institutions, as measured by the World Bank's Rule of Law index. The latter result can be explained by property-rights models. By contrast transaction-costs models would predict that stronger contract enforcement mostly reduces the costs of outsourcing.

ii) Second, our analysis show two important limits of an industry- or product-level approach. On the one hand, some results support to a variant of the property-rights model with firm-specific technologies. Factor intensity appears as an important determinant of firms' sourcing decisions when measured at the firm-level, but loses its explanatory power when measured at the industry level. This is due to substantial within-sector heterogeneity in factor use. On the other hand, we find that some previous results on aggregate intrafirm import shares are driven by import values (intensive margin) rather than individual sourcing mode choices. For instance intrafirm imports are more likely to originate from capital rich countries, when measured by industry intrafirm value shares, but less likely to do so when measured by transaction count. Indeed, import volumes under outsourcing tend to decrease with capital abundance which reconciles the two results. Theory is essentially silent on the determinants of the intensive margin of sourcing modes and one contribution of our paper is to offer new empirical insights to fill the existing gap.

Along with many of the above-cited papers, our paper is related to empirical investigations of vertical integration *within countries*.[4] One can think of two useful ways in which the research program on the boundaries of multinationals complements its domestic counterpart. It exploits more systematically collected data on the nature of transactions, and does not overwhelmingly focus on the transaction-cost approach (although a recent exception is Acemoglu et al. 2010).

Our paper is also related to studies on multinationals that exploit less exhaustive data, and focus on more specific aspects of extensive-margin intrafirm trade. Using a subset of our French data Defever and Toubal (2007) find a positive relationship between TFP and the outsourcing choice among MNCs which report higher fixed costs of outsourcing, and the opposite among

[4]This vast literature is surveyed by Lafontaine and Slade (2007).

MNCs that report higher costs of internalization. Their finding complements the self-selection based on TFP result we point to in our paper,[5] but it is prone to a bias due to data collection. Using the same data Carluccio and Fally (2009) find that complex inputs are more likely to be imported intrafirm from countries with a low level of financial development. We complement that result by providing evidence that complex goods and inputs are more likely to be produced within firm boundaries. Finally Kohler and Smolka (2009), using cross-sectional Spanish data, find that more productive firms are more likely to engage in intrafirm rather than arms' length, and foreign rather than domestic sourcing. However, they do not explore other determinants of the sourcing choice nor investigate the difference between extensive and intensive margin.

The paper is organized as follows. In section 2 we state four testable predictions and explain their intuition. In Section 3 we describe the construction of our estimation sample and give a general overview of our variables, which are described in more detail in Appendix A. In section 4, we present and discuss our econometric tests of the four predictions. In Section 5 we compare our results to existing product- and industry-level evidence, and show the importance of examining both the intensive and the extensive margins of international sourcing. Section 6 concludes and suggests avenues for future research.

2 Theoretical Background

We start by reviewing testable predictions from three models: Antràs (2003), Antràs and Helpman (2004; 2008). All three models explain internalization decisions using property-rights theory (Grossman and Hart, 1986, Hart and Moore, 1990).

In particular, we are interested in the following predictions:

1. capital-, skill-, or headquarter-intensive firms are more likely to engage in intrafirm trade
2. more productive firms are more likely to engage in intrafirm trade
3. intrafirm imports are more likely to originate from capital-abundant countries

[5] As will be explained in more detail below, the fixed costs of internalization have a different interpretation when one considers, like Defever and Toubal (2007), existing multinationals only.

4. more productive firms are more likely to import intrafirm from countries with good contract enforcement, although it may not be the case for the average firm

In what follows we describe the intuition for these predictions.

Antràs (2003) and Antràs and Helpman (2004; 2008) all build on a common partial equilibrium property-rights model of the firm. In a supplier-buyer relationship with relationship-specific assets and investments, contract incompleteness creates a two-sided holdup problem, implying that both parties under-invest ex ante. Property rights critically affect the extent of under-investment. An owner can exclude the other party from the asset, which raises her outside option in bargaining over ex post surplus. Expecting a greater share of that surplus, the owner has greater incentives to invest ex ante. Therefore joint surplus is maximal when the party responsible for the main investment is given ownership rights. With efficient ex post bargaining and costlessly transferrable utility, parties will agree on the organizational form that maximizes joint surplus.

This property-rights result can be applied to the analysis of intrafirm trade thanks to two additional assumptions. First, concerning variable costs, for legal or technical reasons capital investments and headquarter skill intensive services (general management and coordination tasks) are provided by the final producer.[6] Therefore *in capital-, skill-, or 'headquarter'-intensive production processes the final producer needs to be incentivized, and vertical integration is optimal (Prediction 1).* Second, intrafirm imports entail higher *initial* fixed costs than arms' length imports. For example affiliate setup costs are plausibly higher than supplier search costs. Therefore *all else equal a more productive firm is more likely to engage in intrafirm trade (Prediction 2).* In labor-intensive sectors, where by Prediction 1 variable costs are already such that outsourcing is preferred, TFP heterogeneity has no bearing on organizational choice. By contrast, in other sectors the model predicts self-selection of the most productive firms into intrafirm trade: only firms sufficiently productive to leverage variable costs differences on large sales and cover the higher fixed costs of intrafirm will choose this sourcing mode.

[6] Antràs (2003) mentions evidence of higher cost-sharing in capital investments than in labor investments among US multinationals, even in their affiliates. This may come from credit market imperfections, or from the fact that labor investment decisions require local knowledge, but is in any case beyond the scope of the model. That the supplier does not provide *any* capital investment or headquarter services can be thought of as a limit case.

Antràs (2003) embeds the model sketched above in a 2x2x2 general equilibrium framework. Assuming free entry, identical and homothetic preferences, and that immobile endowments are in the Factor Price Equalization set, he shows that *the share of intrafirm imports increases in the country's capital/labor ratio (Prediction 3).* In his Helpman-Krugman model the capital-intensive industry (where, from Prediction 1, all trade is intrafirm) has a greater number of varieties in capital-abundant countries than the labor-intensive industry (where all trade is at arms' length).

Antràs and Helpman (2008) extend their 2004 model to allow for partially contractible production tasks. Both headquarter services and component production require contractible and non-contractible tasks, the extent of which depends on the local contracting environment. Suppose more component production tasks become contractible, ie 'input contractibility' increases. This does not change anything in labor-intensive partnerships, which by Prediction 1 were fully outsourcing their input production. But *in other sectors a ceteris paribus improvement in input contractibility has two effects: first, the most productive domestic producers switch to offshore outsourcing; second, the most productive firms resorting to offshore outsourcing insource from foreign affiliates (Prediction 4).*[7] The second effect derives from a lower need to incentivize component producers after the input contractibility improvement. In sum, improved contract enforcement in the origin country favors international sourcing, but does not clearly favor one sourcing mode. Which effect dominates is an empirical question, which requires data on the contractibility of tasks performed by each party.

3 Data

The population of interest consists of importing firms, since the above theoretical predictions apply to them and not to firms sourcing only domestically.

We use data on the two sourcing modes (either arms' length or intrafirm) of French imports in 1999. The observation unit is a firm-country-product triple: firm i sourcing product p from country c either at arms' length or intrafirm. In what follows we describe how we merge several data sources and construct an estimation sample that addresses a bias in data collection.

[7] Nunn and Trefler term these two effects the Standard and Surprise Effect, respectively.

3.1 Primary Data Sources

We rely on three primary data sources.

First, the EIIG (Échanges Internationaux Intra-Groupe) database documents the sourcing mode in a firm's yearly imports by origin country and by CPA96 or HS4 4-digit product codes in 1999. Intrafirm trade is defined as trade with an affiliate controlled by a single French entity with at least *fifty percent* of its equity capital. The data covers 4,305 firms and comes from a survey conducted in 1999 by the French Ministry of Industry's SESSI (Service des Études Statistiques Industrielles). The survey was addressed to all firms incorporated in France and trading more than 1 million euros, owned by manufacturing groups that control at least fifty percent of the equity capital of an affiliate based outside France. We refer to this group of firms (8,236 units) as the 'EIIG target population'.[8] The response rate was 52.27%, but the 4,305 respondent firms represent more than 80% of total exports and imports of French multinationals. Non-respondent firms are excluded from our analysis due to unavailability of the sourcing mode information. We discuss and address sample selection issues in the next subsection. These data has been previously used, in a different context, by Defever and Toubal (2007) and Carluccio and Fally (2009) who do not deal with sample selection.

Although firms in the EIIG dataset do source part of their imports at arms' length, by construction they all have an affiliate so that limiting ourselves to these firms would bias our results towards intrafirm trade. For instance SESSI estimates that around 36% of the total value of manufacturing imports is intrafirm (Guannel and Plateau, 2003), while in the EIIG data the corresponding value is much higher (55.4%).We must thus complement the EIIG with import data on non-multinational firms.

To this end we use a second database, coming from the French Customs Office, documenting the universe of yearly imports and exports flows in 1999 at the firm, origin country and product level. These data were used (among others) by Eaton et al. (2004). The data are collected from custom declarations.[9]. The total value of imports in the database represents 99% of French aggregate

[8]We thank Boris Guannel from SESSI for providing us with the complete list of firms belonging to the target population.

[9]For trade outside the EU15, there is no minimal amount for data to be recorded. Within the EU, only trade whose total annual amount for a given country-product couple exceeds 250,000 euros per year should be registered.

imports in 1999 as reported by EUROSTAT, with the 1% difference being due to the imputed trade of firms not obliged to report information to the French Customs Office. Regrettably, this dataset does not provide information on whether imports come from a related party (unlike US customs data for example).

Finally, the EAE (Enquête Annuelle Entreprise) database provides balance sheet data on manufacturing firms. The data come from a census of all French firms with at least 20 employees whose primary activity is in the manufacturing sector (NACE rev1 D category), conducted by the French Ministry of Industry's SESSI and the Ministry of Agriculture's SCEES (Service Central des Enquêtes et des Études Statistiques). Firms in the EAE database represent 9.8% of the total number of French manufacturing firms, but 87.2% of production in 1999 as reported by EUROSTAT.

