The University of Nottingham

research paper series

Globalisation, Productivity and Technology

Research Paper 2010/22

Input Characteristics and the Mode of Offshoring: Evidence for French Firms

By

Liza Jabbour and Richard Kneller

The Centre acknowledges financial support from The Leverhulme Trust under Programme Grant F/00 114/AM

GEP

Leverhulme Centre

for Research on Globalisation and Economic Policy

The Authors
Liza Jabbour is a lecturer at the University of Birmingham and an internal fellow of GEP

Richard Kneller is an Associate Professor and Reader in Economics at the University of Nottingham and an Internal Fellow in GEP.

Acknowledgements
We acknowledge financial support from The Leverhulme Trust under grant F114/BF.

Input Characteristics and the Mode of Offshoring: Evidence for French Firms

by

Liza Jabbour and Richard Kneller

Abstract

Using rich data on the international transactions of intermediate inputs by French firms we investigate the determinants of the choice between vertical integration and outsourcing at the international level. Our results show that the probability of vertical integration is reduced by the extent of asset specificity of imported inputs and enhanced by the significance of the inputs in the cost share of the firm. Our findings provide support for the property right models of offshoring and also for the knowledge capital model.

JEL classification: D23, F14, L22, L23, L60

Keywords: Offshoring, Transaction Costs, Property Rights Theory, Knowledge-Capital

Outline

Non-Technical Summary

Rapid improvements in information and communication technologies over the last few decades, combined with the liberalisation of trade and investment policy of countries, has fostered the international fragmentation of the production process. Firms increasingly source the intermediate inputs and service tasks they require from abroad, they offshore, to take advantage of lower production costs, such as lower wages. In some cases the production of these intermediate inputs occurs through the use of vertically integrated affiliates and in others by outsourcing production to independent contractors. An interesting question is why these different procurement strategies are chosen.

In this paper we focus on the empirical relationship between the characteristics of the input and the probability that offshored procurement takes place using an independent supplier versus an integrated affiliate. This is motivated by an apparent contradiction in the existing evidence for measures of supplier relationship specificity when using international trade data on offshoring (FDI versus offshore-outsourcing), compared to those found for the method of procurement solely in the domestic economy (domestic vertical integration and outsourcing).

We re-examine this question using data where we observe for each imported input, the mode of offshoring (outsourcing and vertical integration) chosen by the firm. This data has the advantage that it brings the empirical model of offshoring closer to the firm level decision emphasised within the theory. We find from this analysis evidence that is consistent with the property rights models of offshoring; the probability of procurement through FDI relative to offshore-outsourcing is strongly negatively correlated with the investment and human capital intensity of the input, even when controlling for the characteristics of the firm or the country from which the input is being imported. However, we also find some support for other possible explanations for the type of offshoring: firms are more likely to use FDI when they fear the possible leakage of knowledge.

1. Introduction

Rapid improvements in information and communication technologies over the last few decades, combined with the liberalisation of trade and investment policy of countries, has fostered the international fragmentation of the production process. Firms increasingly source the intermediate inputs and service tasks they require from abroad, they offshore, to take advantage of lower production costs, such as lower wages. In some cases the production of these intermediate inputs occurs through the use of vertically integrated affiliates and in others by outsourcing production to independent contractors.

To understand the complex patterns in the international trade of intermediate inputs that result from these different offshoring strategies has required the development of new theories of international trade. The basis for many of these models of offshoring, including those by Antras (2003), Antras and Helpman (2004), has been the property rights models of firm boundaries outlined in Grossman and Hart (1986) and Hart and Moore (1990). Important within this approach are the concepts of incomplete contracts and the idea that some investments are highly specific to the production of a particular input (Helpman, 2006). Those parties with a weak outside option, and therefore weak bargaining power in the ex-post renegotiation to set prices and bargain over rents that occurs, fear being 'held-up' and not receiving the full marginal return on their investment. For inputs where these investments are a feature, the optimal integration strategy depends on the party realising the specific investment, where that party should control ownership rights. The more important is the relationship specific investment made by the purchaser of the input, the more likely it is that the optimal allocation of property rights will point to supply through a vertically integrated affiliate.[1] In contrast, when the relationship specific investment made by the supplier is the relatively more important, the more likely it is that the firm will outsource production of the input.

In this paper we focus on the empirical relationship between supplier relationship specific investments and the probability that offshored procurement takes place using an independent supplier versus an integrated affiliate. This is motivated by an apparent contradiction in the existing evidence for measures of supplier relationship specificity when using international

[1] In many of these models these relative investments are described as headquarter versus component intensity of the intermediate input.

trade data on the type of offshoring (FDI versus offshore-outsourcing), compared to those found for similar input measures and the fragmentation of input production that occurs solely in the domestic economy (domestic vertical integration and onshore-outsourcing).

Tests of the property rights model of firm boundaries as applied to offshoring have typically been conducted using the share of trade between affiliates in total imports as the dependent variable (see for example Antras, 2003; Yeaple, 2006; Marin, 2006; Bernard et al., 2010 and Costinot et al., 2009). This share of trade between affiliates, the extent of vertical integration, has been found to be positively correlated with variables believed to capture the relationship specific investments made by the supplier. The measures of supplier relationship specific investments used in these models include the capital intensity of the export industry (Antras, 2003; Yeaple, 2006; Marin, 2006; Bernard et al., 2010 and Costinot et al., 2009) human capital (Antras, 2003; Yeaple, 2006; Nunn and Trefler, 2008 and Bernard et al., 2010), R&D (Yeaple, 2006; Costinot et al., 2009), and product contractibility of the input, measured by the level of intermediation (Bernard et al., 2010).

This positive relationship between relationship specificity and the share of intra-firm trade in total imports found in many of the above studies, contrasts with evidence for domestic outsourcing versus domestic vertical integration reported by Acemoglu et al. (2010).[2] Using a combination of information on the industry of UK firms, the industry of their UK plants and input output tables, Acemoglu et al. (2010) generate a measure of the mode of supply according to whether a firm owns a domestic plant producing an input used in the production of a given product. Their results show that the probability of vertical integration in the domestic economy is negatively correlated with both the R&D and capital intensity of the input supplier.

An open empirical question is whether these differences in the evidence between studies reflect differences in the determinants of the relationship between a firm and its domestic versus foreign input suppliers, or the type of data used. Motivation for the former can be found from Antras and Rossi-Hansberg (2009) who have recently argued that the current literature on offshoring has focused too much on hold-up problems as the main drivers of internationalisation. They then discuss the potential for the role of non-appropriable

[2] Acemoglu et al. (2010) argue that their results for domestic outsourcing versus domestic vertical integration can be used to test between the transaction cost versus property rights model of firm boundaries.

knowledge in helping to determine the type of procurement that occurs, as in the model of Ethier and Markusen (1996). Similarly, Costinot et al. (2009) have developed an alternative model of the mode of offshoring based on the concept of routine and non-routine tasks.

We re-examine this question using data where we observe for each imported input, the mode of offshoring (outsourcing and vertical integration) chosen by the firm. This data is therefore closer in spirit to that used by Acemoglu et al. (2010), and as previously identified by Jabbour (2008), Defever and Toubal (2007), Corcos et al., (2009) and Kohler and Smolka (2009),[3] has the advantage that it brings the empirical model of offshoring closer to the firm level decision emphasised within the theory. Empirically this has the advantage that we can control for all observable and unobservable firm characteristics and therefore to focus on differences in the type of procurement that takes place within a firm, across its imported inputs. We also consider the robustness of our results to the inclusion of input variables beyond those suggested by the property rights model. Included amongst these is a measure of the relative importance of the input in the production process, captured by its share in total costs.

We find from this analysis evidence that is consistent with the property rights models of offshoring by Antras (2003) and Antras and Helpman (2004); the probability of procurement through FDI relative to offshore-outsourcing is strongly negatively correlated with the investment and human capital intensity of the input, even when controlling for the characteristics of the firm or the country from which the input is being imported. That those correlations differ from the previous evidence using the share of intra-firm imports in total trade by Antras (2003), Yeaple (2006), Marin (2006), Bernard et al., (2010) and Costinot et al., (2009) suggests therefore that this is due to the different type of data that are available. Creating a measure of the share of intra-firm trade in total imports using our data we find results consistent with the earlier offshoring literature, measures of relationship specificity are positively correlated with the share of intra-firm trade in total imports.

However, we also find a number of differences in our results compared to those presented in Acemoglu et al. (2010) for domestic procurement strategies. In particular, we find that the main measure of relationship specificity that they consider, the R&D intensity of the input, is

[3] We use similar data to these papers but offer a very different focus. We detail more fully these differences in the next section of the paper. Corcos et al. (2009) include some of the same input characteristics that we do, but they conclude that they cannot interpret the results that emerge.

not a significant determinant of the type of foreign procurement. We also find that when we restrict the sample to reduce the likely importance of supplier input characteristics, R&D makes vertical integration more likely. This same variable is also strongly positively correlated when we use the share of intra-firm trade to measure the type of offshoring. We use this combination of results to suggest that the knowledge capital model of FDI also plays a role in determining the method of offshoring. Firms are more likely to use FDI when they fear the possible leakage of knowledge (Markusen, 1995). This interpretation would tend to be supported by evidence in Alfaro and Charlton (2009) who show that multinationals tend to own foreign affiliates that are proximate to their final production (in the same 2 digit industry but a different 4 digit industry), which they interpret as evidence of high-skill intra-industry vertical FDI.

Finally, we also find that other input characteristics are empirically relevant for the type of offshoring. We find that the probability of vertical integration is strongly increasing in the share of the input in total costs, with inputs that account for between 20 to 50 per cent of total costs much more likely to be offshored through FDI. Firms are also more likely to integrate production of differentiated products, as measured by the index created by Rauch (1999).

The rest of the paper is organised as follows; the following section presents a brief review of the theoretical and empirical literature on offshoring. Section 3 describes the data and presents the estimation methodology. Section 4 discusses the results while section 5 presents concluding remarks.

