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"Slicing the Value Chain" Internationally: Empirical Evidence on the Offshoring Strategy by French Firms

by

Liza Jabbour

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GEP Leverhulme Centre for Research on Globalisation and Economic Policy

The Authors

Liza Jabbour is a Research Fellow at the Leverhulme Centre for Research on Globalisation and Economic Policy.

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Abstract

This paper analyzes the offshoring strategy from an empirical view. It focuses on a set of models, extracts a set of testable hypothesises and creates a suitable set of variable to test their validity. This analysis is based on a data set from French manufacturing firms that provides detailed information on the offshoring strategy. The choice of offshoring modes is investigated through the estimation of a multinomial logit model and associated to a set of explanatory variables at the firm, industry and country levels. Our results emphasize the role of firm heterogeneity, input specificity and of market thickness.

JEL classification: D23, F14, F23, L11.

Keywords: Offshoring, Vertical FDI, Outsourcing, Firm Heterogeneity

Outline

Non-Technical Summary

This paper analyzes the offshoring strategy from an empirical view. A growing theoretical literature investigates the international vertical specialization of modern firms and combines elements of the organizational theory of the firm (Williamson, 1975; Grossman and Hart, 1985) with elements of the theories on international trade, foreign direct investment (FDI) and firm heterogeneity. We focus on a set of models (Antras, 2003; Antras and Helpman, 2004; Grossman and Helpman, 2005), extract a set of testable hypothesises and create a suitable set of variable to test their validity.

Our analysis is based on a data set from French manufacturing firms that provides detailed information on the offshoring strategy. More precisely, each firm reports for each of its import transactions the country of origin, the classification of the imported input as well as the mode of organization of the transaction. We are, thus, able to define three modes of offshoring, vertical FDI, partnerships and outsourcing (transactions with independent suppliers).

The choice between these three modes of organization is investigated through the estimation of a multinomial logit model and associated to a set of explanatory variables at the firm, industry and country levels. More precisely, at the level of the firm we focus on the impact of heterogeneity, represented by productivity and scale. At the industry level, we emphasize the impact of input specificity as well as the intensity in headquarter services. At the country level we put forward the role of market thickness, the level of search technologies, the quality of the legal system and the cost of production.

Our results show that the pattern of firm heterogeneity follows the hierarchy of fixed costs associated with each mode of organization. The data suggests that partnerships require the highest fixed cost of organization followed by outsourcing and then by vertical FDI. Partnerships as well as outsourcing require search and matching costs as well as monitoring and control efforts. Our results show that more productive firms and larger ones establish partnerships, relatively low productive and small ones vertically integrate and firms with relatively intermediate levels of productivity and scale establish outsourcing agreements.

Our results confirm the significant effect of relation specific investment on the organizational choice. In industries sensitive to input specificity and intensive in headquarter services, firms prefer to vertically integrate in order to minimize transaction costs related to incomplete contracts and hold-up problems. At the country level, the results emphasize the impact of market thickness and of search technologies. In thicker markets, it is easier to find a suitable partner. Hence, contractual agreements are preferred to vertical integration. The quality of the legal system is important for partnerships. Partnerships correspond to long term relationships and complex contractual agreements. In this sense, partnerships are more sensitive to the degree of contract incompleteness.

A natural extension of this work will be to consider theoretical models based on alternative view of the firm like the theory of managerial incentives (Grossman and Helpman, 2004) or the theory of real and formal authority (Marin and Verdier, 2002).