3.2 Construction of the estimation sample

In order to construct our estimation sample, we start by refining the population of interest. The EIIG survey was addressed to large traders, i.e. firms trading more than 1 million euros. There are 30,028 such firms in French Customs, accounting for the bulk of imports (95.46%) in 1999. Out of these 30,028 large traders, 8,236 belong to the EIIG target population. We match the Customs and EIIG datasets under the assumption that *import flows recorded in Customs data by firms other than the EIIG target population, occur with a third party.* Put differently, we assume that SESSI successfully identified multinational firms among large traders.

Had all the 8,236 firms who received the EIIG questionnaire replied to the survey, a simple match of the EIIG data with imports by the remaining 21,792 non-multinational firms would provide us with full information on the population of large traders. However, about half of them (3,931) did not reply to the survey with these firms accounting for less than 20% of total exports and imports of the EIIG target population. Non-response to the EIIG survey thus seems to be non-random with responding firms likely to be larger and possibly more productive than non-respondents.

To address potential biases, we construct a representative sample of the population of both

Even then many trade flows below this threshold are still registered.

multinational and non-multinational large importing French firms. To deal with sample selection due to non-response in the EIIG survey we use a two-stage Heckman procedure. In the first stage we estimate the probability that one of the 8,068 importing firms in the EIIG target population[10] responds to the survey, using firm total imports value, number of product categories imported, origin countries involved, and NACE rev1 3-digit industry dummies. These variables reflect our presumption that a higher data collection effort was allocated by SESSI to large importers and/or certain sectors. This generates an inverse Mills ratio ($IM1$) at the firm-level for all firms responding to the EIIG survey, which we subsequently use in the second stage firm-product-country analysis to correct for selection bias. Further details on the two-stage probit model that we estimate are provided in Sections 4.2 and 4.3.

Finally, we construct a random sample of the population of non-multinational French large importers, i.e. importers that trade 1 million euros or more but do not belong to the EIIG target population. We do so by drawing a fraction that matches the response rate of the EIIG survey. By merging such a random sample with the EIIG data on respondent firms we get our final sample. Throughout the analysis we will refer to this final sample as the 'large sample'. It includes 281,419 observations spanning over 14,711 firms, 219 countries and 272 CPA96 4-digit products. Matching that sample with the EAE survey that documents manufacturing firm characteristics generates a 'small' sample of 98,168 observations spanning over 5,175 firms, 185 countries and 270 products.

3.3 Variables Used in the Empirical Analysis

In most of the analysis our dependent variable $y_{i,p,c}$ is a binary variable that takes value one if a French firm i imports product p from country c (mostly) from a foreign affiliate in 1999, and zero otherwise. We use a binary variable for two reasons. First, only a few product-country-firm triples involve both intrafirm and arms' length imports.[11] Second, the theoretical predictions we consider apply to this binary choice and not to the value of import transactions under each mode, as acknowledged by Antràs (2003). For this reason we do not weigh observations according to

[10] As the 1 million euros threshold applies to the sum of imports and exports, not all firms in the EIIG target population import goods in 1999. The remaining 168 firms are only involved in exports.

[11] We keep most of this 'mixed transactions' information by recording as intrafirm or outsourcing a transaction for which at least 80% of the total value occurs with one of the two sourcing modes. That way we exclude only 0.4% of all transactions. See Appendix A for details

import value in the main analysis. That said, in Section 5 we look simultaneously at the extensive (sourcing mode) and the intensive (import value for a given sourcing mode) margins.

Table I describes our covariates. Additional information about data sources and the construction of the variables, as well as some descriptive statistics, are provided in Appendix A.

4 Firm-, Country-, and Product-Level Determinants of the intrafirm vs. Outsourcing Decision

We start by stating two important facts about the data in Section 4.1. The methodology and results for the two sets of estimations, one focusing on firm-level determinants and the other on country- and product-level determinants, are presented in Sections 4.2 and 4.3 respectively.

4.1 Descriptive analysis

Descriptive statistics reveal two interesting insights. First, intrafirm import flows are fewer but larger. Second, potential determinants of internalization show considerable within-sector heterogeneity.

Intrafirm flows are larger. In the large sample only 8.49% of transactions are intrafirm but they correspond to 38.86% of total imports' value. In the small sample (for which we have balance sheet information) intrafirm transactions account for 13.65% of all transactions but 42.67% of the value of imports.[12] Figure I shows the kernel-smoothed distribution of log transactions' value (in euros) for both intrafirm and outsourcing. As showed by the Figure, the distribution of intrafirm transactions values somewhat lies to the right of that of outsourcing. The two distributions have similar shapes and upper bounds of the supports (21.39 for intrafirm and 21.82 for outsourcing).

Summarizing:

Fact 1 Intrafirm import transactions are rare but typically involve larger amounts.

[12] Among respondents to the EIIG survey, intrafirm transactions represent 31.3% of all transactions but 55.4% of the value of imports. Again, this suggests some bias in non-response, which further motivates our systematic treatment of sample selection bias.

While there are many possible interpretations of Fact 1, it is definitely consistent with Prediction 2. If intrafirm imports require higher initial fixed costs than outsourcing, the most productive and larger firms will self-select into intrafirm sourcing.

Within-sector heterogeneity. A first look at the data suggests that the determinants of internalization identified by the theory should be examined at the level of the firm and not the industry.

First of all, intrafirm trade and outsourcing coexist in virtually all NACE rev1 3-digit manufacturing industries (roughly 100 units). Taken literally, the industry models reviewed in Section 2 do not allow for this possibility.

Second, we also find considerable heterogeneity in firm characteristics within NACE rev1 3-digit industries. Table IV reports the standard deviations (as well as correlations) of key covariates, and decomposes them into a between- and a within-sector component. Statistics are reported for both all EAE firms (top panel) and the 'small sample' used in estimations (bottom panel).

Considering that TFP_i, k_i and η_i^{sk} are constructed using logs (and thus unit-free), while η_i^{hq} varies between 0 and 1, Table IV first reveals substantial heterogeneity (i.e. high standard deviations) in general despite we trimmed observations based on the distribution of value added and capital per worker to control of outliers. This is a quite well known fact in, for example, the TFP literature and the magnitudes we get are in line with previous evidence. However, what is usually not very emphasized while being very much important in our analysis is that firms appear to be highly heterogeneous also *within* sectors. For instance in the sample used to test Prediction 1 most of the standard deviation of capital intensity (80.51%) comes from within-industry differences in k_i. The same observation applies to headquarter- and skill-intensity (88% and 88.58% respectively). Within-industry heterogeneity in these variables is in fact even more pronounced than in the well-documented case of productivity, and is in line with evidence in Bernard et al. (2003) who argue that "industry [...] is a poor indicator of factor intensity".

We can thus state that:

Fact 2 Firm characteristics such as k and η display much more variance within than across industries.

This suggests that the firm is the correct unit of analysis in order to study the impact of technology and factor intensity on sourcing modes. Now, firms that use the same technology may in principle have different observed factor intensities if the technology is not CES and they operate at different scales. While this is difficult to falsify, one would then expect that TFP and factor intensities are correlated, since TFP determines scale. However, Table IV revels weak correlations between TFP and factor intensities and this holds even considering correlations after deflating for industry averages.[13]

Finally we acknowledge that our factor intensity variables are prone to some measurement error, which might cause some spurious heterogeneity. Large magnitudes of within-sector heterogeneity should therefore be interpreted with caution, but suggest that a firm-level econometric analysis is preferable.

4.2 Testing Predictions 1 and 2: Firm-Specific Determinants

In most of the analysis we estimate a probit model of $y_{i,p,c}$, the binary variable that takes value one if firm i imports product p from country c intrafirm and zero otherwise.[14] We test predictions involving firm characteristics and country and product characteristics separately. Simple correlations of $y_{i,p,c}$ with the key variables used in our estimations are reported in Table II.

First, we estimate the probability that a transaction is intrafirm on firm-level characteristics, using product and country dummies to control for unobserved heterogeneity. This approach reduces the risk of omitted variable bias without imposing further assumptions on the correlation between the dummies and the firm-level regressors. In addition, as we systematically cluster standard errors by firm, our estimations allow for correlations in the error structure across countries and products involved in a same firm's sourcing decisions.

Second, we analyze the probability that a transaction is intrafirm based on country and product characteristics. This second set of estimations, presented in the next subsection, makes use of both the 'large sample' and the 'small sample', allowing us to control for firm-specific heterogeneity in several ways.

[13]The Table on variations from industry averages is omitted to save space but is available upon request.
[14]The alternative logit specification yields similar results, which are available upon request.

To study the impact of firm determinants we estimate the following two-stage probit model:[15]

$$Response_i = \mathbf{1}_{[Response_i^*>0]}$$

$$Response_i^* = a + b_1 \ln(Imports_i) + b_2 \ln(NbProducts_i) + b_3 \ln(NbCountries_i) + \mathbf{D}_s + \xi_i \quad (1)$$

$$y_{i,p,c} = \mathbf{1}_{[y_{i,p,c}^*>0]}$$

$$y_{i,p,c}^* = \alpha + \beta_1 TFP_i + \beta_2 k_i + \beta_3 \eta_i^{hq} + \beta_4 \eta_i^{sk} + \mathbf{D}_p + \mathbf{D}_c + IM1_i + \varepsilon_{i,p,c} \quad (2)$$

In the first-stage equation, which is estimated on the group of firms belonging to the EIIG target population, $Response_i$ takes value one if firm i has responded to the EIIG survey, $Imports_i$ equals the total value of firm i's imports, while $NbProducts_i$ and $NbCountries_i$ measure the number of product categories and origin countries involved in firm i's imports, respectively. $\mathbf{D}_s$ refers to NACE 3-digit sector dummies. These variables reflect our presumption that a higher data collection effort was allocated to large importers and/or certain sectors. Indeed all variables are highly significant and have the expected sign ending up with a Pseudo R^2 of 0.2788.

In the second-stage equation $y_{i,p,c}$ takes value 1 if the transaction is intrafirm and 0 otherwise, and $\mathbf{D}_p$ and $\mathbf{D}_c$ stand for product and country dummies. The key variables in our analysis are firm productivity (TFP_i), capital intensity (k_i), headquarter intensity (η_i^{hq}) and skill intensity (η_i^{sk}). In unreported estimations, we also considered lags of key variables finding the same qualitative pattern.[16] $IM1_i$ is the inverse Mills ratio coming from the first stage which is set to zero for firms not in the EIIG data. Estimations are carried out on the small sample for which firm-level variables are available from the EAE database. The number of observations in the estimations is a bit smaller than the small sample size because some country and/or product dummies perfectly predict the outcome and the corresponding observations are thus dropped.