2. Economic Background

Theoretical Literature

Many theories of offshoring rely on either the transaction cost or the property rights models of firm boundaries developed by Willamson (1975), Grossman and Hart (1986) and Hart and Moore (1990) amongst others.[4] Important within both approaches are the concepts of incomplete contracts and the idea that some investments are highly specific to the production of a particular input (Helpman, 2006). For investments of this type, such as those in specialised tools and specific training programmes for workers, their value is greater inside than outside the relationship (Lafontaine and Slade, 2007). Those parties with a weak outside

[4] Leahy and Montagna (2008) show how outsourcing and vertical integration choices might differ amongst otherwise identical firms according to cost and strategic interactions.

option, and therefore weak bargaining power in the ex-post renegotiation to set prices and bargain over rents that occurs, fear being 'held-up' and not receiving the full marginal return on their investment. The transaction costs theory assumes that when asset specificity is significant, vertical integration is optimal because it reduces opportunistic behaviour by one or both parties.

The property rights model extends this set-up to recognise that the hold-up problem may occur even within the integrated firm (Grossman and Hart, 1986; Hart and Moore, 1990). The extent of the hold-up problem is affected by the allocation of ownership between the producer and the supplier. The party given the ability to decide on issues not stipulated in an arms-length contract, the party given residual property rights, will not suffer from the possibility of hold-up. The optimal allocation of property rights should therefore assign this control to the party whose investment has the greater impact on the joint surplus from production.

Extended to offshoring by Antras (2003) and Antras and Helpman (2004), sectoral differences in contract dependency interact with the differences in location specific costs to generate patterns of procurement that differ across industries and countries. While both outsourced and integrated production have the ability to take advantage of differences in production costs across locations, most obviously lower wage costs, they are assumed to differ in the fixed costs of establishing such relationships. The fixed costs associated with outsourcing refer to the costs needed to search and match with a suitable partner (Grossman and Helpman, 2002) and to write and enforce contracts (Antras and Helpman, 2008). However, because of contract incompleteness and of asset specificity, transaction costs are higher in the case of outsourcing (Williamson, 1975; Grossman and Hart, 1986). The literature on firms boundaries does not agree on the hierarchy of fixed costs between vertical integration and outsourcing; for example Antras and Helpman (2004, 2008) assume that these fixed costs are higher in the case of vertical integration while Grossman Helpman and Szeidl (2005) assume the opposite structure of fixed costs. In addition there may be differences across countries because locations have characteristics that make one procurement modes more likely, for example higher quality legal systems (Nunn, 2007).

Firms within the same industry make different choices about the mode of supply if they have different abilities (productivity) to cover the costs associated with those different organisational forms. In Antras and Helpman (2004) it is the most efficient firms in an

industry that engage in offshoring. In the industries intensive in manufacturing components vertical integration is not profitable. In these industries, the most efficient firms establish international outsourcing relationships while the least productive one outsource domestically. In the industries intensive in headquarter services both vertical integration and outsourcing take place. The firms sort themselves into the different sourcing strategies according to their efficiency. The most efficient firms engage in vertical foreign direct investment and the least efficient firms outsource in the domestic market. While we do not offer direct tests of the relationship between firm characteristics and the mode of offshoring we use this to highlight a need to control for differences in firm characteristics within the empirical framework we adopt.

Although traditionally applied in models of horizontal FDI, and therefore the choice between FDI and licensing, the internalisation decision of Dunning's OLI framework captures aspects of the boundaries of the firm for example. Models of this type are reviewed in Markusen (1995) and include discussions of aspects of knowledge capital such as the non-excludability of knowledge, asymmetric information, moral hazard, adverse selection and incomplete contracting.[5] They predict that the firm will establish an affiliate overseas in order to prevent aspects of its firm-specific knowledge from leaking out to rivals, to maintain reputation etc. This would seem to suggest that the greater the knowledge intensity of the input the more likely it is that its production will be retained within the boundaries of the firm.

Costinot et al. (2009) also develop a model of offshoring with (routine) tasks. In this model issues of contractual frictions are again prominent, except they now arise because some tasks are non-routine and therefore more likely to encounter problems that cannot be fully specified in a contract ex-ante. The model assumes that when those issues arise they are more efficiently dealt with and managed when their production is carried out within the boundaries of the firm. Intermediate inputs where non-routine activities are more likely to be prominent are therefore more likely to be vertically integrated rather than outsourced by the firm.[6]

Empirical Literature

[5] Indeed Antras and Rossi-Hansberg (2009) suggest that incorporating the non-appropriable nature of knowledge on the internationalisation decision offers a fruitful line of future research on this topic.
[6] They generate a measure of routineness that they then use in their empirical work. Unfortunately we find that this measure is too aggregated to be used in our empirical work.

The empirical literature on offshoring might be broadly categorised into three types. In the first group might be placed those studies that model how input and country characteristics affect the share of intra-firm trade in total imports of a particular product. A second group compares the characteristics of those firms that offshore, outsource, or are multinationals, while a final group focuses on firm, final good and country variables in a single framework. We review each branch of this literature in turn.

Thus far the bulk of the empirical work on the mode of offshoring has centred on a set of predictions taken from the property rights models of offshoring. These include whether capital intensive (measured by the capital intensity of the export industry) imports are more likely to be produced inside the firm and sourced from capital abundant countries. Antras (2003), Yeaple (2006) and Nunn and Trefler (2008) using 6-digt HS level data and Bernard et al. (2010) using 10-digit HS level data find support for both of these predictions. Other measures of the characteristics of the input have however proved less robust. Yeaple (2006) finds for example, that the share of intra-firm imports is increasing in the R&D intensity of the industry, but like Antras (2003) finds no role for human capital intensity. In contrast Nunn and Trefler (2008) and Bernard et al. (2010) find a positive correlation with human capital. Bernard et al. (2010) also find a role for the product contractibility of the input, measured by the level of intermediation, leading to lower levels of imports from vertically integrated suppliers.

Drawing on the extensions of the offshoring model to allow for firm heterogeneity (Antras and Helpman, 2004), the empirical literature has also consistently found that firms that have affiliates abroad, or import goods and services, are different from those firms that do not. Tomiura (2007, 2009), Kurz (2006) and Görg et al. (2007) model a firm's decision to outsource and find that more productive firms are more likely to outsource for example. In a more complete test, Tomiura (2007) compares the characteristics of those firms that are engaged in FDI and international outsourcing for Japan, finding that those firms which undertake FDI are more productive than those that offshore by outsourcing.

Most recently a number of studies have begun to include firm, industry and country level variables as determinants of the type of offshoring. Jabbour (2008) and Defever and Toubal (2007) use the same data source as this paper, that on the international transactions of French firms, while Corcos et al. (2009) supplement this with additional data on international trade

by French firms. In all of these discussions the role of input characteristics is largely ignored. In each case the dependent variable is a dummy indicating whether the firm buys an input from a given country through outsourcing or FDI, and in the case of Jabbour (2008) also through partnerships. Defever and Toubal (2007) focus on a small number of explanatory variables, suggested from a theoretical model of offshoring they develop. Their main explanatory variables are a measure of productivity of the firm, the quality of the contracting environment in the exporting country and what they label as the supplier's input intensity of production.[7] Jabbour (2008) in contrast is focused on testing a larger number of predictions from the recent theoretical models of offshoring, in particular the relative productivity of those firms choosing international outsourcing versus FDI, as well as country characteristics such as capital intensity, the quality of the legal system and market thickness and input characteristics such as capital and R&D intensity. Corcos et al (2009) are interested in the robustness of a similar set of variables, in particular those on firm characteristics, to a broader sample of firms. Of these Corcos et al. (2009) include a sub-set of the input characteristics (human and physical capital) that we use in this paper, although provide no discussion of the results that emerge. They find that the probability of FDI is increasing in the physical and human capital intensity of the input.

Finally, while not concerned with outsourcing versus vertical integration within an international context, Acemoglu et al. (2010) provide a recent test of the predictions of the transactions costs versus property rights model models of firm boundaries. Using a combination of plant level information for the UK and input-output tables between 1996 and 2001 they generate two measures of vertical integration. The first is a dummy indicating whether the firm owns a domestic plant producing an input (measured at the 4-digit SIC level) used in the production of a product, where input-output tables (available at the 2-3 digit SIC level) are used to determine the range of inputs used in the production of a given product. The second captures the proportion of each input that the firm can produce itself. Focusing on technological intensity as the form of relationship specific investment their empirical results suggest the technological intensity of the firm and its suppliers have oppositely signed effects on the probability whether the firm vertically domestically integrates the production of the input. The probability of vertical integration is increasing in the technological intensity of the

[7] This later variable is measured at the firm level and is calculated as the share in total output of all externally supplied inputs, where the numerator is defined by the total amount of inputs supplied to the firm by independent and affiliated suppliers irrespective of their location. They predict that outsourcing is more likely the greater is the share of output that a firm produces externally (the greater is the supplier's input intensity).

purchaser and decreasing in that of the supplier. They also show that these outcomes are more likely the greater is the share of total costs accounted for by the input.

3. Data and Empirical Specification

The data on international transactions of intermediate inputs we use in this paper is from the "International Intra-Group Exchanges" (IIGE) survey conducted by the French Ministry of Economy via the SESSI (Service Des Etudes Statistiques Industrielles) for the year 1999.[8] This survey covers manufacturing firms that own an affiliate located outside of France (where ownership is defined as holding at least 50 per cent of the equity). The IIGE sample is not designed as a census or stratified random sample of all firms that offshore within France. Indeed, Corcos et al. (2009) show how the construction of the sample affects the results found for the relationship between the mode of offshoring and firm characteristics such as TFP. We discuss further the implications of the sampling structure of the IIGE for our modelling approach below. For some descriptive analysis of the firms that offshore by outsourcing versus those that have foreign affiliates, and to identify the industry of the purchaser, we combine the IIGE data with the "Enquête Annuelle d'Entreprise (EAE)". This survey is exhaustive, obligatory and concerns all firms with more than twenty employees in the French manufacturing industries.

The data on import transactions from the IIGE are rich in detail. For each firm we have information on each import transaction, the 4-digit HS classification of the imported input (of which there are 800), how much of that input was imported from an (foreign) affiliate in the same group or from a third-party, and the country from which it was imported. The data include information on 48,500 international transactions of intermediate inputs by 2,530 firms, with a total value representing €45.8bn.[9] In part because of limitations on those firms sent the survey, but also because importing firms are relatively rare, the firms in the survey

[8] This survey was conducted in order to draw a clear picture of the organisation and of the structure of international trade by French firms. One of the main objectives of the survey was to analyse the strategy of French firms, and especially French groups, toward globalisation and how this strategy is affecting the organisation of their international trade transactions. We provide further information on the method through which the IIGE sample was collected within the Appendix.