1 Introduction

Globalization is changing the patterns of international economy. Foreign direct investment (FDI) and international trade are growing faster than world GDP. Through FDI and trade, national economies are getting more and more linked and interdependent. The decline of trade barriers and of transportation costs is the most perceptible explanation of the growing internationalization of economies. However, it seems that this decline explains only a part of the growth of FDI and trade. In fact many observations, case studies (Feenstra, 1998; Hummels et al., 1998) and empirical analysis (Campa and Goldberg, 1997; Feenstra and Hanson, 1999; Hummels et al., 2001) indicate that the cause is the changing structure of the economic activity toward vertical specialization. For example, Feenstra (1998) presents the case of the Barbie doll and of the Nike shoes. Both products are designed and marketed by the American parent firms. However the production process is disintegrated and outsourced to firms in China, Taiwan, Philippines, South Korea and other Asian countries. Campa and Goldberg (1997) analyze the external orientation of manufacturing industries for the United States (U.S.), Canada, Japan and the United Kingdom (U.K.). Combining data on imports with input-output tables, they show that the use of imported inputs is steadily increasing especially in the case of the U.S. and the U.K. The increase in international activities and of vertical specialization has raised several questions and concerns in the academic sphere as well as in the political and public opinion. The growth of input's trade has created fears of job losses and production delocalizing from developed toward developing and low wages countries.

The question of vertical specialization has mainly been addressed theoretically. Given the growing extent of the international vertical specialization phenomenon and the implications it may have on economies, several authors (Grossman and Helpman, 2003; Antras, 2003; Antras and Helpman, 2004) have developed theoretical models to explain the firm's offshoring strategy. The analysis of offshoring needs to explain at the same

time the organization of production (make or buy) as well as the location of production (at home or abroad). For this purpose, the combination of theoretical elements from the international trade literature with elements of the industrial organization literature is necessary.

From our point view, offshoring corresponds to the delocalization of production to a different country. This delocalization can either take place within the firm boundaries, through vertical FDI, or at arm's length ,through international outsourcing.

Grossman and Helpman (2003), Grossman and Helpman (2004) Antras (2003), Antras and Helpman (2004) are examples of this emerging literature. In these models, final good producers face several choices to acquire intermediate inputs. They can produce the inputs through vertical integration or outsource the production to independent suppliers. Moreover the production of the inputs can take place either at home or abroad (in low wage countries). The choice of each firm depends on several trade-offs: difference between organization costs, difference between production costs and difference in the contractual environment. This literature puts forward the importance of firm heterogeneity and of sector specificities (headquarter intensity, capital intensity) in the prevalence of one mode of vertical specialization over the others. Although these models have similar aspects, they differ significantly in their conclusions, especially regarding the sorting pattern of heterogenous firms and offshoring choices.

As stated by Antras and Helpman (2004): "*Empirical evidence is needed to discriminate between [them] the models*" which is the aim of this paper.

For the time being, the empirical evidence on the determinants of the offshoring strategy is very scarce especially at the firm level. Antras (2003) presents an empirical analysis on U.S. intra-firm imports from 28 countries for 23 manufacturing industries. Intra-firm trade data was, first aggregated by industry and explained by industry characteristics, then aggregated by country and explained by country characteristics. The Antras (2003) analysis shows that intra-firm trade is prevalent in exporting industries intensive in capital and research and development (R&D) and with countries relatively abundant in

capital. Yeaple (2006) reproduces the Antras (2003) analysis for imports by U.S. multinationals from their foreign affiliates. The data is aggregated by industry and different sets of countries. Yeaple (2006) shows that intra-firm trade increases with the developing level of the exporting country, that capital intensity is relevant only for imports from low developed and emerging countries, and that R&D intensity is relevant especially in the case of developed countries. Marin (2006) presents the case of offshoring by Austrian and German firms to East-European countries. The distinction between vertical integration and arm's length transaction is based on the share of the parent company in the capital of the foreign affiliate. Marin (2006) shows that intra-firm imports by German parent companies expands with proximity and by the R&D intensity of the activity of the parent company and decreases with its capital intensity and with the wage level of the exporting country. Conversely, intra-firm trade by Austrian parent companies increases with the capital intensity of the activity of the parent and decreases with its R&D intensity.