Table V reports second-stage estimations using variants of 2. Columns 1 to 5 report marginal

[15] The model is estimated in two steps making use of the inverse Mills ratio coming from the second step as an additional regressors in the second step.

[16] Reverse causality would be a concern if the two types of international sourcing (intrafirm vs outsourcing) had a different impact on firms' characteristics, such as productivity or headquarter intensity. This is a priori unlikely. Nonetheless, we have estimated variants of the model with lagged firm variables, and found the same qualitative pattern. Results are omitted to save space but available upon request.

effects of the four firm-level regressors independently and jointly. In Column 6 we estimate a different probit model where the regressors are the NACE rev1 3-digit industry counterparts to the firm-level regressors, k_s, h_s, η_s^{hq}, and η_s^{sk}.

Explanatory variables have overall positive and significant coefficients. Columns 1 to 4 reveal that all four regressors, taken separately, have significant coefficients (at the 1% level) with a sign consistent with Prediction 1. Column 5 shows that three of the four regressors keep their sign and significance in the estimation of (2). By contrast Column 6 shows that a model with industry-level regressors fails to explain sourcing modes having a lower Pseudo R^2 than, for example, the specification with firm-level TFP alone while ending up with only the coefficient of η_s^{sk} being statistically significant. Therefore Prediction 1, coming from the residual property rights literature finds empirical support, but heterogeneity in capital, headquarter and skill intensity needs to be accounted for. In sum:

Result 1 : Firms with higher capital, headquarter and skill intensity are more likely to engage in intrafirm trade, as in Prediction 1. However, factor intensities need to be evaluated at the level of the firm.

Result 2 Intrafirm trade is more likely, the higher is firm total factor productivity. This finding is in line with Prediction 2.[17]

Result 1 supports Prediction 1 and confirms the results found on industry- and product-level US data mentioned in the Introduction.

Result 2 is a new and complementary empirical result with respect to Tomiura (2007) and Defever and Toubal (2007). In his detailed firm-level analysis of Japanese imports Tomiura (2007) does not identify affiliated-party trade. Defever and Toubal (2007) run a regression similar to the second stage of (2) on the sample of firms responding to the EIIG only without controlling for selection. They find that the sign of the TFP coefficient switches with the firm's relative magnitude of (fixed) outsourcing and integration costs (as reported by the firm), suggesting self-selection as in Antràs and Helpman (2004). However the Antràs and Helpman (2004) self-selection result

[17] In unreported regressions we use both a more conservative measure of productivity (value added per worker) and the alternative Olley and Pakes (1996) TFP and obtain the same qualitative results.

applies to affiliate setup costs, which are already sunk in a population of existing multinationals (EIIG firms). They are therefore likely to pick up the effect of recurrent fixed costs associated with each mode. An additional concern with that study is sample selection. All firms in the EIIG survey have foreign affiliates, and virtually all firms engage in both intrafirm and outsourcing transactions, depending on the product and country. Since each firm has a unique TFP measure, identification of the TFP coefficient does not come from comparing firms that do with firms that do not engage in intrafirm, but rather from the share of intrafirm transaction within a firm. For these two reasons we find our sample and the non-response correction we apply more appropriate to test the Antràs and Helpman (2004) prediction (Prediction 2).

4.3 Testing Predictions 3 and 4: Country and Product Determinants

In this Section we explore country and product determinants of intrafirm trade, using several methods to control for observed and unobserved firm characteristics.

We expect intrafirm imports to be positively correlated with human capital abundance h_c and capital abundance k_c of the country of origin of goods (Prediction 3). The correlation with the quality of a country's judicial institutions Q_c and measures of, respectively, intermediate and final product contractibility (μ_p and μ_f) is a priori indeterminate, but should differ along the firm productivity dimension (Prediction 4). Finally Antràs (2003) also predicts that capital- and skill-intensive products are more likely to be produced in-house. We therefore expect positive coefficients for our variables k_p and h_p.

In addition to these key covariates we control for other variables which may affect the optimal sourcing mode. We denote by $\mathbf{CC_c}$ the vector of control variables. We first include an OECD dummy ($OECD_c$) and the country's corporate tax rate (Tax_c) as additional country regressors. Prediction 3 relies on factor price equalization, which is more likely to hold among OECD countries due to similar factor endowments. Corporate tax rates proxy for the benefits of profit-shifting, which may affect sourcing choices. We also control for variables commonly used in gravity equations, such as the log of distance of country c to France ($Distw_c$), past colonial status ($Colony_c$), common language ($Language_c$) and common legal origin ($Same - leg - orig_c$) indicators.[18] Fi-

[18]We do not include GDP per capita for two reasons. First, it is highly correlated with the capital/labor ratio,

nally, since FDI (leading to intrafirm trade) can partly substitute for weak financial markets we also control for the origin country's level of financial development ($Fin-Dev_c$). This is measured by the ratio of private credit to GDP, which we borrow from Beck (2002).

Again, we use a two-stage procedure to address sample selection bias. As earlier we estimate the probability of response to the EIIG survey according to (1). We then consider four alternative models for the second-stage equation, jointly described by Equations 4-6.

$$Response_i = \mathbf{1}_{[Response_i^*>0]}$$

$$Response_i^* = a + b_1 \ln(Imports_i) + b_2 \ln(NbProducts_i) + b_3 \ln(NbCountries_i) + \mathbf{D}_s + \xi_i \quad (3)$$

$$y_{i,p,c} = \mathbf{1}_{[y_{i,p,c}^*>0]}$$

$$y_{i,p,c}^* = \alpha + \beta_1\ k_c + \beta_2\ h_c + \beta_3\ \mu_p + \beta_5\ Q_c + \beta_6\ k_p + \beta_7\ h_p + \mathbf{CC_c b} + IM1_i + \varepsilon_{i,p,c} \quad (4)$$

$$y_{i,p,c}^* = \alpha + \beta_1\ k_c + \beta_2\ h_c + \beta_3\ \mu_p + \beta_4\ \mu_f + \beta_5\ Q_c + \beta_6\ k_p + \beta_7\ h_p + \mathbf{CC_c b} + f_i + IM1_i + \varepsilon_{i,p,c} \quad (5)$$

$$y_{i,p,c}^* = \alpha + \beta_1\ k_c + \beta_2\ h_c + \beta_3\ \mu_p + \beta_4\ \mu_f + \beta_5\ Q_c + \beta_6\ k_p + \beta_7\ h_p + \mathbf{CC_c b_1} + \mathbf{FC_i b_2} + IM1_i + \varepsilon_{i,p,c} \quad (6)$$

The pooled regression in (4) maximizes the number of observations available (all firm-country-product combinations in the large sample), but prevents us from considering both firm heterogeneity and the final product contractibility μ_f which is available only for (essentially) manufacturing firms.[19] To account for unobserved firm heterogeneity we can estimate (5) by either random or fixed effects, depending on our assumptions on f_i. The random effects probit model allows for unobserved firm effects but at the cost of assuming independence with other regressors. We choose to estimate that model on the group of manufacturing firms only in order to use information on

the human capital/labor ratio as well as with the quality of institutions. Second, although wages can affect the sourcing choice (e.g. in Antràs and Helpman, 2004), GDP per capita is at best a poor proxy for labor costs. Wages and productivity vary across countries and what we would really need is a productivity-deflated measure of wages in country c (we leave this exercise for future work).

[19] Our contractibility measure builds on the Rauch (1999) classification, which is mostly limited to manufacturing, agriculture and mining goods. We thank Sébastien Roux from INSEE for providing us with data on the NACE code of the whole population of French firms.

μ_f.[20] We also estimate (5) using a conditional fixed effects logit model. Naturally, $IM1_i$ becomes unidentified in this case and identification relies on firms that import different products from several countries under different sourcing modes. This reduces drastically the number of observations used in the estimation. Another drawback is that we cannot identify the impact of the contractibility of the final good μ_f, as it is firm-specific. Finally (6) is estimated by a probit model on the small sample, for which firm-level information from the EAE database is available. The vector of firm controls $\mathbf{FC_i}$ corresponds to the firm characteristics used in the previous subsection. In all specifications, some observations are lost during estimations because of the lack of data for some countries and/or products.

The four columns of Table VI report the results of the estimation of the different models.[21] Looking across columns, Table VI reveals that, with very few exceptions, the sign and significance of coefficients follow a clear and coherent pattern. We can state two results.

Result 3 Intrafirm trade is more likely with capital scarce countries. This original finding is at odds with Prediction 3. This result is robust to considering either k_c as the only explanatory variable or k_c and a subset of the other covariates. In particular the result still holds if we do not include the OECD dummy and/or h_c.

Result 3 stands in sharp contrast with Antràs (2003), who predicts that the share of intrafirm trade should increase with k_c, and is extremely robust holding for different firm samples and estimation techniques.

Do our empirical findings invalidate this prediction? A first caveat is that Antràs (2003) result is derived under the very strong assumptions of immobile endowments and factor price equalization. However, in an unreported robustness check, we interact capital abundance with OECD membership (a proxy for a common diversification cone) and find a non-significant coefficient. This suggests that the prediction by Antràs (2003) fails to hold even in the favorable setting of OECD origin countries. Second, to control for the origin country's level of financial development

[20] Thus in Column (2) of Table VI observations come from all French manufacturing firms for which the Rauch classification allows to compute μ_f, not just firms in the EAE database.

[21] To save space we do not report coefficients of covariates $\mathbf{FC_i}$ and industry dummies. In addition coefficients of other product and country covariates are relegated to Table X.

in 1999 we must exclude China from the analysis. In an unreported robustness check we find that removing that control and including China among origin countries does not affect Result 3.

Result 3 also seem to contradict evidence on US imports (Antràs 2003, Yeaple 2006, Nunn and Trefler 2008, and Bernard et al. 2010). However as these empirical studies apply to the industry or product level the results are not directly comparable. In Section 5 we bridge the gap between our and the above-mentioned results by considering both the extensive and intensive margins of import sourcing.

Result 4 Intrafirm trade is more likely with countries having good judicial institutions.