[9] A small number of observations within the dataset use both outsourcing and FDI. We follow Defever and Toubal (2007) and Corcos et al. (2009) in choosing to exclude this data.

represent 12% of the number of firms active in the census of French manufacturers (the Enquête Annuelle d'Entreprise),[10] but 55 per cent of all total French imports.[11]

In Table 1 we provide information on the number of firms on which we have information for each industry, the number of firms engaged in offshoring within that industry, the average number of offshored inputs per firm and the method of offshoring according to the industry of the purchaser. In Table 2 we present information according to the industry of the input. As is evident from Table 1 we have a relatively modest number of firms per industry, but on average these firms purchased between 4 (printing and publishing) and 15 (leather & wearing apparel) inputs from abroad. The most common method of procurement for firms was through outsourcing, although there is variation across industries. Outsourcing accounted for 90 per cent or more of the total inputs purchased by firms in the food, leather and other transport industries. In contrast less than 75 per cent of inputs in the electric and electronic products and electronic component industries were purchased through outsourcing.

From Table 2 it is evident that even when organised according to the industry of the input outsourcing is the most common method of overseas procurement, although both outsourcing and FDI are again present for all types of input. Differences across industries remain, although perhaps slightly smaller than in Table 1. Outsourcing is most common in the production of leather, textiles and wood and paper and least common in pharmaceuticals, electric products and electronic components and printing and publishing.

In Table 3 we show the ten countries the French firms in our data most frequently purchase inputs from. Together these ten countries account for 77 per cent of the total number of transactions. Aside from China, which itself accounts for just 2.1 per cent of the observations, all are OECD countries. Germany is by far the most common source country, with just under $1/5^{th}$ of all observations, while the other neighbours of France (Italy, Belgium, UK, Netherlands, and Spain) are also frequently used. The US accounts for just over 6 per cent of the observations, and Japan 2.4 per cent.

[10] This coverage ratio varies across industries; from 3.9% in the leather and wearing apparel industry to 30% in the pharmaceutical industry.

[11] We measure the total number of firms on the basis of the firm annual survey for the year 1999. The firm annual survey covers only the firms with more than twenty employees. Small firms are not accounted for in the survey and in our calculations.

We explore the determinants of outsourcing versus vertical integration using the pair of regressions set out in equations 1 and 2 below, which we estimate as a probit regression. In equations (1) and (2) *y* is a zero-one variable denoting whether a firm *i* producing product *j* imports an input *k* from an overseas affiliate (y=1: if FDI) or from an unrelated party (y=0: if outsourcing). In equation 2 we additionally allow this choice to vary across countries, denoted by *c*.

Differences in the information content of the data mean that this dependent variable differs from that used by Acemoglu et al. (2010). There the dependent variable is a measure of whether firm *i* producing product *j* owns a plant that produces an input *k*. To identify relevant inputs they use information on the output of plants at the SIC 4-digit industry level. An important assumption made in their analysis is that all inputs produced within the boundaries of the firm are manufactured in separate plants. In addition, this information on the output of plants is available only for production units located in the UK. We are, arguably, able to identify vertically integrated inputs more accurately, but only for those inputs that are imported.

$$y_{ijk} = \alpha_i + \beta_k + \gamma X_k + \varepsilon_{ijk} \qquad (1)$$

$$y_{ijkc} = \alpha_i + \beta_k + \delta_c + \gamma X_k + \varepsilon_{ijkc} \qquad (2)$$

This procurement choice is assumed to be determined by a set of variables that measure the characteristics of inputs, which we discuss below, as well a series of dummy variables that are used to control for firm, input and country characteristics. In order to control for the effect of the sampling structure on the relationship with the mode of offshoring, and any firm characteristics (observable or unobservable) that determine this choice, we include in the regression a full set of firm dummies. Identification of the relationship between input characteristics and the method of offshoring procurement therefore comes from the variation in those choices within firms. In order to establish whether our results are due to some omitted input characteristics we additionally include a full set of input dummies, measured at the 2-digit level. In this specification this further restricts identification of the effect of the input variables to the variation within 2-digit HS products. Finally, in equation 2 we include a full set of country effects. Again this removes differences in country characteristics as a possible explanation for our results for input characteristics.

An implication of the inclusion of a large number of dummy variables within the estimating equation is that firms that import solely using FDI or outsourcing are perfectly identified and dropped. Our final sample is therefore 5,179 observations at the firm-input level and 20,599 at the firm-input-country level across some 609 firms. Of those firms that are dropped from the regression we calculate that most, 61 per cent, are firms that have only used outsourcing. The firms dropped from the sample can be shown to be different to the 609 firms included in the final sample. For completeness in Table 4 we report the firm characteristics on those firms in the broader sample as well as this sub-sample of the total number of observations. As is evident from this table the firms in the narrower sample of 609 firms are on average smaller, while there is some suggestion they are less productive, more likely to be foreign owned and investment intensive. If the effect of the input characteristics on the type of offshoring does not differ according to the characteristics of firms then this should not affect the generality of our findings. To test the robustness of our results to this point, in Table 9 we consider the replacement of firm fixed effects with a set of firm characteristics that include, productivity, capital intensity, average wage and ownership, and which allow us to use the full sample of firms. We leave the detail of how these firm level variables are constructed to the Appendix. In Table 3 we report the distribution of countries within our final sample. Comparing the two columns in Table 3 suggests little effect from restricting the number of firms for the distribution of source countries within the data.

We refer within our analysis to a firm as a separate legal entity that has its own separate managerial structure. A firm can be made up of a collection of plants, which we also refer to as affiliates. A firm-group is defined as a collection of firms that are under the control of a single (holding) company. In the IIGE survey, intra-group trade is defined as trade between affiliates (i.e. plants) of the same group. Therefore while the IIGE survey is sent to firms, the same level of observation as the EAE data, the survey asks firms to identify as intra firm trade transactions that take place within the same group of firms. These intra-firm trades are therefore at a more aggregated level of ownership and can include trade between domestic firms and foreign plants for which the direct managerial relationship is at a different (higher) level. It is possible to identify the firms that make up an international industrial group within the data, but we are unable to identify which foreign plants belong to which firm within the group. In our base regressions we follow Corcos et al. (2009), Defever and Toubal (2008) and Jabbour (2008) and assume in the analysis that the intra-group international exchanges relate to intra-firm international exchanges. We test the robustness of this assumption by also

presenting evidence at the firm-group level. To ensure direct comparability, and because we have no additional information on the characteristics of the group, its size or productivity for example, we include in these group level regressions firm-group effects. We find that this assumption does not affect our results for the input variables.

Input Characteristics

Aside from the HS classification of the input and the relationship with the purchaser we have little direct information on the characteristics of the inputs purchased by French firms or on the firm that produced them. We therefore follow the existing literature and use industry level information to proxy for this. While this places a restrictive assumption that inputs purchased by different firms, in different industries, from different countries are identical in their characteristics on the analysis, according to Antras and Rossi-Hansberg (2009) it has the advantage of reducing the possible endogeneity of the measures of relationship specific investment that we use. The property rights model predicts that firm-specific measures of relationship specificity including capital, R&D and skill intensity, will be affected by the final integration decision chosen. To further reduce this bias where possible we use industry data for the US.

We capture the relationship specific investments made by the supplier of the input using information on the equipment intensity, skill intensity and technological intensity of the industry. Equipment intensity is measured as investment expenditures on equipments over value-added and is from the NBER production database for the US (at the 4-digit level). Skill intensity is measured as share of non-production workers in the total wage bill, again for the US and from the same source. We measure the technological intensity of the purchased input using data from the French R&D survey at the 4-digit level for 1999. As in Acemoglu et al. (2010) this is calculated as the ratio of R&D expenditures to total value added of the input's industry (where value added includes that of both firms that conduct R&D and those that do not). In those regressions where we do not include firm specific fixed effects we measure technological intensity of the purchaser in a similar way.

In Table 5 we report the average characteristics of these three input specificity measures in the data as a whole and when the input is offshored through outsourcing or FDI. The differences between the averages in the table are relatively modest. To the extent that there

are differences it would seem that those inputs that are more technologically intensive, investment and skill intensive are more likely to be purchased from an affiliated supplier.[12]

We also add to the regression a set of other input characteristics that might determine the method of overseas procurement. Firstly, Grossman and Helpman, (2005) have previously argued that in thicker markets the probability of finding a suitable partner increases and the viability of outsourcing improves. To capture the availability of specialised suppliers we include the Rauch (1999) measure of product differentiation. This indicates whether the input is sold on an organised exchange or reference priced or not. This is available at the 6 digit level and so we use the simple average of this data within a given HS4 digit code. We add to this a measure of the number of suppliers. This variable is constructed as the total number, expressed in natural logarithm, of active establishments at the 2-digits product level across OECD countries. The data is extracted from the OECD Structural Business and Demographic Database for 1999. In Table 5 we find that products that are purchased from an affiliated supplier (through FDI) are less likely to be reference priced or sold on an organised exchange, and come from industries in which the number of possible suppliers are fewer, although again these differences are slight.

Finally, we follow Acemoglu et al. (2010) in including the input cost share as a determinant of the method of overseas procurement. We measure this as the ratio of the imported value of the input over the firm's total cost, where total costs are measured as the sum of the wage bill, the taxes and input purchases. Of the input characteristics that we use this is perhaps the most likely to be endogenous. Production of an input is offshored because it can be purchased from overseas firms at a lower cost. It may also be affected by issues such as transfer pricing within multinational firms. In the absence of an appropriate instrument, to reduce the possible effect this may have on the results, we instead construct five categories of cost: less than 5% of total costs; 5%-10%; 10%-20%; 20%-50% and greater than 50% of total costs. While this prevents us making any causal interpretation of this variable we believe the correlation remains of interest.

Table 6 provides information on these variables. Interestingly most transactions are a very small percentage of total costs: 88 per cent of the transactions are less than 5 per cent of total

[12] Except for skill intensity, differences between the mean of input's characteristics are not statistically significant across the two modes of offshoring.

costs and a further 5.7 per cent are between 5 and 10 per cent. We also present in the table the percentage of observations within each of the 5 different ranges of cost share that involve, FDI or outsourcing, while in the final row we present the share of the total transactions by procurement method within the sample more generally.