The aim of the paper is to bring evidence on the determinants of the offshoring strategy. More precisely, our empirical analysis is based on the conclusions of the theoretical literature on this subject. We have selected a certain number of hypotheses and have constructed appropriate measures in order to investigate empirically their validity. We particularly focus on the relation between firm heterogeneity and the fixed costs related to each form of organization, on industry characteristics like the intensity in headquarter services, and on inputs specificity. We have also emphasized the role of market thickness and of the contractual environment of the exporting country.
The empirical analysis presented here is based on the "International Intra-group exchanges" survey realized by the French ministry of economy for the year 1999. This survey covers all international trade transactions by a sample of 4305 firms located in France. Although the number of firms present in the sample is relatively small, the survey covers, on average, 55% of the French imports and 61% of the French exports.

The "International Intra-group exchanges" survey provides very rich information on the structure of French trade and allows us to analyze the offshoring strategy by combining firm level, industry level and country level characteristics.
We define three modes of organization, vertical integration, partnerships and arm's length transactions. We investigate how the firm, industry and country characteristics affects the relative prevalence of these modes of organization. We take the analysis a step further by aggregating the data by country and industry to verify how the extent of firm heterogeneity [1], the headquarter services and capital intensities of industries, and the capital endowment of countries affect the relative share of each form of offshoring.

Our analysis shows that partnerships are associated with the highest level of fixed costs followed by arm's length relations while vertical integration is the cheapest in terms of fixed costs. Interestingly, the sorting pattern of firms regarding their offshoring strategy follows the hierarchy of fixed costs. More productive firms, as well as larger ones, import inputs from their partners, firms with intermediates level of productivity and scale import from independent suppliers and least productive firms vertically integrate. Moreover, the dispersion of productivity enlarges the share of trade with partners and reduces intra-firm trade. The analysis also shows that, as predicted by the property right theory of the firm (Grossman and Hart, 1986), intensity in headquarter services and input specificity favor vertical integration. On the country level, the results show that market thickness enhances arm's length transactions while the quality of the contractual environment is significant for the establishment of partnerships with foreign firms.

The organization of the paper is as follows; The next section discusses the literature on offshoring and specifies the theoretical hypotheses that we will test. The third section

[1]The extent of firm heterogeneity is represented by the dispersion of the productivity distribution in each industry.

presents the data. the fourth section presents the empirical investigation (methodology and results). Conclusions are presented in the fifth section.

2 Vertical FDI vs International Outsourcing: A Theoretical Framework for Offshoring

Vertical specialization gives firms several possibility to acquire inputs. They can use local or imported inputs produced within their boundaries or outsourced to independent suppliers. The analysis of vertical specialization needs, thus, to take account of the two dimensions characterizing this strategic choice; the geographical dimension (domestic vs imported inputs) and the organizational one (integration vs outsourcing). The traditional literature on the firm's boundaries (Williamson, 1975; Grossman and Hart, 1986) and that on internationalization (Helpman and Krugman, 1985; Markusen, 1984) analyze, each, one dimension of the vertical specialization strategy and are thus not sufficient to create an appropriate theoretical framework for offshoring.

The growth of vertical trade and of vertical FDI has motivated recent theoretical contributions on internationalization based on the theory of the Firm. These contributions can mainly be connected to three theories of the firm: the incomplete contracts and the property rights theory of the firm (Grossman and Hart, 1986; Hart and Moore, 1990), the theory of the firm as an incentive system (Holmstrom and Milgrom, 1994) and the theory of formal and real authority in organization (Aghion and Tirole, 1997). In this paper we will focus mainly on theoretical papers related to incomplete contracts, hold-up problems and the property rights theory of the firm since these theories are the most widely used to analyze firms'organization choices.