Result 4 states that the better a country's judicial system (high Q_c), the less likely firms are to engage in arms' length relationships. The result is robust to controlling for imported and final good contractibility.

According to Prediction 4, improved product contractibility in the origin country has two opposite effects. First, more domestic firms turn to arms' length imports (the Standard Effect). Second, the most productive importers switch to intrafirm trade, due to a weaker need to provide the supplier with high-powered incentives (the Surprise Effect). Our results suggest that the Surprise Effect dominates the Standard Effect. In addition, in unreported regressions we break firms into quartiles of TFP and find a higher coefficient of Q_c for more productive firms. This provides further support for Prediction 4. We therefore broadly confirm the findings by Nunn and Trefler (2008) on product-level US data at the firm level.[22]

Interestingly, Result 4 challenges the transaction-cost approach of, among others, McLaren (2000) and Grossman and Helpman (2002). In these models stronger legal protection should reduce costs of agents' interactions outside the firm, and favor arms' length relationships instead. In the property-rights approach suitably enforced contracts substitute for the high-powered incentives given by firm ownership.

[22]Our contract enforcement measure Q_c differs from that of Nunn and Trefler (2008), who interact Q_c with the Nunn (2007) product contractibility measure. We consider our measure more appropriate to test the theory. Antràs and Helpman (2008) consider improvements of input contractibility in the South *keeping contractibility in the North constant*, while they only model one input. Therefore the comparative statics can only be applied to countries, not inputs. In our linear model - the simplest possible function $f(\mu_p, Q_c)$ representing contractibility of input p from country c - the coefficient of Q_c captures the model's comparative statics. This argument notwithstanding, we also introduced an additional interaction term $\mu_p * Q_c$ in unreported regressions and found that it is not significant.

Moving to product characteristics, we report a consistent pattern on the role of intermediate and final product contractibility:

Result 5 The production of complex intermediate and final goods (low μ_p and μ_f) is more likely to occur within firm boundaries.

This result does not correspond to a theoretical prediction of the property rights approach. In Antràs and Helpman (2008) comparative statics rely on contractibility by input-country pair. It is generally unclear how a joint improvement in the contractibility of inputs both in the North and the South affects the make-or-buy decision in the South.

However the result can be explained by the transaction-cost approach. Products that are neither sold on an organized exchanged nor reference-priced, according to Rauch (1999), are likely to have three important attributes. First, as suggested by Nunn (2007), these products involve more relationship-specific investments, which creates appropriable quasi-rents. Transaction-cost theory, starting from Williamson (1971), predicts that ownership prevents costly haggling over appropriable quasi-rents. Second, these products are more complex, which again increases the risk of costly ex post renegotiation (see for instance Costinot et al. 2010). Third, these products typically embody costly R&D efforts, which are more protected against imitation within firm boundaries.

Finally, neither product skill intensity (h_p) nor country skill abundance (h_c) have a clear effect. Coefficients take either sign and are not significant in some cases.

5 Reconciling Firm- and Industry-Level Evidence: the Intensive and Extensive Margins

Some of our results, in particular Result 3, strongly challenge the findings of several previous studies using US *industry*- or *product*-level data: Antràs (2003), Yeaple (2006), Nunn and Trefler (2008), Bernard et al. (2010).

Why are our results different? We start by showing that neither differences in methodology nor data can explain the discrepancy. Instead we show that variables of interest have different

effects at the extensive (source mode choice) and intensive margins (transaction value for a given mode) of international sourcing. Since the theory applies to extensive margin and is virtually silent on intensive margin, we conclude that firm-level data are necessary to obtain a coherent picture.

5.1 France is Not Different From the US!

We start by replicating US results on the French data. We want to rule out the possibility that differences in results come from differences between the two economies or in data collection.[23]

Table VII reproduces the cross-industry (column 1) and cross-country (column 2) regressions of Antràs (2003) for France. The dependent variable $Share_{cs}$ is the share of intrafirm imports value at the country-sector level. Industry-level regressors are NACE rev1 3-digit sector averages of capital intensity (k_s), a ratio of value-added to sales (η_s^{hq}), skill intensity (η_s^{sk}) and the contractibility measure μ_f.[24] Country regressors are mostly as in the previous section with $Population_c$ being the log of country c population in 1999 taken from the IMF World Economic Outlook database. Country and industry dummies are included in, respectively, columns 1 and 2.

Our results on country-sector intrafirm shares mirror findings on US data by Antràs (2003) and other authors. In particular, the intrafirm share increases with industry capital-intensity as well as with the capital abundance of the origin country.

The first finding contrasts with the previous Section, where the same industry average factor intensity failed to explain individual sourcing choices (Column 6 in Table V). The difference between these country-sector and transaction-level regressions provides additional support for the view that the property-rights model should be tested at the firm level. Naturally, a replication of our firm-level analysis on US data would be needed to assess the generality of that view. We note however that Bernard et al. (2010, p. 5) report substantial heterogeneity in US intrafirm import shares within NAICS 6-digit industries across countries and products.

The second finding, in turn, contrasts abruptly with our result in Table VI, where the coefficient

[23]Definitions of affiliate trade differ in the two countries. Our French data record imports from affiliates where the parent holds more than 50% of the stock. In the US the equivalent thresholds are 6% in Customs data and 10% in the Bureau of Economic Analysis survey of multinationals. Besides, as already discussed, the EIIG only covers about 80% of French multinationals' imports due to non-response, while US Customs data are exhaustive.

[24]Data on advertising and R&D intensity, used in Antràs 2003, are not available.

of k_c was significantly negative across all specifications.

To confirm that the discrepancy is not specific to the French data we replicate product-country-level findings on US data by Bernard et al. (2010). These authors estimate a model of intrafirm shares at the country-product level ($Share_{pc}$). Since at their level of disaggregation $Share_{pc}$ has many zeros they use a Heckman two-stage procedure to control for selection bias. In particular their model has a first-step probit model on the variable $\widetilde{Share}_{pc} = 1$ if $Share_{pc} > 0$, and a second equation similar to our Equation (4).

Table VIII reports estimation results with $IM2$ being the inverse Mills ratio coming from the first step. Our excluded variables are $Colony_c$, $Same - leg - orig_c$ and $Population_c$. Our results echo those of Bernard et al. (2010). In particular, we find again a positive coefficient of k_c at the product-country level. In addition, we find that the quality of institutions (Q_c) has a positive effect in the first-stage equation, and a negative effect in the second-stage equation (but not significant at the 10% level).

We generally conclude that French industry- or product-level intrafirm imports behave in the same way as US intrafirm imports. Why individual import transactions behave differently remains to be explained, which we attempt to do in the next subsection.

5.2 Determinants of Sourcing Modes at the Extensive and Intensive Margins

We now go beyond the binary choice between intrafirm and arms' length imports, or 'extensive margin' of intrafirm imports, and examine how firm-, product- and country-level characteristics affect the value of a transaction for a given sourcing mode ('intensive margin').

One particular issue we aim to shed light on is how can intrafirm trade be more likely in capital-rich countries (Prediction 3) when considering industry- or product-level shares but not at the firm-product-country level. Since intrafirm trade value shares can vary at both margins, it may well be that capital abundance has different effects on the extensive and intensive margin. More broadly, we hope to offer new insights to theory since it has remained quite silent on the intensive margin.

We proceed by estimating a two-stage Heckman model. The first-stage equation is based on Equation 6. To satisfy the exclusion restriction we add the firm multinational status in 1994 as

an additional regressor in the first stage.[25] We then run two separate second-stage regressions, one for intrafirm (log) import values and one for outsourcing (log) import values with IM3 being the inverse Mills ratio coming from the first stage. To save space, the results on key variables for all three estimations are reported in Table IX while controls are reported in Table X.

Columns 2 and 3 of Table IX provide the key results for the two intensive margins. k_c reveals a negative and significant coefficient at the outsourcing intensive margin, while the coefficient at the intrafirm intensive margin is not significant. Imports from capital-abundant countries are thus more likely to occur outside the firm but, in relative terms, average values of intrafirm transactions increase with capital abundance. Given the positive coefficient of k_c in Tables VII and VIII, we conclude that the intensive margin effect dominates.

How can we interpret this result? Existing theories offer little guidance on the *value* of intrafirm and outsourcing transactions. It is unlikely that it reflects different factor intensities in fixed and variable costs. The negative coefficient at the extensive margin would require lower capital-intensity in fixed costs under integration than under outsourcing, which seems rather implausible. We can however risk a conjecture that relates capital abundance to upstream market thickness. Relax the assumption of perfect transferability between the two parties, and suppose that independent suppliers must pay capital costs upon entry. Capital-rich countries are more likely to benefit from 'thick-market externalities' among independent suppliers, for example through the alleviation of ex-post hold-up problems, as in McLaren (2000), or search frictions, as in Grossman and Helpman (2005). Then outsourcing becomes relatively more profitable in capital abundant countries. Regrettably, we do not have data on the number of available suppliers to test this conjecture.

We also find that the coefficient of Q_c is positive at the extensive margin but negative at the intensive margin for both modes, with a greater magnitude for intrafirm imports. This echoes

[25] This information comes from the LIFI ('Liaisons Financières') database collected by the French Statistical Office (INSEE), which describes ownership ties between firms that have a legal entity in France. These data exhibit strong persistence of multinational status, which suggests the presence of substantial sunk costs of creating a foreign affiliate. For this reason we argue that, conditional on other firm variables, past multinational status conveys information on a firm's incentives to engage in intrafirm imports without *directly* affecting their value. The logic echoes analyses of the persistence of export status in Roberts and Tybout (1997) or Bernard and Jensen (2004). In our dataset the correlation between multinational status in 1994 and 1999 is 0.38. The correlation between between multinational status in 1994 and y_{ipc} is 0.25.

results on product-country intrafirm shares in Bernard et al. (2010) which we replicate in Table VIII. One plausible explanation is that judicial systems matter more for the fixed costs of integration while they matter more for the variable costs of outsourcing. Again, more theoretical research on this topic would certainly be desirable.

Finally the contractibility of the imported product μ_p has a negative effect on both the extensive and intensive margins of intrafirm trade, with a lower magnitude for outsourcing import values. This result is consistent with Bernard et al. (2010) and our replication of their results, although our contractibility measure is less disaggregated than theirs.