Of interest are the deviations of each cell from the figure for all observations in the final row. The most obvious pattern within the data is that inputs imported through FDI are much more prevalent within the data when the share of the input in total costs is higher than 20 per cent. Correspondingly transactions involving outsourcing are more common when the value of the transaction in total costs is small. For example, outsourcing accounts for 84 per cent of the transactions with a value of less than 5 per cent and 75 per cent when the value is above 50 per cent. In contrast offshoring using affiliates within the same group accounts for 16 per cent of transactions of less than 5 per cent and 25 per cent when the value is above 50 per cent. This evidence would appear to suggest that this variable is likely to be a strong predictor of the type of offshoring that we observe.

4. Econometric Evidence

In Table 7 we report the results from our estimation of equation 1 and in Table 8 those from the estimation of equation 2 where the model is extended to include information on the country of origin of the input. All coefficients presented in these tables are the estimated marginal effects, calculated at the mean of the right hand side variables. As a reminder, in order to concentrate on the variation in procurement within a firm, all regressions in Tables 7 and 8 include a full set of firm dummies. To control for any country characteristics that may affect this choice in Table 8 we additionally include a full set of country dummies. In regressions 7.2 and 8.2 we consider the robustness of our results to the inclusion of input dummies at the 2-digit level. In these regressions we assume that any omitted input characteristics affect the FDI, outsourcing choice at the 2-digit level. As a consequence the significance of the input characteristics is identified from the within 2-digit variation (within firms and countries) only. Our results are largely robust to their inclusion and we retain their use through the remaining regressions within the paper.

We find consistent evidence that a number of aspects of the characteristics of inputs matter for the method of offshoring that is chosen. The results are also largely robust to the inclusion and exclusion of the various country and input effects and to considerations of the use of

firms versus firm-groups. In both Tables 7 and Table 8 we find that equipment intensity and skill intensity of the input significantly affects the choice between outsourcing and vertical integration, whereas technological intensity does not. The equipment and skill variables also have the expected negative signs. We interpret this as consistent with the prediction of the offshoring models of Antras and Helpman (2004) and others that the greater is the relationship specific investment required by the supplier of the input the more likely it is that its production will be outsourced. Consistent with Acemoglu et al. (2010), the results for equipment intensity and skill intensity appear to offer support for the property rights model of firm boundaries over the transactions costs model even when applied to offshored inputs.

The marginal effect also suggests that there are differences in the magnitude of the types of input characteristics on the type of offshoring. According to regression 7.2 a 1 unit increase in equipment intensity reduces the probability of FDI by 6 percentage points, while in regression 8.2 the effect from the same change is 3 percentage points. The estimated marginal effect of skill intensity on the type of offshoring is even stronger. A one unit increase in skill intensity is associated with a 22 percentage point decrease in the probability of supply through an overseas affiliate (regression 7.2), and a 19 percentage point decrease when we add information on countries in Table 8 (regression 8.2). According to the information in Table 5 the standard deviation of investment intensity is around 7 times greater than that of skill intensity however, suggesting that the investment intensity variable will explain more of the differences in the type of offshoring observed in the data.

We develop these points in Figures 1 and 2, where we display the estimated probability of choosing FDI over outsourcing at different values of investment intensity and skill intensity (with all other right hand side variables set at their mean values), along with 95 per cent confidence intervals for those estimates. As the figures make clear the effect of both investment and skill intensity on the probability of using FDI is relatively modest, although should be remembered that as on average each firm in the sample offshores around 10 inputs this will affect the supply relationship for a relatively large number of inputs. Across the full range of values for investment intensity the probability varies between 0.19 when investment intensity is low and 0.12 when investment intensity is at its highest. For skill intensity the corresponding figures are 0.17 when the skill intensity of the input is low to 0.13 when skill intensity is at its highest value within the data.

The insignificant effect of technological intensity on the type of offshoring contrasts with that found for domestic procurement by Acemoglu et al. (2010). Its insignificance might be explained because it is not an input characteristic that matters for French firms overseas procurement choices. Alternatively it might be that instead this variable captures both aspects of the knowledge capital model and the property rights model. A similar interpretation is made by Costinot et al. (2009) for why this variable has the strongest effect on the share of intra-firm trade in total trade. In our specification these effects would tend to work in opposite directions. The R&D intensity of the input makes it more likely the firm will vertically integrate production under the knowledge capital model, but less likely if the property right model has simultaneous support. We return to this point below where we separate the sample according to the investment intensity of the producer.

Of the remaining input characteristics the cost share variable has the strongest effect on the mode of procurement. Indeed of all of the input variables included within Tables 7 and 8 this has the strongest effect on the observed type of offshoring. We find that an input is more likely to be internally sourced through FDI when its share in total costs rises above 20 per cent. Below this level the relationship between the producer and supplier would appear unimportant. The more important the input is to the final goods producer, the greater is its share in total costs, the more likely the final good producer will choose to integrate its production. The estimated marginal effects reported for these variables are large. Inputs that account for more than 20 per cent of total costs are between 25 and 30 percentage points more likely to be offshored, depending on the specification, through FDI rather than outsourcing. In Figure 3 we show how the probability of using FDI changes for different values of investment intensity and at different levels of cost share. As the figure makes clear the cost share variable has a strong effect on this probability. Combined with the effect of investment intensity the estimated probability now lies between 0.31 for the least investment intensive inputs that account for the greatest share of costs, to 0.16 for those inputs with the highest investment intensity and the lowest cost share.

When we condition on country factors in Table 8 there are some differences for this variable. Perhaps of greatest surprise the over 50 per cent cost share variable is no longer statistically significant, while the marginal effect on the dummy indicating that the cost share is between 20-50 per cent falls by around one-third compared to the previous table. This would seem to suggest that some inputs that are important within the production process are sourced from

particular countries. Which countries, and the characteristics of those countries, we leave as an avenue for future research.

In contrast to the three measures most commonly used to identify relationship specificity, the variable that captures the number of input suppliers, which we include as a measure of market thickness has no statistically significant effect in the regressions. We do however find a positive association between the degree of product heterogeneity developed by Rauch (1999) and the method of procurement. The estimated marginal effect of this input characteristic is about the same size, but oppositely signed to that for equipment intensity, in regression 7.2. The ordering reverses in regression 8.2 in Table 8, with the marginal effect on the product heterogeneity variable now larger than that for equipment intensity. The greater the degree of differentiation of HS6 digit products within a 4-digit HS category the more likely it is that the input will be vertically integrated. It follows that goods sold on organised exchanges, or reference priced are more likely to be outsourced.[13] Again the size of the standard deviation of this variable suggests that this has quantitatively important effects on the probability of outsourcing versus FDI.

Finally in Tables 7 and 8 we repeat the estimation of regressions 7.3 and 8.3 but at the firm-group rather than the firm level. While this represents an aggregation of the data, and would therefore normally be expected to lead to a fall in the number of observations, the number of observations actually increases because the number of perfectly identified firms (which are dropped from the regression) is reduced. The differences compared to the firm level regressions are minor, and are confined to the cost share variable. The 20-50 per cent cost share dummy ceases to be significant in Table 7, while that on the dummy indicating that the input accounts for more than 10-20 per cent becomes significant. Finally the dummy indicating that the input accounts for more than 50 per cent is now significant in Table 8,

[13] It is worth noting that this is not the measure of contract intensity developed using Rauch's product classification by Nunn (2007), which has previously been interpreted as a measure of relationship specificity. A variable based on that measure could not be meaningfully included in our specification. Nunn calculates his measure based on the US input-output tables. It therefore captures the contract intensity of the total production process of the firm (i.e. it does not vary across the inputs used by the firm). This variable would therefore be perfectly correlated in our specification with the firm effects. A similar variable could of course be constructed for each input used by the firm, where this would capture the contract intensity of the production of that input. However, under an assumption that the optimal integration strategy is determined independently at each stage of the production process, such a variable would capture the likelihood that the input producer was integrated with the supplier of its inputs.

while that between 5-10 per cent is no longer so. Perhaps the bigger effect of using group rather than firm level data is the drop in the size of the estimated marginal effects, which universally fall in size.

Selection Issues

A condition on being included within the dataset over which we estimate our regressions is that the input is offshored through either outsourcing or FDI. As a test of the robustness of our findings we replace the firm effects with the firm characteristics that might determine the choice between outsourcing and FDI and we consider whether the use of observations of input transactions that are offshored generates a selection bias. In Table 9 we replace the firm effects with measures of the size of the firm (employment), TFP, average wage, the volatility of firm's sales and whether the firm is foreign owned. As the firm effects were also collinear with the industry of the purchaser in our cross-section of data, we also include equivalent measures of our input characteristics measured according to the industry of the purchaser of the input. These include the R&D and investment intensity of the producers' industry, and the Nunn (2007) measure of contract complexity at the level of the final good.

To control for possible selection effects we estimate a Heckman selection model. Here, we estimate in the first-stage a regression that models the determinants of offshoring versus domestic sourcing.[14] For each 2-digits industry j we define a set of imported inputs as the set of inputs imported by all firms within this industry (Table 1). Whenever a firm i in industry j imports an input k from this set of inputs, we model the offshoring decision as taking the value 1. If we do not observe a transaction where the firm i imports input k we consider that the firm prefers the domestic sourcing of that particular input and we model the offshoring decision as taking the value 0. In the second stage, we estimate a regression that models the choice international outsourcing and vertical FDI conditional on a positive outcome in the first stage. We consider that the availability of suppliers at the international level is more likely to influence the decision of the firm to source a certain input at the domestic or international level rather than the choice between vertical integration and outsourcing (This assumption is supported by the lack of significance on the Number of Suppliers variable in

[14] The possibility that domestic firms purchase imported inputs through wholesalers and retailers means that the regression perhaps more accurately describes the choice between direct foreign sourcing versus indirect and domestic sourcing.

Tables 7 and 8). We, thus, use the Number of Supplier variable as an exclusion variable that is included only in the first stage of the Heckman model.

Table 9 aggregates the data across countries and controls for 2-digit level input effects. Regression 9.1 models the decision to offshore a particular input and regressions 9.2 models the choice between outsourcing and FDI once offshored. We begin by noting the insignificance of the inverse Mills variable in the second stage regression, suggesting that selection is not present within our results.[15] The relationship between the input characteristics and the type of offshoring are also largely unaffected by the additional observations and the use of the Heckman approach. We continue to find that inputs that are equipment intensive and skill intensive are less likely to be purchased from a foreign affiliate, whereas differentiated products are more likely to be. Again the noticeable difference with earlier results concerns the R&D variable. We now also find a significant positive effect from the R&D variable on the type of offshoring. Increases in the R&D intensity of the input raise the probability that the input will be purchased from an integrated affiliate, providing support for the knowledge capital model.