6 Conclusion

We conducted a detailed examination of firm-, country- and product-level determinants of intrafirm trade on a sample of 281,419 French import transactions in 1999.

We identified four key testable predictions from the recent property-rights theory of the multinational firm, due to Antràs (2003), Antràs and Helpman (2004), and Antràs and Helpman (2008). Our findings support three of these four predictions, thereby confirming prior industry- and product-level US evidence. Holding origin country and product attributes constant, we find that more productive, capital-, skill- and headquarter-intensive firms are more likely to engage in intrafirm imports. This supports directly the first two predictions. In addition, controlling for observed and unobserved firm heterogeneity, we find that intrafirm imports are *more* likely to originate from countries with good judicial institutions. The effect is strongest for highly productive firms. Again, this supports property-rights theory and in fact would be hard to make sense with transaction-cost theory. Overall, our results broadly support the property-rights approach to the multinational firm.

A second important message is that *industry*- and *product*-level studies can be misleading. On the one hand they hide strong within-sector heterogeneity in important covariates. On the other hand they hide the role of the intensive margins of import.

Most of the variance in capital-, skill-, and headquarter-intensity occurs within (even narrowly defined) industries. In addition, unlike individual characteristics, industry average characteristics

fail to explain the likelihood that an import transaction is intrafirm. Of course some heterogeneity may be due to random measurement error. In addition, since theories of the firm are non-exclusive and abstract, their relative importance may vary in firms of the same sector and empirical applications require some firm-specific tailoring (Gibbons, 2005). While these points are beyond dispute, they would imply that we should find stronger idiosyncrasies in firm-level analysis. Instead our findings reveal some strongly significant empirical regularities. We conclude that key determinants of intrafirm imports should be studied at the firm level.

Industry-level results may be also be misleading in that industry intrafirm shares vary at the intensive margin (transaction values) and the extensive margin (binary mode decisions). Since the theory only applies to the extensive margin, using these shares to test the theory can be problematic. For instance, firms are more likely to engage in intrafirm imports from *capital-scarce* countries, but industry (and product-country) intrafirm shares increase with capital abundance. The firm-level result contradicts Prediction 3 as well as consistent evidence on *industry- and product-level* US imports. However, it is very robust and holds even when controlling for observable and unobservable firm characteristics. Using a two-stage regression analysis, we find that capital abundance has a positive impact on the value of intrafirm transactions relative to outsourcing imports. Therefore the 'intensive margin' effect dominates in industry- and product-level regressions.

Interpreting this discrepancy is not straightforward. Existing theory does not offer predictions on the value of intrafirm relative to outsourcing transactions, and further theoretical research would definitely be desirable.[26] Obviously further empirical research replicating our analysis on other datasets would also be desirable. Nonetheless, the result confirms that industry- or product-level studies have the potential to be misleading.

Finally, we find some robust empirical evidence that complex goods and inputs are more likely to be produced within firm boundaries. This is consistent with the recent property-rights model by Carluccio and Fally (2009), where the desirability of transferring ownership to suppliers of complex products is limited by the latter's financial constraints. Our finding, however, is also

[26]We may however risk a conjecture. If independent suppliers cannot fully transfer the capital costs of entry to foreign investors, then capital-rich countries are more likely to benefit from 'thick-market externalities' among independent suppliers. These externalities may come from the alleviation of ex-post hold-up problems, as in McLaren (2000), or search frictions, as in Grossman and Helpman (2005). That way capital abundance could increase the relative profitability of outsourcing. Regrettably our data are not rich enough to test this conjecture.

consistent with a dissipation of intangible assets explanation. Complex inputs embody costly R&D efforts or the use of other intangible assets, which are likely to more effectively protected against imitation within firm boundaries. Further research on how to disentangle these competing explanations would be welcome.

A Data Appendix

A.1 The EIIG database

Intrafirm trade is defined in the EIIG database as trade with an affiliate controlled by a single French entity with at least fifty percent of its equity capital. The SESSI defines two types of trade with independent suppliers: 1) formal contractual relationships that refer to alliances, franchising, joint-ventures, and licensing agreements; 2) 'informal' relationships that involve less stringent contractual links. We consider both types of trade with independent suppliers as outsourcing. In the primary EIIG data 20,952 out of the 81,217 import flows (25.80%) are 'pure' intrafirm (in the sense that 100% of imports of product p from country c come from a foreign affiliate), 50,021 (61.59%) are 'pure' outsourcing,[27] and 10,244 (12.61%) are 'mixed transactions'. For a detailed description of the EIIG database see Guannel and Plateau (2003).

A.2 Firm Variables

A.2.1 Firm productivity

We estimate TFP as the residual (plus the constant) of a log-linearized three-factor Cobb-Douglas production function with labor, capital and material inputs. We use the value-added based Levinsohn and Petrin (2003) estimator (LP).[28]

We estimate TFP based on the unbalanced EAE panel of 28,587 firms over 3 years (1998 to 2000) for a total of 74,120 observations. Observations with negative or missing values of value added, production, capital stock, material inputs and wages are eliminated. Outliers, identified

[27] In particular 48,603 are pure informal third party imports, 1,093 are pure formal third party imports and 325 are mixed formal and informal third party imports.

[28] We have also experimented with the Olley and Pakes (1996) estimator (OP), obtaining qualitatively identical results. We prefer LP because the OP procedure obliges us to throw away quite a few firms, due to non-positive values of investments.

as observations falling outside the 1st and 99th percentile of the distributions of value added per worker and capital stock per worker, are also not considered. This leaves us with TFP information on 22,673 firms for the core year 1999. TFP estimation has been carried out separately for each of the NACE 3-digit industries in the manufacturing sector.

Labor is the full time equivalent average number of employees in a given year. Material inputs are calculated as input purchases minus inventory variation. Deflators for value added and material inputs are obtained from the national accounts system of the French Statistical Office (INSEE) at the NACE rev1 two digit level.

A.2.2 Firm level factor intensities

Our measure of capital intensity k_i is the log of the ratio between the capital stock and employment of firm i. $\eta_i^{hq} \in [0,1]$ is the ratio of value added over total sales of a firm i. We consider it as a proxy of the relative importance of the final production stage in the value added chain.[29] Finally η_i^{sk} is the log of the ratio between total wage expenses and employment of firm i. This variable is meant to capture the average skills of workers of firm i with the underlying hypothesis being that more skilled workers are paid higher salaries.

A.3 Imported Product Variables

A.3.1 Contractibility variables

Our contractibility measure is based on the same idea as Nunn (2007): inputs sold on an organized exchange or reference priced are likely to be less relationship-specific, and therefore that sales contracts of these inputs are less incomplete. We also use the Rauch (1999) product classification.[30]

However we apply the relationship-specificity index to imported products *directly*. In Section 2 we contended that a proper test of Antràs and Helpman (2008) would need to distinguish between

[29] In the model, under complete contracts and competitive factor markets η would simply be the cost share of services provided in the North. Under incomplete contracts the link between factor intensity and cost shares is less evident, so that this variable should be considered as a proxy.

[30] In particular we use his 'Liberal' classification. Results are virtually unchanged if we use the 'Conservative' classification.

contractibility of the inputs provided by the foreign supplier and those provided by the final producer. A second advantage of having product-level measures is that a final producer typically imports several products, with potentially different organizational decisions.

Our approach contrasts with Nunn (2007) and Nunn and Trefler (2008) who compute a weighted average of that index *by final industry*, using input-output matrix coefficients as weights. In their approach an emphasis on institutional comparative advantage makes it logical to measure how much *exporting* industries rely on complex inputs. Our approach focuses on organizational decisions by *importers*, so that a measure at the imported product level is more appropriate.

Denoting by $R_j^{neither}$ a dummy variable that takes value 1 if the HS6 product j is neither sold on an organized exchange nor reference priced, and by $\theta_{p,j}$ the share of the HS6 product j in the French imports of CPA96 4digit product p in 1999 we have:

$$\mu_p = 1 - (\sum_j \theta_{p,j} R_j^{neither})$$

The basic data needed to construct contractibility measures comes from Rauch (1999) and are organized on the basis of the SITC rev2 4 digit (975 products for which information is available). Our import data are at the CPA96 4digit classification (490 products). However, the Rauch classification covers almost exclusively manufacturing and agricultural goods. Restricting ourselves to such goods leaves us with 259 CPA96 4digit products. To aggregate the Rauch data at the imported goods level, we proceed in two steps. First we establish a correspondence between HS6 and SITC rev2 4 digit and a correspondence between HS6 and CPA96 4digit.[31] Then we use import trade data in 1999 for France at the HS6 level (provided by EUROSTAT) as weights to aggregate the original SITC rev2 4 digit information to the CPA96 4digit. Summary statistics on μ_p are provided in Table III.

A.3.2 Other imported product variables

Capital k_p and skill intensity h_p of the imported product p are constructed using French technology. We introduce these variables because in Antràs (2003) factor intensities of the imported product

[31] Correspondence tables have been obtained using RAMON data available from EUROSTAT at the website: http://ec.europa.eu/eurostat/ramon/relations/index.cfm?TargetUrl=LST_REL

play a key role. In the absence of cross-country product-level data on technology these variables should be seen as reasonable proxies.

To build k_p and h_p, we start by using a correspondence table between the industry classification NACE rev1 4digit (available in our EAE firm dataset) and the product classification CPA96 4digit. We then compute the average capital intensity (log of capital/labor ratio) and skill intensity (log of total wage expenses/number of full time equivalent workers) of French firms associated to a given CPA96 4digit product.

A.4 Final Product Variables

Contractibility of a final good f is measured in the same way as that of an imported product. Defining $R_j^{neither}$ as dummy variable that takes value 1 if the PRODCOM2002 8 digit product j is neither sold on an organized exchange nor reference priced, and by $\theta_{f,j}$ the share of the PRODCOM2002 8 digit product j in the French production of CPA96 4digit product f in 1999 we have:

$$\mu_f = 1 - (\sum_j \theta_{f,j} R_j^{neither})$$

Table III displays summary statistics on the final product contractibility measure. Two things are worth noting. First, looking at transaction patterns, the correlation between μ_p and μ_f is positive (0.28) and significant. This means that firm producing final complex goods import complex inputs. Second, μ_f is highly correlated with the Nunn (2007) measure of complexity in the whole production process. Comparing them across the 29 ISIC rev2 3 digit sectors (the only classification for which data are comparable) the correlation is 0.78.

A.5 Origin Country Variables

Among origin country c determinants, k_c and h_c stand (respectively) for the capital and skill abundance of country c. They are respectively measured by the log of the capital/labor and human capital/labor ratios provided by Hall and Jones (1999). Q_c is a measure of the quality of institutions based on the "Rule of Law" index from Kaufmann, Kraay, and Mastruzzi (2003).

This is a weighted average of a number of variables that measure individuals' perceptions of the effectiveness and predictability of the judiciary and the enforcement of contracts in each country between 1997 and 1998.

Among country-specific control variables, Tax_c is the top corporate tax rate prevailing in a given country in 1999 taken from the World Tax Database (University of Michigan). $Fin-Dev_c$ is a proxy for the degree of development of financial markets and is measured by the ratio of private credit to GDP, which we borrow from Beck (2002). $OECD_c$ is a dummy indicating membership to the OECD in 1999. $Same-leg-orig_c$ is a dummy indicating whether country c has a French civil law system, where the data are borrowed from Djankov et al. (2003). $Distw_c$ is the log of distance of country c to France. $Colony_c$ is dummy indicating whether country c is a former French colony and $Language_c$ is a dummy indicating whether French is spoken in country c. Data on $Distw_c$, $Colony_c$, and $Language_c$) come from CEPII (Centre d'Etude Prospectives et d'Informations Internationales). $Distw_c$ is the log of distance of country c to France. Distance is calculated by aggregating regional distances at the country level, using regional populations as weights. Further details can be found in Head and Mayer (2002).

References

[1] Acemoglu, Daron, Philippe Aghion, Rachel Griffith, Fabrizio Zilibotti, "Vertical Integration and Technology: Theory and Evidence ", forthcoming, *Journal of European Economic Association*

[2] Anderson, James E. and Douglas Marcouiller, "Trade, Insecurity, and Home Bias: An Empirical Investigation," *The Review of Economics and Statistics 84:2* (2002), 342-352

[3] Antràs, Pol, "Firms, Contracts and Trade Structure," *Quarterly Journal of Economics*, 118 (2003), 1375-1418.

[4] Antràs, Pol, and Elhanan Helpman, "Global Sourcing," *Journal of Political Economy*, 112 (2004), 552-580.

[5] Antràs, Pol, and Elhanan Helpman, "Contractual Frictions and Global Sourcing," forthcoming in Helpman, E., D. Marin, and T. Verdier, *The Organization of Firms in a Global Economy*, Harvard University Press, 2008.

[6] Antràs, Pol, and Esteban Rossi-Hansberg, "Organizations and Trade," *NBER Working Paper* 14262, 2008

[7] Barba Navaretti, Giorgio, and Anthony J. Venables, *Multinational Firms in the World Economy* (Princeton: Princeton University Press, 2004).

[8] Beck, Thorsten "Financial Development and International Trade. Is There a Link?" *Journal of International Economics*, 57 (2002), p.107-131.

[9] Bernard, Andrew B. and J. Bradford Jensen, "Why Some Firms Export," *The Review of Economics and Statistics*, 86(2) (2004), 447-464.

[10] Bernard, A., Eaton, J., Jensen, J. and Kortum, S. (2003). 'Plants and Productivity in International Trade', *American Economic Review* Vol. 93, 1268-1290.

[11] Bernard, Andrew B., J. Bradford Jensen, Stephen Redding and Peter K. Schott, "intrafirm Trade and Product Contractibility,"NBER working paper No 15881, 2010.

[12] Carluccio, Juan F. and Thibault Fally, "Global Sourcing Under Imperfect Capital Markets, "mimeo Paris School of Economics, 2009.

[13] Costinot, Arnaud, LIndsay Oldenski and James E. Rauch, "Adaptation and the Boundaries of Multinational Firms ", forthcoming, *the Review of Economics and Statistics*

[14] Defever, Fabrice, and Farid Toubal, "Productivity and the Sourcing Modes of International Firms: Evidence from French Firm-Level Data,"mimeo, 2009. A previous substantially different version circulated as a CEP Discussion Paper No 842 (2007).

[15] Djankov, Simeon, Rafael La Porta, Florencio López-de-Silanes, and Andrei Shleifer, "Courts", *Quarterly Journal of Economics*, 118 (2003), 453-517.

[16] Eaton, Jonathan, Samuel Kortum, and Francis Kramarz "Dissecting Trade: Firms, Industries, and Export Destinations, " *AEA Papers and Proceedings*, 94 (2004), 150-154.

[17] Feinberg, Susan and Michael Keane, "Accounting for the Growth of MNC-based Trade using a Structural Model of U.S. MNCs," *American Economic Review*, 96(5) (2006), 1515-1558

[18] Gibbons, Robert, "Four Formal(izable) Theories of the Firm, " *Journal of Economic Behavior and Organization* 58 (2005): 202-47.

[19] Grossman, Gene M. and Elhanan Helpman, "Integration versus outsourcing in industry equilibrium," *Quarterly Journal of Economics*, 117 (2002): 85-120.

[20] Grossman, Gene M. and Elhanan Helpman, "Outsourcing versus FDI in industry equilibrium," *Journal of the European Economic Association* 1 (2003), 317-327.

[21] Grossman, Gene M. and Elhanan Helpman, "Managerial incentives and the international organization of production," *Journal of International Economics*, 63 (2004): 237-262.

[22] Grossman, Gene M. and Elhanan Helpman, "Outsourcing in a global economy," *Review of Economic Studies*, 72 (2005): 135- 159.

[23] Grossman, Sanford J., and Oliver D. Hart, "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, 94(4) (1986), 691-719.

[24] Guannel, Boris, and Claire Plateau, "Les échanges internationaux intragroupe dans la mondialisation industrielle en 1999," SESSI (2003).

[25] Hall, Robert E., and Charles I. Jones, "Why do Some Countries Produce So Much More Output per Worker than Others? " *Quarterly Journal of Economics*, 114 (1999), 83-116.

[26] Hart, Oliver, and John Moore, "Property Rights and the Nature of the Firm," *Journal of Political Economy*, 98(6) (1990), 1119-58.

[27] Head Keith and Thierry Mayer, "Illusory Border Effects: Distance Mismeasurement Inflates Estimates of Home Bias in Trade,"(2002), *CEPII Working Paper* 2002-01.

[28] Helpman, Elhanan, Dalia Marin, and Thierry Verdier, *The Organization of Firms in a Global Economy* (Cambridge, MA: Harvard University Press, 2008).

[29] Helpman, Elhanan, Marc Melitz and Yona Rubinstein, " Estimating Trade Flows: Trading Partners and Trading Volumes," *Quarterly Journal of Economics*, 123(2) (2008), 441-487.

[30] Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi, "Governance Matters III: Governance Indicators for 1996–2002," *World Bank Working Paper* No. 3106, 2003.

[31] Kohler, Wilhelm and Marcel Smolka, "Global Sourcing Decisions and Firm Productivity: Evidence from Spain", CESifo Working Paper No. 2903 (2009)

[32] Lafontaine, Francine and Margaret Slade "Vertical Integration and Firm Boundaries: The Evidence", *Journal of Economic Literature*, 45(3) (2007), 631-687.

[33] Levinsohn James, and Amil Petrin "Estimating Production Functions Using Inputs to Control for Unobservables," *Review of Economic Studies*, 70 (2003), 317-342.

[34] Markusen, James, "The Boundaries of Multinational Enterprises and the Theory of International Trade," *Journal of Economic Perspectives*, 9(2) (1995):169-189.

[35] McLaren John, "Globalization and Vertical Structure, " *American Economic Review* 90:5 (2000): 1239-1254.

[36] Marin, Dalia and Thierry Verdier, "Globalization and the New Enterprise," *Journal of the European Economic Association*, 1(2-3) (2003): 337-344.

[37] Marin, Dalia and Thierry Verdier, "Power Inside The Firm and The Market: A General Equilibrium Approach," *Journal of the European Economic Association*, 6(4) (2008), 752-788.

[38] Melitz, M.J., "The impact of trade on intra-industry reallocations and aggregate industry productivity," *Econometrica* 71 (2003), 1695-1725.

[39] Nunn, Nathan, "Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade," *Quarterly Journal of Economics*, 122 (2007), 569-600.

[40] Nunn, Nathan, and Daniel Trefler, "The Boundaries of the Multinational Firm: An Empirical Analysis," in Helpman, E., D. Marin, and T. Verdier, *The Organization of Firms in a Global Economy* (Cambridge, MA: Harvard University Press, 2008).

[41] Olley, Steven and Ariel Pakes, "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica*, 64 (1996), 1263-1297.

[42] Ranjan, Priya and Justin Tobias, "Bayesian Inference for the Gravity Model," *Journal of Applied Econometrics*, 22(4) (2007), 817-838.

[43] Rauch, James E., "Networks versus Markets in International Trade, " *Journal of International Economics*, 48 (1999): 7-35.

[44] Roberts, Mark and James Tybout, "The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs," *American Economic Review*, 87(4) (1997), 545-563.

[45] Spencer, Barbara, "International outsourcing and incomplete contracts," *Canadian Journal of Economics*, 38(4) (2005), 1107-1135.

[46] Tomiura, Eiichi, "Foreign Outsourcing, Exporting, and FDI: A Productivity Comparison at the Firm Level, " *Journal of International Economics*, 72 (2007), 113-127.

[47] Yeaple, Stephen, "Offshoring, Foreign Direct Investment and the Structure of U.S. Trade," *Journal of the European Economic Association*, 4(2-3) (2006): 602-611.