Input characteristics also appear to matter for the decision to offshore. The results in regressions 9.1 suggests that inputs that are equipment intensive and for which there is a wide range of possible suppliers are more likely to be offshored, whereas differentiated products are less likely to be. The skill and R&D intensity have the opposite effect on the decision to offshore. The effect of skill and R&D intensity is negative and significant in regression 9.1. This would seem to suggest that French firms are reluctant to internationalise the production of inputs intensive in knowledge.

Regression 9.1 also suggests that the decision to offshore production of an input is affected by a number of the firm and producer industry variables included in the regression. Following Antras and Helpman (2004) we anticipate that those firms that offshore are likely to differ from those that choose to purchase the same input from domestic sources. We find strong evidence for such differences; firm size, TFP, average wage and foreign ownership are all positively correlated with the decision to offshore. Conditional on the decision to offshore in

[15] We have estimated several specifications of the Heckman selection model with different sets of exclusion restrictions. In all these specifications the inverse Mills variable is not significant and the results of interest are similar to those presented in table 9.

regression 9.2 we find evidence similar to Defever and Toubal (2007) and Jabbour (2008) that the firms that outsource internationally are more likely to be bigger and more productive, to have higher wage costs and are more likely to be foreign. As discussed by Corcos et al., (2009), since the data do not cover all offshoring decisions made by French firms these relationships may be sensitive to the coverage of the sample.[16]

Finally we also find that the probability of offshoring is affected by the characteristics of the industry of the producer. Often these work in the opposite direction to that of the supplier industry variables. For example, the probability of offshoring an input is increasing in the technological intensity of the producers industry in regression 9.1, but decreasing in that of the supplier. It would seem from this that in France firms in more technologically intensive industries purchase less technologically intensive inputs from abroad.

Focusing on the type of offshoring we find that in contrast to the property rights model the measures of relationship specificity do not have opposite signs. The probability of offshoring using FDI is decreasing in both the equipment intensity of the supplier and the investment intensity of the producer, while firms producing differentiated products are more likely to use FDI for differentiated products. Acemoglu et al. (2010) find that that these variables have the opposite signs. We are not clear whether our results for the characteristics of the purchasing industry are driven by the nature of the sample in the same way that the firm variables are, and so we refrain from making strong interpretations that might explain that difference.

Are differences explained by the context or the methodology?

A question that might be asked about the above findings is whether they are driven by differences in the empirical specification compared to the existing offshoring literature, or whether they can be explained by the use of French data. To explore this point in Tables 10 and 11 we reconstruct the measure of offshoring adopted in the previous literature, the share of intra-firm trade in total imports, but using our data for French firms.[17] In Table 10 we calculate this share for each HS 4-digit input and in Table 11 for each combination of input and country.

[16] Corcos et al. (2009) attempt to overcome this problem by merging French Customs data on imports with the SESSI data. They then assume that all imports not recorded within SESSI are not intra-firm. It is not possible to assess the validity of this assumption, but it does have a strong effect on the relationships found between the mode of offshoring and firm characteristics compared to those reported by Defever and Toubal (2007).

[17] Corcos et al. (2009) undertake a similar exercise to that found here.

These results suggest very strongly that the differences in our findings compared to the previous literature arise because of differences in the question and not the use of French data. For our three measures of relationship specificity we find a positive and significant association with the share of intra-firm imports for R&D intensity and skill intensity in both Tables 10 and 11, while that for equipment intensity is positive in both, but significant in Table 10 only. The results for the technological intensity variable are perhaps most striking, given the lack of significance of the same measure in Tables 7 and 8. In line with Costinot et al. (2009) we also find that the effect of changes in the technological intensity of the input has the largest coefficient. As already noted, they argue that this occurs because of support from both the property rights and the knowledge capital model.

The exact source of the difference between the two sets of regressions is beyond the scope of the paper. Possible explanation might focus on the differences in the intensive and extensive margins contained within each of the regressions: whereas Tables 7 and 8 focus just on the extensive margin between outsourcing and FDI, those in Tables 10 and 11 also include the effects of the intensive margin. That would require that the relationship between investment intensity, skill intensity, R&D and the intensive margin of offshoring is the reverse of that of the extensive margin. Firms are less likely to organise the production of inputs through FDI when relationship specificity is high, but purchase those inputs in larger quantities when they do. An alternative explanation might be that the share of intra-firm trade ignores information on the industries that are purchasing those inputs. As we show below, the characteristics of the industry of the purchaser appears to affect the relationship between input characteristics and the mode of offshoring. For example, in contrast to the results presented thus far in some versions of the model we find a significant positive relationship between R&D and the mode of offshoring, while those for skill and investment intensity are insignificant.

Relative Input Characteristics

Within the property rights model of firm boundaries the decision to source the supply of an input from an affiliated or unaffiliated firm is determined according to the relative importance of the relationship specific investments made by each party. This raises the possibility that the estimated relationship for each of the input variables will be affected by the characteristics of the industry of the purchaser of the input. We have so far controlled for these effect in the above regressions, under an assumption of their independence, using a full set of firm effects. In this section we consider this possibility by separating the sample

according to whether the industry of the producer lies above or below the mean level of investment intensity (Table 12).[18] For the regressions where the sample includes only observations on firms operating in industries with above average capital intensity, we anticipate that by reducing the relative importance of the supplier investment we may also uncover additional motives behind the mode of supply beyond the property rights model.

In the table we report the results using the aggregation of the data ignoring country variation (regressions 1 and 2 in each Table) and results that includes this information (regressions 3 and 4). There are some differences when we separate the sample in this way. Perhaps most obvious in this regard is the difference in the sign on the R&D intensity variable between regression 12.1 and 12.2. For firms that are in industries with above mean levels of investment intensity the probability of using FDI to purchase inputs is increasing in the R&D intensity of the input, whereas for firms in industries with below mean levels of investment intensity the probability of using FDI is decreasing in the R&D intensity of the input. We take from this that the R&D variable does indeed capture both relationship specific investment and firm specific knowledge. Where the RSI made by the firm is more important (regression 12.1), we find evidence consistent with knowledge capital model, whereas when the RSI made by the supplier is likely to be the more important we evidence of the property rights model.

This does not hold when we include information on the country from which the input was purchased (regressions 12.3 and 12.4). This would seem to suggest that the country effects are capturing the variation identified in regression 12.1 using the technology intensity variable. This might be because R&D activity is clustered within a relatively small number of countries (Keller, 2004). This would tend to be supported by the information in Table 3, where the suppliers most commonly used to purchase inputs by our sample of French firms are almost exclusively located in OECD countries. In support of this view, the equipment

[18] We also performed a similar exercise separating observations according to whether the buyer operates in an industry with above or below mean levels of R&D and human capital. The general pattern across these results was for the number of significant input characteristics to fall when we use data from industries that have above average skill or R&D intensity. This would appear consistent with the interpretation that the greater are the investments made by the purchaser of the input into human capital, physical capital or R&D the less important are the characteristics of the input itself in discriminating between the types of offshoring that are observed. When the investments made by the purchaser are less important we found the characteristics of the input play a more important role.

intensity also ceases to be significant in regression 12.3, while the marginal effect on the skill intensity variable falls by one-third.

The role of skill intensity also differs across the regressions 12.1 and 12.2, although again here the results from regressions 12.3 and 12.4 suggest that this may be because we have ignored country information. In these regressions the skill intensity variable is negatively correlated with the probability of using FDI. The other noticeable change that occurs between regressions 12.1 and 12.2 in Table 12 is the significance of the product diversity variable in regression 12.2. Products that are sold on an organised exchange or referenced priced are no less likely to be outsourced or bought from an overseas affiliate when the investment intensity of the industry of the producer is above the mean. The same variable is significant and positive when we consider firms in industries with below mean investment intensity. Here the estimated marginal effect from a one unit change in product diversity is 8 percentage points.

5. Conclusions

This paper presents an empirical analysis of the organisation of offshoring activities. We investigate the choice between FDI and international outsourcing and focus on the characteristics of the imported inputs as determinants of this choice. The empirical analysis is based on the "IIGE" survey of French firms and conducted at the level of the transaction. The use of input level variables allows us to test conflicting predictions regarding the effect of technology, skill and investment intensity on the procurement mode while the use of firm and country fixed effects allow us to control for any bias due to unobserved characteristics or sample selection.

Our results provide support to the property right theory of the firm. Our measures of asset specificity at the input level have a negative effect on the probability of FDI. Our results also provide support for the knowledge-capital model of the firm. Our findings contrast with the evidence presented in the literature (Antras, 2003; Yeaple, 2006; Costinot et al., 2009). However, we show that the difference in our results is not specific to the French context but due to the methodology that we use. We argue that our empirical approach is more in line with the theoretical modelling of offshoring decisions where the decision is made at the level of the firm for the purchase of a specific input.

Our results also suggest venues for future research. The differences between tables 7 and 8 highlight the impact of country level characteristics on the procurement choice while the findings presented in table 9 draw attention to the role of producer industry level variables.

References

Acemoglu, D., P. Aghion, R. Griffith, and F. Zilibotti (2010). Vertical integration and technology: Theory and evidence. Journal of the European Economic Association 8(5), 989-1033.

Alfaro, L. and Charlton, A. (2009). Intra-industry foreign direct investment. American Economic Review 99(5), 2096-2119.

Antras, P. (2003). Firms, contracts, and trade structure. Quarterly Journal of Economics 118(4), 1375–1418.

Antras, P. and E. Helpman (2004). Global sourcing. Journal of Political Economy 112(3), 552–580.

Antras, P. and E. Helpman (2004). Contractual frictions and global sourcing. In: E. Helpman, D. Marin, T. Verdie (Eds.), The Organization of Firms in a Global Economy, Harvard University Press, Cambridge, MA.

Antràs, P. and E. Rossi-Hansberg (2009). Organizations and trade. Annual Review of Economics 1, 43-64.

Bernard, A. B., J. B. Jensen, S. J. Redding, and P. K. Schott (2010). Intra-firm trade and product contractibility. American Economic Review 100(2), 444-448.

Corcos, G., D. M. Irac, G. Mion, and T. Verdier (2008). The determinants of intra-firm trade. Development working papers, Centro Studi Luca dÁgliano, University of Milano.

Costinot, A., L. Oldenski, and J. E. Rauch (2009). Adaptation and the boundary of multinational firms. Review of Economics and Statistics (forthcoming).

Defever, F. and F. Toubal (2007). Productivity and the sourcing modes of multinational firms: Evidence from French firm-level data. CEP discussion papers, Centre for Economic Performance, LSE.

Ethier, W. J. and J. R. Markusen (1996). Multinational firms, technology transfer and trade. Journal of International Economics 41(1-2), 1–28.

Görg, H., A. Hanley, and E. Strobl (2008). Productivity effects of international outsourcing: Evidence from plant level data. Canadian Journal of Economics 41(2), 670–688.

Grossman, G. M. and E. Helpman (2002). Integration vs outsourcing in industry equilibrium. Quarterly Journal of Economics 117(1), 85–120.

Grossman, G. M. and E. Helpman (2005). Outsourcing in a global economy. Review of Economic Studies 72, 135–159.

Grossman, G. M., E. Helpman, and A. Szeidl (2005). Complementarities between outsourcing and foreign sourcing. American Economic Review 95(2), 19–24.

Grossman, S. J. and O. Hart (1986). The cost and benefit of ownership: a theory of vertical and lateral integration. Journal of Political Economy 94(4), 691–719.

Hart, O. and J. Moore (1990). Property rights and the nature of the firm. Journal of Political Economy 98(6), 1119–1158.

Helpman, E. (2006). Trade, FDI, and the organization of firms. Journal of Economic Literature 44(3), 589–630.

Jabbour, L. (2008). Slicing the value chain internationaly: Empirical evidence on the offshoring strategy by French firms. GEP Working Papers 2, Leverhulme Centre for Research on Globalisation and Economic Policy.

Kohler, W. and M. Smolka (2009). Global sourcing decisions and firm productivity: Evidence from Spain. CESIFO working paper series, CESIFO Group Munich.

Kurz,C. (2006). Outstanding outsourcers: A firm- and plant-level analysis of production sharing. Finance and Economics Discussion Series 2006-04, Board of Governors of the Federal Reserve System (U.S.)

Lafontaine, F. and M. Slade (2007). Vertical integration and firm boundaries: The evidence. Journal of Economic Literature 45(3), 629–685.

Leahy, D. and C. Montagna (2009). Outsourcing vs. FDI in oligopoly equilibrium. Spatial Economic Analysis 4(2), 149–166.

Marin, D. (2006). A new international division of labor in Europe: outsourcing and offshoring to Eastern Europe. Journal of the European Economic Association, Papers and Proceedings 4(2-3),612–622.

Markusen, J. R. (1995). The boundaries of multinational enterprises and the theory of international trade. Journal of Economic Perspectives 9(2), 169–89.

Nunn, N. (2007). Relationship-specificity, incomplete contracts, and the pattern of trade. The Quarterly Journal of Economics 122(2), 569–600.

Nunn, N. and D. Trefler (2008). The boundaries of the multinational firm: an empirical analysis. In E. Helpman and D. Marin (Eds.), Globalization and the Organization of Firms and Markets. Cambridge, MA: Harvard University Press. Forthcoming.

Olley, G. S. and A. Pakes (1996). The dynamics of productivity in the telecommunications equipment industry. Econometrica 64(6), 1263–1297.

Rauch, J. E. (1999). Networks versus markets in international trade. Journal of International Economics 48(1), 7–35.

Tomiura, E. (2007). Foreign outsourcing, exporting, and FDI: A productivity comparison at the firm level. Journal of International Economics 72(1), 113–127.

Tomiura, E. (2009). Foreign versus domestic outsourcing: Firm-level evidence on the role of technology. International Review of Economics and Finance 18(2), 219–226.

Williamson, O.E., 1975. Markets and Hierarchies: Analysis and Antitrust Implications. Free Press, New York.

Yeaple, S. (2006). Offshoring, foreign direct investment and the structure of U.S trade. Journal of the European Economic Association, Papers and Proceedings 4(2-3), 602–611.

Figure 1: Estimated Probability of FDI at Different Values of Investment Intensity

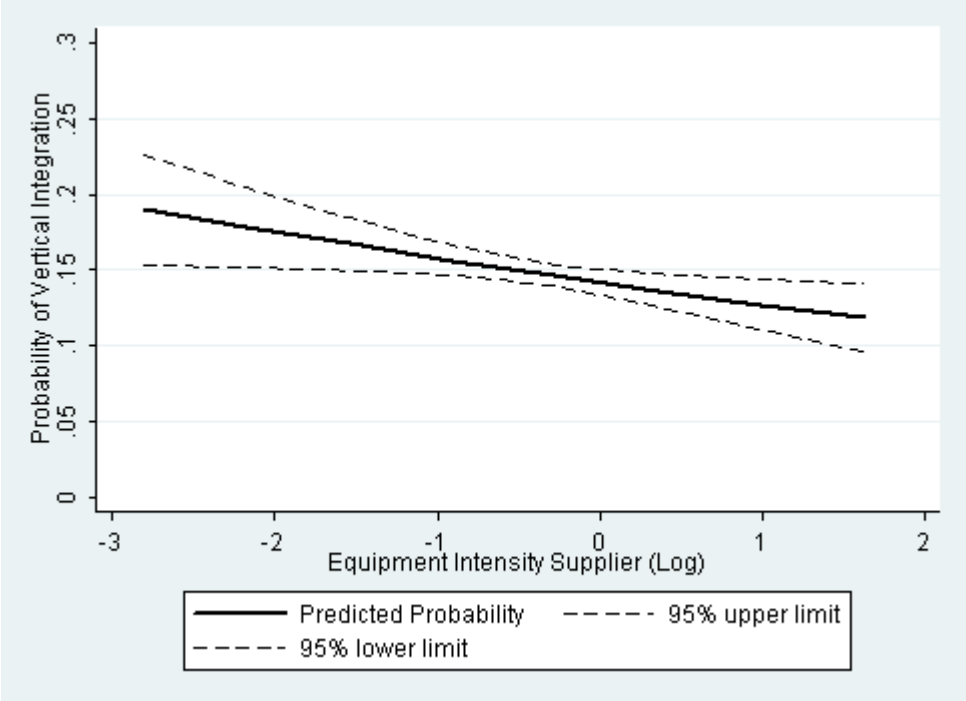

Figure 2: Estimated Probability of FDI at Different Values of Skill Intensity

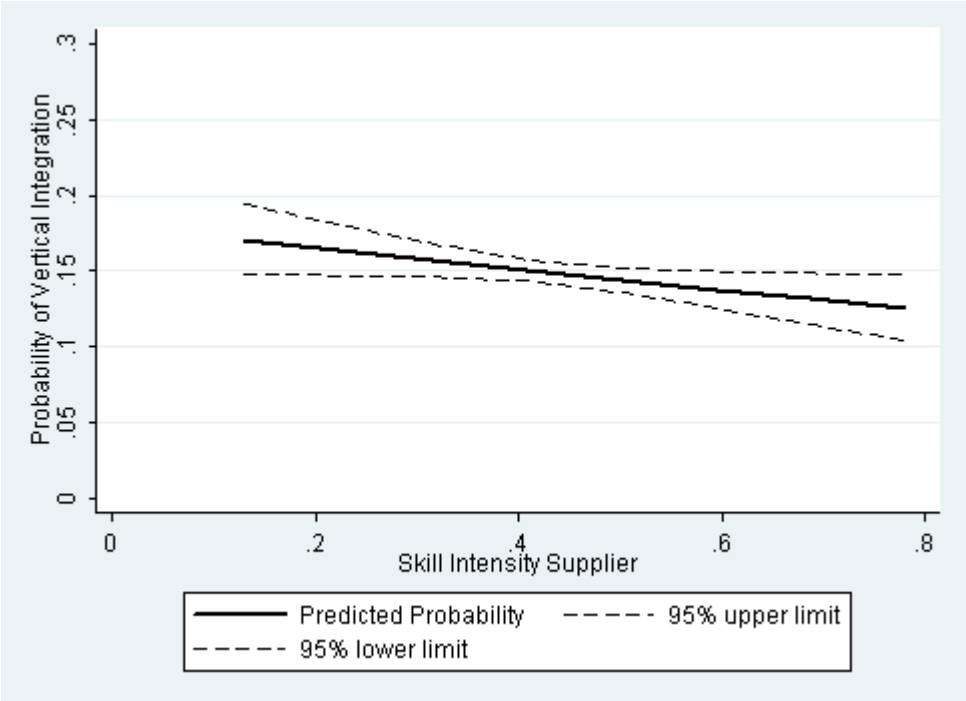

Figure 3: Estimated Probability of FDI at Different Values of Investment Intensity and Costs