[48] Zeile, William J., "Trade in Goods Within Multinational Companies: Survey-Based Data and Findings for the United States of America", Working Paper prepared for the OECD Committee on Industry and Business Environment (2003)

Table I: List of variables used in estimations

Symbol	Variable name	Description	Source
Firm-level variables			
TFP_i	Total Factor Productivity	estimated using the Levinsohn and Petrin (2003) technique	EAE
k_i	capital Intensity	log of capital stock per fulltime equivalent worker	EAE
η_i^{hq}	'headquarter Intensity'	ratio of value added over total sales	EAE
η_i^{sk}	skill Intensity	log of total wage bill per fulltime equivalent worker	EAE
Imported product-level variables			
μ_p	'input contractibility'	relationship-specificity index of input p	Rauch (1999)
k_p	embodied capital intensity	final product-level capital intensity in France	EAE
h_p	embodied skill intensity	final product-level skill intensity in France	EAE
Sector-level variables			
μ_f	'final product contractibility'	relationship-specificity index of primary final good of sector f.	Rauch (1999)
Country-level variables			
k_c	capital abundance	log of capital/labor ratio	Hall and Jones (1999)
h_c	human capital abundance	log of human capital/labor ratio	Hall and Jones (1999)
Q_c	contract enforcement	Rule of Law index	Kaufman et al. (2003)
Tax_c	corporate tax rate	corporate tax rate in 1999	University of Michigan World Tax Database
$Fin - Dev_c$	financial development	ratio of private credit to GDP	Beck (2002)
$OECD_c$	OECD dummy	takes one if OECD membership in 1999	OECD
$Colony_c$	colonial past dummy	takes one if former French colony	CEPII
$Language_c$	language dummy	takes one if common language	CEPII
$LegOrig_c$	legal origin dummy	takes one if French legal origin	CEPII

Further details on data sources and construction of variables are relegated to Appendix A.

Table II: Correlations of $y_{i,p,c}$ with key variables used in estimations

Firm variables			
TFP_i	k_i	η_i^{hq}	η_i^{sk}
0.1230	0.1070	0.0917	0.1680
Country variables			
k_c	h_c	Q_c	
-0.0094	0.0525	0.0389	
Product variables			
μ_p	μ_f	k_p	h_p
-0.0548	-0.0763	0.0068	0.0793

Correlations with firm variables refer to the small sample while in all other cases but μ_f correlations are computed in the large sample. In the case of μ_f, correlation is computed on the subset of the large sample referring to firms with main activity in (essentially) manufacturing.

Table III: Summary statistics on our measure of imported products (μ_p) and final products (μ_f) contractibility.

Variable	Observ.	Mean	St. Dev	Min	Max
μ_p	259	0.415	0.448	0	1
μ_f	218	0.373	0.440	0	1

See Appendix A for further details.

Table IV: Summary statistics on firm-level variables

				% Intra-NACE3			Correlation with			
Variable	Obs	Mean	Std. Dev.	Std. Dev.	Min	Max	TFP_i	k_i	η_i^{hq}	η_i^{sk}
Full EAE firm data										
TFP_i	22,673	3.8076	1.4065	0.3116	-79.0078	11.7314	1.0000			
k_i	22,673	3.3040	1.0257	0.8261	-8.2213	8.3878	0.0452	1.0000		
η_i^{hq}	22,673	0.6684	0.1939	0.8371	0.0000	1.0000	-0.0310	-0.2339	1.0000	
η_i^{sk}	22,673	3.0357	0.3093	0.8804	-6.6951	6.2796	0.1808	0.2114	0.0588	1.0000
EAE firm sample used in estimations										
TFP_i	5,134	3.9955	1.9309	0.2363	-55.8379	11.1462	1.0000			
k_i	5,134	3.7547	0.9764	0.8051	-6.7092	7.4743	0.0357	1.0000		
η_i^{hq}	5,134	0.6109	0.1897	0.8800	0.0000	1.0000	0.0282	-0.0696	1.0000	
η_i^{sk}	5,134	3.1075	0.3484	0.8858	-6.6951	5.3584	0.1474	0.1751	0.1459	1.0000

Summary statistics on firm productivity TFP_i, capital intensity k_i, headquarter intensity η_i^{hq}, and skill intensity η_i^{sk} refer to either the full EAE firm data (top panel) or to the sub-sample of EAE firms used in estimations (bottom panel). % Intra-NACE3 Std. Ded. refers, for each variable considered, to the ratio between standard deviation within NACE 3-digit industries and overall standard deviation.

Table V: Firm i-specific determinants of intra-firm trade.

Dependent variable: $y_{i,p,c}$	(1)	(2)	(3)	(4)	(5)	(6)
Key Variables						
	Firm-level					Industry-level
TFP_i	0.0599^a				0.0391^a	-0.0002
	(0.0109)				(0.0106)	(0.0003)
k_i		0.0235^a			0.0159^a	0.0001
		(0.0068)			(0.0059)	(0.0001)
η_i^{hq}			0.0768^b		0.0337	0.0067
			(0.0302)		(0.0286)	(0.0730)
η_i^{sk}				0.1030^a	0.0682^b	0.0045^a
				(0.0324)	(0.0285)	(0.0016)
Controls						
IM1	0.1693^a	0.1665^a	0.1711^a	0.1675^a	0.1573^a	0.1723^a
	(0.0118)	(0.0122)	(0.0119)	(0.0125)	(0.0120)	(0.0122)
Country and product dummies	yes	yes	yes	yes	yes	yes
Number of observations	95,493	95,493	95,493	95,493	95,493	95,493
Pseudo R^2	0.1467	0.1405	0.1380	0.1502	0.1570	0.1416
Log Likelihood	-32,767	-33,005	-33,102	-32,634	-32,372	-32,965

The dependent variable $y_{i,p,c}$ equals 1 if imports by firm i of product p from country c are intra-firm and zero otherwise. Productivity TFP_i, capital intensity k_i, headquarter intensity η_i^{hq}, and skill intensity η_i^{sk} are evaluated at the firm-level in columns (1) till (5) while, in column (6), they instead refer to the NACE 3 digit industry to which the firm belongs. IM1 is the inverse Mills ratio, coming from the estimation of selection into response to the EIIG survey, which is set to zero for firms outside the EIIG target population. A Probit model is estimated for all specifications. Marginal effects are presented. Firm-clustered standard errors in brackets. ^{a}, ^{b}, ^{c} denote significantly different from 0 at 1%, 5% and 10% level, respectively.

Table VI: Product p and Country c-specific determinants of intra-firm trade.

Dependent variable: $y_{i,p,c}$	(1)	(2)	(3)	(4)
		Key Covariates		
k_c	-0.0083^a	-0.1575^a	-0.0227^a	-0.0188^a
	(0.0024)	(0.0290)	(0.0080)	(0.0055)
h_c	0.0317^a	0.0665	-0.0104	0.0598^a
	(0.0080)	(0.0932)	(0.0190)	(0.0190)
μ_p	-0.0379^a	-0.2290^a	-0.0369^b	-0.0445^a
	(0.0040)	(0.0284)	(0.0178)	(0.0068)
μ_f	–	-0.2730^a	–	-0.0765^a
	–	(0.0907)	–	(0.0145)
Q_c	0.1020^a	0.6891^a	0.1611^c	0.1487^a
	(0.0165)	(0.1661)	(0.0849)	(0.0382)
k_p	0.0085^a	-0.0600^a	-0.0183^b	0.0028
	(0.0024)	(0.0186)	(0.0088)	(0.0051)
h_p	0.0750^a	0.1061^c	0.0231	0.0597^a
	(0.0067)	(0.0555)	(0.0171)	(0.0176)
		Controls		
	IM1 and Country controls	IM1 and Country controls	Country controls and firm FE	IM1, Country controls and Firm controls
		Estimation method		
	Probit	Random effects Probit	Conditional firm fixed effects Logit	Probit
Number of observations	234,786	101,771	35,802	82,923
Pseudo R^2	0.2002	–	–	0.1110
Log Likelihood	-58,470	-18,749	-13,948	-30,549

The dependent variable $y_{i,p,c}$ equals 1 if imports by firm i of product p from country c are intra-firm and zero otherwise. Covariates are country c capital intensity k_c, skill intensity h_c, and quality of judicial institutions Q_c, as well as imported product p contractibility μ_p, capital intensity k_p, and skill intensity h_p. In some specifications, the contractibility of the importing firm main final product μ_f is also considered. As our measures of contractibility are available only for merchandized goods, estimating μ_f requires us to focus on firm with primary activity in (essentially) manufacturing reducing, as can be seen by comparing columns (1) and (2), considerably the number of observations. With the conditional firms fixed effects Logit – column (3) – the identifying variation is provided by those observations (35,802) referring to firms doing, depending on the country and/or product, both intra-firm and outsourcing. In this case μ_f, which is firm-specific, cannot be estimated. Finally, column (4) corresponds to observations for which firm-level controls are available from the EAE database. Marginal effects are presented in all cases. In the fixed effects logit case, marginal effects are obtained by setting fixed effects to zero. Firm-clustered standard errors (except for the random effects probit and fixed effects logit) in brackets. ^{a}, ^{b}, ^{c} denote significantly different from 0 at 1%, 5% and 10% level, respectively.

Table VII: Reproducing previous aggregate findings: share of intra-firm trade at the *industry-country* level.

Dependent variable: $Share_{cs}$	(1)	(2)
k_s	0.0002^a	
	(0.0001)	
η_s^{hq}	-0.0186	
	(0.0437)	
η_s^{sk}	0.0070^a	
	(0.0009)	
μ_f	-0.0963^a	
	(0.0099)	
k_c		0.0136^a
		(0.0033)
h_c		0.0373^a
		(0.0138)
$Distw_c$		-0.0256^a
		(0.0027)
$Colony_c$		0.0167^c
		(0.0086)
$Language_c$		-0.0365^a
		(0.0079)
$Population_c$		0.0063^a
		(0.0017)
Country dummies	yes	no
Industry dummies	no	yes
Number of observations	7,108	10,414
R^2	0.1067	0.3268

The dependent variable $Share_{cs}$ is the share of intra-firm trade in industry (NACE rev1 3-digit) s with country c. Estimation is carried via OLS. Robust standard errors in brackets. ^{a}, ^{b}, ^{c} denote significantly different from 0 at 1%, 5% and 10% level, respectively.

Table VIII: Reproducing previous aggregate findings: share of intra-firm trade at the *product-country* level with Heckman selection model.