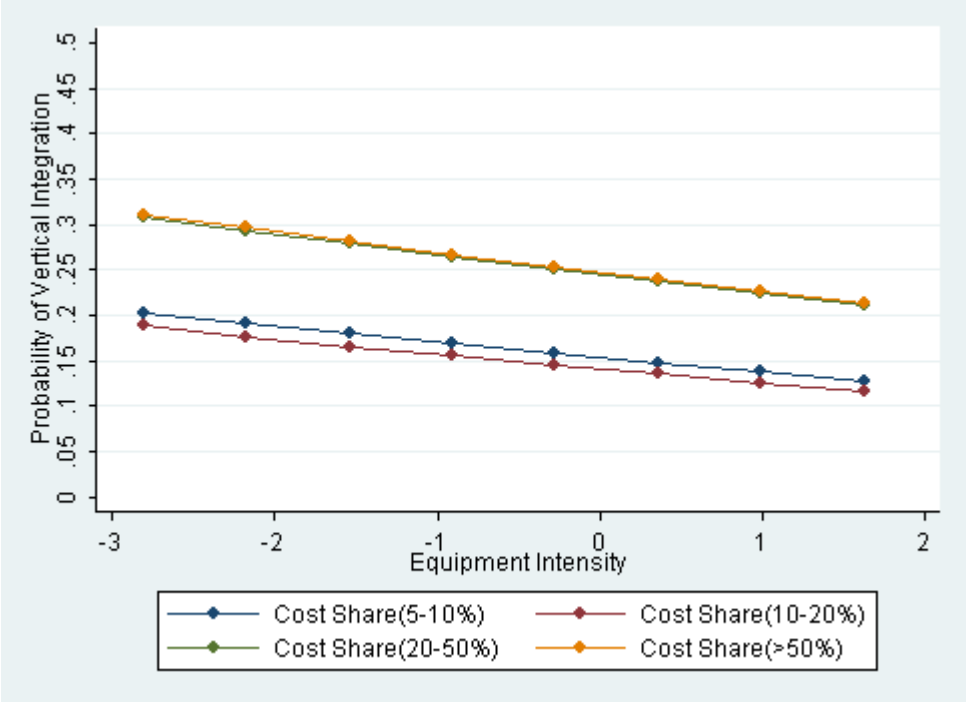

Table 1: Offshoring Transaction by Industry of the Firm

Industry	No. of Firms	Set of Inputs	Average No. of Imported Inputs by Firm	Share (%) in total Observations	Offshored by FDI	Offshored by Outsourcing
Food industry	350	286	6.16	11.63	10.11	89.89
Leather & wearing apparel	65	165	15.03	5.27	8.29	91.71
Printing and Publishing	75	79	3.69	1.49	14.08	85.92
Pharmaceutical	165	291	9.81	8.73	18.41	81.59
Home equipment	165	336	7.55	6.72	19.9	80.1
Motor industry	116	202	7.86	4.92	14.58	85.42
Other transport industry	52	182	11.17	3.13	6.88	93.12
Mechanical products	364	249	5.63	11.05	18.26	81.74
Electric & electronic products	197	219	6.93	7.36	25.2	74.8
Textile	101	221	7.10	3.87	14.5	85.5
Wood & paper	163	215	7.42	6.52	11.91	88.09
Chemicals, rubber & Plastic Product	475	455	8.89	22.77	16.16	83.84
Electronic components	151	218	8.00	6.52	28.64	71.36

Table 2: Offshoring Transaction by Industry of the Intermediate Input

Inputs (2 digits)	Set of Input	Share (%) in total Observations	Offshored by	
			FDI	Outsourcing
Food industry	117	6.72	15.33	84.67
Leather & wearing apparel	54	3.8	11.35	88.65
Printing and Publishing	12	1.01	21.39	78.61
Pharmaceutical	27	3.73	24.02	75.98
Home equipment	77	4.12	18.46	81.54
Motor industry	11	1.43	19.25	80.75
Other transport industry	13	0.4	17.57	82.43
Mechanical products	91	19.32	16.2	83.8
Electric & electronic products	34	7.16	22.38	77.62
Textile	84	6.43	11.75	88.25
Wood & paper	50	6.53	12.98	87.02
Chemicals, rubber & plastic products	197	31.94	15.22	84.78
Electronic components	25	7.41	21.4	78.6

Table 3: Top Ten Source Countries for Imported Inputs

Country	Percentage share in total observations	Percentage share in total observations (Based on estimation sample)
Germany	19.34	18.98
Italy	11.87	10.57
Belgium	9.73	8.91
United Kingdom	9.29	9.27
Netherlands	7.18	6.91
Spain	6.73	6.18
United States	6.24	6.86
Japan	2.36	3.18
Switzerland	2.28	2.68
China	2.08	2.32
Total	*77.1*	*75.86*

Table 4: Firm Characteristics

Variable	Full "EIIG" Sample				
	Number Observations	Mean	Standard Deviation	FDI (Mean)	Outsourcing (Mean)
Employment	2439	532	1338	593	552
TFP	2373	4.67	1.12	4.63	4.67
Investment Intensity	2439	0.17	0.50	0.16	0.18
Foreign	2439	0.57	0.49	0.75	0.55
	Firms in Final Sample				
Employment	609	693	1642		
TFP	601	4.61	1.07		
Investment Intensity	609	0.18	0.38		
Foreign	609	0.76	0.43		

Note: Monetary figures are expressed in thousands of Euros.

Table 5: Input Characteristics

Variable	Total Sample			FDI	Outsourcing
	Number Observations	Mean	Standard Deviation	(Mean)	(Mean)
Investment Intensity	775	0.85	0.82	0.86	0.85
Skill Intensity	775	0.41	0.13	0.42	0.41
Technological Intensity	701	0.06	0.10	0.07	0.06
Product Differentiation	792	0.61	0.48	0.63	0.61
Number of Suppliers	792	40522	44161	40348	41271

Table 6: Share in Total Costs

Share in total costs	**Percentage share in positive transactions**	**FDI**	**Outsourcing**
Share in total costs (<5%)	88.2%	16.39%	83.61%
Share in total costs(5-10%)	5.7%	15.65%	84.35%
Share in total costs(10-20%)	3.4%	13.72%	86.28%
Share in total costs(20-50%)	2.14%	23.62%	76.38%
Share in total costs(>50%)	0.54%	24.75%	75.25%
Share in Total Sample		16.46%	83.54%

.

Table 7: Choice between FDI and Outsourcing at the Firm-Input Level

Regression No.	7.1	7.2	7.3
Dependent Variable	FDI vs. outsource	FDI vs. outsource	FDI vs. outsource
Sample	Firms	Firms	Group
Input Characteristics			
Technology Intensity	0.117	-0.0856	0.0817
	(0.0967)	(0.0951)	(0.0781)
Equipment Intensity	-0.0679***	-0.0608***	-0.0521***
	(0.0172)	(0.0171)	(0.0125)
Skill intensity	-0.235***	-0.224**	-0.183***
	(0.0850)	(0.0878)	(0.0604)
Number of Suppliers	-0.00691	0.0106	0.00923
	(0.0106)	(0.0116)	(0.00829)
Product Differentiation	0.0508**	0.0585***	0.0331**
	(0.0219)	(0.0218)	(0.0160)
Relationship Importance			
Cost Share(5-10%)	0.0447	0.0460	-0.0261
	(0.0336)	(0.0342)	(0.0215)
Cost Share(10-20%)	0.0294	0.0157	-0.0476**
	(0.0495)	(0.0485)	(0.0229)
Cost Share(20-50%)	0.341***	0.312***	0.0413
	(0.0638)	(0.0664)	(0.0338)
Cost Share(>50%)	0.322**	0.271**	0.118**
	(0.126)	(0.136)	(0.0585)
Firm effects	X	X	X
Input effects (2-digit)		X	X
Observations	5179	5179	6315

Notes: This table reports the results from a probit regression of the mode of offshoring in which FDI=1 and Outsourcing=0 using data for 1999. The data are aggregated to exclude information on the country of origin of that input. Regressions 1 and 2 are estimated at the firm level, while regression 3 uses information at the firm-group level. All coefficients are the marginal effects estimated at the mean value for the remaining right hand side variables. The cost share variables are dummies indicating the share in total costs. The marginal effects for these variables are reported as the effect on the probability of the mode of offshoring when changing this variable from 0 to 1. *** , ** and * denote significance at the 1, 5 and 10 per cent level respectively. Standard errors are clustered at the input 4-digit level.

Table 8: Choice between FDI and Outsourcing at the Transaction (Firm-Input-Country) Level

Regression No.	8.1	8.2	8.3
Dependent Variable	FDI vs. outsource	FDI vs. outsource	FDI vs. outsource
Sample	Firms	Firms	Group
Input Characteristics			
Technology Intensity	0.0221	-0.0330	0.000547
	(0.0458)	(0.0536)	(0.0440)
Equipment Intensity	-0.0371***	-0.0320***	-0.0316***
	(0.0122)	(0.0118)	(0.00898)
Skill intensity	-0.222***	-0.192***	-0.155***
	(0.0566)	(0.0545)	(0.0410)
Number of Suppliers	-0.00631	-0.000228	5.63e-05
	(0.00708)	(0.00775)	(0.00580)
Product Differentiation	0.0489***	0.0491***	0.0363***
	(0.0168)	(0.0165)	(0.0123)
Relationship Importance			
Cost Share(5-10%)	0.0433**	0.0424***	0.00417
	(0.0172)	(0.0162)	(0.0114)
Cost Share(10-20%)	0.0154	0.0101	0.0219
	(0.0254)	(0.0259)	(0.0153)
Cost Share(20-50%)	0.133***	0.116***	0.0559***
	(0.0324)	(0.0309)	(0.0168)
Cost Share(>50%)	0.0416	0.0111	0.0524**
	(0.0577)	(0.0519)	(0.0214)
Firm effects	X	X	X
Input effects (2-digit)		X	X
Country effects	X	X	X
Observations	20599	20599	26184

Notes: This table reports the results from a probit regression of the mode of offshoring in which FDI=1 and Outsourcing=0 using data for 1999. Regressions 1 and 2 are estimated at the firm level, while regression 3 uses information at the firm-group level. The data includes information on the country of origin of the input. All coefficients are the marginal effects estimated at the mean value for the remaining right hand side variables. The cost share variables are dummies indicating the share in total costs. The marginal effects for these variables are reported as the effect on the probability of the mode of offshoring when changing this variable from 0 to 1. *** , ** and * denote significance at the 1, 5 and 10 per cent level respectively. Standard errors are clustered at the input 4-digit level.

Table 9: Heckman Selection Estimation: Decision to Offshore and Choice between FDI and Outsourcing

Regression No.	9.1	9.2
Dependent Variable	Offshore versus not offshore	FDI vs. outsource (Marginal effects)
Input Characteristics		
R&D Intensity Supplying	-0.253***	0.125***
	(0.0463)	(0.0625)
Equipment Intensity Supplying	0.0621***	-0.022***
	(0.00738)	(0.0114)
Skill Intensity supplying	-0.0973**	-0.0937**
	(0.0409)	(0.0432)
Number of Suppliers	0.134***	
	(0.0052)	
Product Differentiation	-0.0224**	0.0405***
	(0.0107)	(0.0160)
Relationship Importance		
Cost Share(5-10%)		0.0188
		(0.0188)
Cost Share(10-20%)		0.00221
		(0.0233)
Cost Share(20-50%)		0.135***
		(0.0397)
Cost Share(>50%)		0.139**
		(0.0653)
Firm Characteristics		
TFP	0.0416***	-0.0426***
	(0.00498)	(0.0140)
Scale	0.190***	-0.0216
	(0.00310)	(0.0144)
Average Wage	0.0364***	0.118***
	(0.00646)	(0.0309)
Foreign	0.0243***	0.167***
	(0.00760)	(0.0464)
Volatility	0.00937	0.160***
	(0.0194)	(0.0463)
Producer Industry Characteristics		
R&D Intensity Producing	0.203***	0.0351
	(0.0316)	(0.0338)
Investment Intensity Producing	-0.0288*	-0.0465***
	(0.0163)	(0.0198)
Product Differentiation	-0.0263***	0.0435***
	(0.00854)	(0.0165)
Inverse Mills		-0.127
		(0.158)
Observations	561307	561307

Notes: This table reports the results from a Heckman estimation of the decision to offshore the production of an input (first stage) and the choice between FDI and international outsourcing conditional on a positive decision to offshore (second stage). All coefficients are the marginal effects estimated at the mean value for the remaining right hand side variables. The cost share variables are dummies indicating the share in total costs. The marginal effects for these variables are reported as the effect on the probability of the mode of offshoring when changing this variable from 0 to 1. *** , ** and * denote significance at the 1, 5 and 10 per cent level respectively. Standard errors are clustered at the firm-input level.

Table 10: Inputs Characteristics and Intra-Firm Trade: Aggregation at the (4-digits) Input Level

Regression No.	9.1	9.2	9.3
Dependent Variable	Intra-Firm Share	Intra-Firm Share	Intra-Firm Share
Sample	Input	Input	Input
R&D Intensity Supplying	0.461***	0.366***	0.360***
	(0.104)	(0.111)	(0.113)
Equipment Intensity Supplying	0.00631	0.0140	0.0174
	(0.0117)	(0.0117)	(0.0139)
Skill Intensity supplying		0.212***	0.217***
		(0.0773)	(0.0787)
Product Differentiation			0.00991
			(0.0215)
Constant	0.189***	0.109***	0.103***
	(0.0113)	(0.0301)	(0.0334)
Observations	701	701	701
R-squared	0.038	0.048	0.049

Notes: This table reports the results from an OLS regression of the mode of offshoring in which FDI=1 and Outsourcing=0 using data for 1999. The dependent variable is constructed as the share of imported inputs in total trade of a given HS 4-digit product that come from affiliated parties. *** , ** and * denote significance at the 1, 5 and 10 per cent level respectively. Standard errors are clustered at the input 4-digit level.

Table 11: Inputs Characteristics and Intra-Firm Trade: Aggregation at the Input-Country Level

Regression No.	10.1	10.2	10.3
Dependent Variable	Intra-Firm Share	Intra-Firm Share	Intra-Firm Share
VARIABLES	Input-Country	Input-Country	Input-Country
R&D Intensity Supplying	0.214***	0.165**	0.135*
	(0.0688)	(0.0728)	(0.0726)
Equipment Intensity Supplying	-0.000944	0.00496	0.0267**
	(0.00829)	(0.00823)	(0.0104)
Skill Intensity supplying		0.117**	0.141**
		(0.0578)	(0.0568)
Product Differentiation			0.0618***
			(0.0161)
Constant	-0.00219	-0.0279**	-0.0104
	(0.0163)	(0.0139)	(0.0288)
Country effect	X	X	X
Observations	9214	9214	9214
R-squared	0.063	0.065	0.070

Notes: This table reports the results from an OLS regression of the mode of offshoring in which FDI=1 and Outsourcing=0 using data for 1999. The dependent variable is constructed as the share of imported inputs in total trade of a given HS 4-digit product from a given country that come from affiliated parties. *** , ** and * denote significance at the 1, 5 and 10 per cent level respectively. Standard errors are clustered at the input 4-digit level.

Table 12: Choice between FDI and Outsourcing by the Capital Intensity of the Firm

Regression No.	12.1	12.2	12.3	12.4
Dependent Variable	FDI vs. outsource	FDI vs. outsource	FDI vs. outsource	FDI vs. outsource
Sample	Above mean Capital Intensity of Buyer Industry	Below mean Capital Intensity of Buyer Industry	Above mean Capital Intensity of Buyer Industry	Below mean Capital Intensity of Buyer Industry
Input Characteristics				
Technology Intensity	0.289*	-0.220**	-0.0272	-0.0433
	(0.154)	(0.0952)	(0.0928)	(0.0591)
Equipment Intensity	-0.0449*	-0.0600***	-0.0183	-0.0409***
	(0.0235)	(0.0216)	(0.0162)	(0.0150)
Skill intensity	-0.667***	-0.0533	-0.269***	-0.153**
	(0.145)	(0.102)	(0.0812)	(0.0601)
Number of Suppliers	0.0111	0.00321	0.00121	-0.00126
	(0.0177)	(0.0135)	(0.0108)	(0.0101)
Product Differentiation	0.0332	0.0854***	0.0327	0.0610***
	(0.0300)	(0.0267)	(0.0216)	(0.0192)
Relationship Importance				
Cost Share(5-10%)	0.0252	0.0459	0.0353	0.0373*
	(0.0416)	(0.0511)	(0.0255)	(0.0214)
Cost Share(10-20%)	-0.0349	0.0693	-0.0304	0.0329
	(0.0623)	(0.0781)	(0.0297)	(0.0381)
Cost Share(20-50%)	0.313***	0.286***	0.130***	0.0954**
	(0.108)	(0.0925)	(0.0462)	(0.0468)
Cost Share(>50%)	0.122	0.515***	-0.0236	0.0463
	(0.183)	(0.160)	(0.0582)	(0.0861)
Firm effects	X	X	X	X
Input effects	X	X	X	X
Country effect			X	X
Observations	1947	3228	8304	12214

Notes: This table reports the results from a probit regression of the mode of offshoring in which FDI=1 and Outsourcing=0 using data for 1999. Regressions 1 and 3 use observations for when the industry of the purchaser has above average capital intensity. Regressions 2 and 4 use observations for when the industry of the purchaser has above average capital intensity. All coefficients are the marginal effects estimated at the mean value for the remaining right hand side variables. The cost share variables are dummies indicating the share in total costs. The marginal effects for these variables are reported as the effect on the probability of the mode of offshoring when changing this variable from 0 to 1. *** , ** and * denote significance at the 1, 5 and 10 per cent level respectively. Standard errors are clustered at the input 4-digit level.

Appendix

The sample to be used in the "International Intra-group exchanges" survey was determined as follows. The identification of international industrial groups is based on the Financial Liaisons survey (LIFI). The LIFI survey provides information on the financial relations between affiliates: it identifies the parent firm as well as the country of origin. The IIGE survey was restricted to firms for which the parent firm (or group) has majority control as well as to those belonging to a joint-venture. This generated a sample of 38414 firms controlled by 4826 groups. However, only 15205 firms (belonging to 4661 groups) were active in international trade. The framework was then further narrowed to firms having an industrial or a commercial activity since they represent 96% of the international trade of the international industrial groups. This limited the sample to 12055 firms (belonging to 4582 groups). Finally, the survey was addressed only to commercial or industrial firms with more than one million Euros of trade flows or more than 500 thousands Euros of trade flows towards the emerging countries. This limitation reduced sharply the number of firms to 8239 (controlled by 4032 groups) while providing a significant coverage of the trade flows. Among these 8239 firms, only 4367 answered the survey. This rate of answer covers 53% of the firms but 82% of the trade flows of international industrial groups. The surveyed firms account on average for 55% of French imports and 61% of exports. We limit our analysis to the manufacturing firms and imports transactions.

Within this survey each firm was asked to provide for every international trade transaction it conducted, the precise relationship between itself and the supplier; the share of the total value of the transaction conducted with an affiliate located abroad, the share traded with partners and the share traded with third parties or independent suppliers. The survey considers as partnership: technological alliances, licensing agreements, franchise and subcontracting agreements.[19] In this paper we consider trade with partners and trade with independent suppliers as “Outsourcing” and that with affiliates located abroad as FDI. Each transaction relates to the origin country of the import and the (4 digit) Harmonised System industry. Unfortunately while there are multiple transactions within a 4-digit code from a given destination within the data, relating to different intermediate inputs, the industry classification is not available at a more disaggregated level. Examples of 4-digt HS codes include ‘spark-ignition reciprocal or rotary internal comb piston engines’ (4707) and ‘compression-ignition internal combustion piston engines’ (4708).

[19] Since each firm reports separately each of its transactions, there are several observations per firm.

Table A1: Sample Coverage by Industry

Industry	Total Nb of Firms	Nb of firms in the Sample	Coverage Ratio
Food Industry	3110	370	11.9%
Leather and Wearing Apparel	1689	66	3.9%
Printing and Publishing	1823	77	4.22%
Pharmaceutical	554	169	30.5%
Home Equipment	1378	169	12.26%
Motor Industry	554	122	22.02%
Other Transport Industry	305	54	17.7%
Mechanical Products	3639	391	10.7%
Electric and Electronic Products	1205	208	17.26%
Textile	1378	103	7.47%
Wood and Paper	1252	165	13.2%
Chemical, Rubber and Plastic Products	2116	484	22.8%
Electronic Components	876	157	17.9%
Total	19879	2535	12.75%

Firms Characteristics:

Table 9 presents results based on a regression that include variables representing firms' characteristics. In these regressions we include the following variables:

- TFP: We apply the semi-parametric methodology proposed by Olley and Pakes (1996) and estimate total factor productivity industry by industry using the total number of firms in the "EAE" survey.
- Scale: total number of employees
- Average wage: ratio of the firm's wage bill over the total number of employees.
- Investment intensity producer: ratio of investment expenditure over the value added. This variable is calculated at the firm level.
- Foreign: A dummy indicating if the firm is controlled by a foreign parent firm.
- Volatility: this variable measures the volatility of the firm's sales. Volatility is measured as the standard deviation of the sales, adjusted by the mean of the sales, over a nine years period.[20]
- Product Differentiation (Final Good): This variable corresponds to the "Relation Specificity" from Nunn (2007). Nunn (2007) uses the Rauch (1999) classification of differentiated inputs and the input-output table from the United Stated to construct a measure of "Relation Specificity" at the final good level as the proportion of inputs, used for the production of the final good, which are "relationship-specific". Inputs are considered "relationship-specific" if they are differentiated according to the Rauch (1999) classification.

[20] The "EAE" survey covers the period between 1990 and 1999. We use the panel structure of the "EAE" survey to construct the volatility measure.