	First Stage	Second Stage
	(1)	(2)
Dependent variable:	$\widetilde{Share}_{pc}$	$Share_{pc}$
k_p	-0.0166	0.0580^a
	(0.0290)	(0.0106)
h_p	0.4246^a	0.2705^a
	(0.0861)	(0.0304)
μ_p	-0.2231^a	-0.1524^a
	(0.0458)	(0.0165)
k_c	0.1359^a	0.0633^a
	(0.0332)	(0.0129)
h_c	0.3758^a	0.0059
	(0.1175)	(0.0402)
Q_c	1.9991^a	-0.1060
	(0.1705)	(0.0674)
$Distw_c$	-0.3364^a	-0.0288^a
	(0.0190)	(0.0080)
$Language_c$	-0.1846^a	-0.0519^a
	(0.0571)	(0.0181)
$Colony_c$	-0.0637	–
	(0.0632)	–
$Same-leg-orig_c$	0.3321^a	–
	(0.0447)	–
$Population_c$	0.2935^a	–
	(0.0137)	–
IM2	–	0.2687^a
	–	(0.0253)
Number of observations	7,500	3,202
R^2	0.2135	0.0944
Log Likelihood	-4,026	–

The dependent variable $\widetilde{Share}_{pc}$ in the first stage of the Heckman procedure - column (1) - equals 1 if the share of intra-firm trade of product p with country c is positive and zero otherwise. The excluded variables in the second stage are ex French colony, same (French) legal origin, and population. The dependent variable $Share_{pc}$ in the second stage of the Heckman procedure - column (2) - corresponds to the positive values of the share of intra-firm trade of product p with country c with covariates including the inverse Mills ratio coming from the first stage (IM2). Robust standard errors in brackets. ^{a}, ^{b}, ^{c} denote significantly different from 0 at 1%, 5% and 10% level, respectively. Marginal effects and pseudo R^2 are reported for the first stage.

Table IX: The Extensive and Intensive margin of *firms*' international sourcing: Heckman selection model

	First Stage	Second Stage	
	(1)	(2)	(3)
Dependent variable:	y_{ipc}	Intra-firm import value	Outsourcing import value
	Key Covariates		
TFP_i	0.0318^b	0.1590^c	0.5881^a
	(0.0126)	(0.0926)	(0.0760)
k_i	0.0148^b	0.0987^b	0.3663^a
	(0.0065)	(0.0436)	(0.0307)
η_i^{hq}	0.0249	-0.1308	-1.1738^a
	(0.0313)	(0.2001)	(0.1749)
η_i^{sk}	0.0799^b	-0.1756	0.0915
	(0.0320)	(0.1393)	(0.1094)
k_c	-0.0191^a	-0.1131	-0.1670^a
	(0.0053)	(0.0843)	(0.0385)
h_c	0.0549^a	-0.0972	-0.3699^a
	(0.0186)	(0.2482)	(0.1270)
μ_p	-0.0404^a	-0.1063	0.7338^a
	(0.0067)	(0.0941)	(0.0493)
μ_f	-0.0639^a	0.0530	0.0131
	(0.0137)	(0.1075)	(0.0799)
Q_c	0.1282^a	-1.8375^a	-1.1889^a
	(0.0390)	(0.4028)	(0.2377)
k_p	0.0031	0.2693^a	0.1910^a
	(0.0050)	(0.0615)	(0.0296)
h_p	0.0572^a	0.7245^a	-0.0971
	(0.0170)	(0.1684)	(0.0972)
	Controls		
	IM1, Past MNE status, Country and Firm controls	IM1, IM3, Country and Firm controls	IM1, IM3, Country and Firm controls
Number of observations	82,923	11,973	70,739
R^2	0.1340	0.1151	0.1656
Log Likelihood	-29,757	–	–

The first stage of the Heckman procedure - column (1) - is a probit on the variable y_{ipc} who equals 1 if imports by firm i of product p from country c are intra-firm and zero otherwise. Estimations are carried out on the small sample for which firm-level data are available from the EAE. The excluded variable in the second stage is firm Multinational status in 1994. The second stage of the Heckman procedure - columns (2) and (3) - is an OLS regression on the values of (log) imports for a given mode (either intra-firm or outsourcing) and contains the inverse Mills ratio coming from the first stage (IM3) as well as the inverse Mills ratio coming from the selection into response for EIIG firms (IM1). The latter is set to zero for firms outside the EIIG target population. Firm-clustered standard errors in brackets. ^{a}, ^{b}, ^{c} denote significantly different from 0 at 1%, 5% and 10% level, respectively. Marginal effects and pseudo R^2 are reported for the first stage.

Table X: Estimations for control variables in Tables VI and IX.

	Controls of Table VI			
	(1)	(2)	(3)	(4)
Dependent variable:	$y_{i,p,c}$	$y_{i,p,c}$	$y_{i,p,c}$	$y_{i,p,c}$
Tax_c	-0.0319	-1.0351^a	-0.1613^c	-0.1364^b
	(0.0252)	(0.3297)	(0.0840)	(0.0593)
$Fin-Dev_c$	-0.0154^a	-0.2370^a	-0.0471^b	-0.0237^b
	(0.0042)	(0.0364)	(0.0238)	(0.0093)
$OECD_c$	0.0149^a	0.1734^a	0.0214^c	0.0167^c
	(0.0036)	(0.0444)	(0.0111)	(0.0093)
$Distw_c$	0.0129^a	0.0465^a	-0.0015	0.0228^a
	(0.0022)	(0.0179)	(0.0030)	(0.0050)
$Colony_c$	-0.0076	0.5912^a	0.1944^a	0.0075
	(0.0054)	(0.0474)	(0.0642)	(0.0140)
$Language_c$	0.0040	0.1016^b	0.0133	0.0091
	(0.0041)	(0.0437)	(0.0105)	(0.0100)
$Same-leg-orig_c$	0.0073^a	0.1220^a	0.0190^c	0.0236^a
	(0.0024)	(0.0332)	(0.0099)	(0.0055)
IM1	0.1901^a	3.7431^a	–	0.1709^a
	(0.0087)	(0.1245)	–	(0.0140)

	Controls of Table IX		
	(1)	(2)	(3)
Dependent variable:	y_{ipc}	Intra-firm import value	Outsourcing import value
Tax_c	-0.1250^b	-2.7847^a	-1.9385^a
	(0.0595)	(1.0013)	(0.3972)
$Fin-Dev_c$	-0.0190^b	0.6313^a	-0.0067
	(0.0094)	(0.1238)	(0.0518)
$OECD_c$	0.0148	0.1111	0.5100^a
	(0.0096)	(0.1362)	(0.0562)
$Distw_c$	0.0211^a	-0.2268^a	0.1697^a
	(0.0050)	(0.0616)	(0.0303)
$Colony_c$	0.0094	0.5682^a	0.3020^a
	(0.0141)	(0.1665)	(0.0679)
$Language_c$	0.0087	-0.0543	0.4448^a
	(0.0101)	(0.1623)	(0.0548)
$Same-leg-orig_c$	0.0219^a	0.0558	0.0526
	(0.0056)	(0.0859)	(0.0419)
MNE_1994	0.1147^a	–	–
	(0.0165)	–	–
IM1	0.1485^a	-2.3796^a	1.6918^a
	(0.0145)	(0.2118)	(0.1092)
IM3	–	0.1321	0.4951^c
	–	(0.1889)	(0.2937)

Firm-clustered standard errors in brackets. ^{a}, ^{b}, ^{c} denote significantly different from 0 at 1%, 5% and 10% level, respectively. Marginal effects are reported.

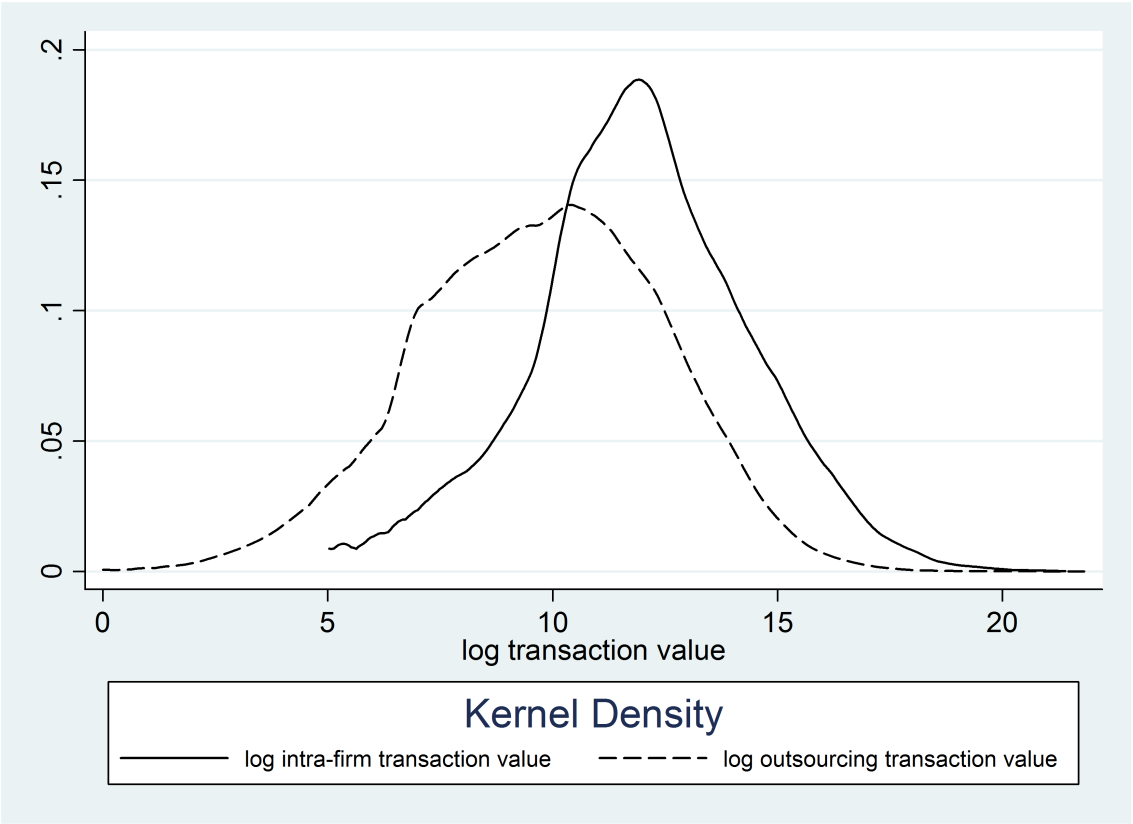

Figure I: Kernel smoothed distribution of log transactions' value