Real word transactions are characterized by the incompleteness of contracts. Con-

tracts are incomplete when they can not specify all contingencies related to a transaction. Contract incompleteness is mainly due to bounded rationality, leading to unforeseen contingencies, as well as to the cost of writing and enforcing contracts. Being unable to determine ex-ante all the contingencies, parties engaged in a relationships needs to renegotiate ex-post, after the production has took place and the production costs have been incurred,to set the price of the transaction and to bargain over the rents it generates. Ex-post renegotiation and bargaining are problematic when a transaction implicates a relation specific investment (RSI) by one or the two parties. RSI implies that the input is tailored to the specific needs of the parties engaged in the relationship and that it has no, or a very weak, value for an outside party. Parties with a limited outside option and thus a weak bargaining power fear to be "held-up" and not to receive the full marginal returns on their investment. Foreseeing this outcome, they will realize sub-optimal levels of RSI.

The property rights theory of the firm, elaborated by Grossman and Hart (1986), Hart and Moore (1990) and Hart (1995), emphasizes that the optimal allocation of ownership rights needs to depend on the parties RSI. In the context of this theory, contract incompleteness and hold up problems are not specific to outsourcing. Transactions within integrated firms are also subject to incomplete contracts. However ownership rights increase ex-post bargaining power and thus reduce ex-ante underinvestment. The allocation of ownership rights to the party realizing the most valuable RSI for the transaction will lead to the optimal outcome by reducing the severity of underinvestment by this party. In other words, when the input is intensive in the final good producer's services vertical integration is more optimal than outsourcing. Conversely, when the input is intensive in the supplier's services outsourcing is preferred.

The property rights and incomplete contracts theory constitutes the framework used by models like the ones of Feenstra and Hanson (2005), Grossman and Helpman (2003, 2005), Antras (2003) and Antras and Helpman (2004) to analyze the internationalization strategy.

Antras (2003) introduces incomplete contracts and ownership rights into the general equilibrium models of trade in the aim of offering a new view of the trade theory based on differences in factor intensities and factor endowments. He considers a final good producer requiring a specialized input from its supplier. Inputs are produced using the combination of two factors; capital and labor. Because of contracts incompleteness, RSI in capital and labor are non-contractible ex-ante. Antras (2003) extends the Grossman and Hart (1986) framework and considers that investment decisions in capital are transferable between parties. Labor investment decisions are harder to transfer. Local suppliers may have a better knowledge of the labor market, moreover managing workers may require a physical presence in the plant.

When the bargaining power of the supplier is weak, the allocation of the residual rights of control may not sufficiently incite the supplier to realize optimal levels of investment. In this case, the final good producer improves its profit by baring the capital investment costs of its supplier and thus reducing the severity of the hold-up problem faced by the supplier. In the case of capital intensive inputs, investment in capital is more relevant to the transaction than investment in labor. According to the property rights theory, ownership rights must be allocated to the party realizing capital investment. In the presence of capital cost sharing (when the final good producer bares the costs of capital investment) vertical integration is optimal. In the case of labor intensive sectors and since labor investment is always realized by the supplier, ownership must be allocated to the supplier, thus giving rise to outsourcing agreements.

On the international level, countries differ in their factor endowments while input's factor intensity are similar across countries. Production factors as well as final good are immobile internationally, only inputs are traded between countries. Under factor price equalization, the demand for each factor, in each country, will depend on the number of varieties produced in that country. Capital (labor) abundant countries will produce a share of the world production of capital (labor) intensive input varieties larger than

their share in world income. Trade of capital intensive inputs is realized within the boundaries of the firm while trade of labor intensive varieties is realized at arm's length. Antras (2003) shows that, for any pair of countries, the volume of intra-firm imports, as well as the share of intra-firm imports in total imports, of a country increases with the capital-labor ratio of the exporting country.
From the Antras (2003) model we can drive two testable hypotheses:
- ***Vertical Integration prevails in capital intensive input industries.***
-The share of Intra-Firm imports in total trade increases with the capital intensity of the exporting industry and with the capital abundance of the exporting country.

A major extension of the transaction costs and property rights theories was offered by papers like the ones of McLaren (2000) and Grossman and Helpman (2002). These models allows for the interdependence among firms' choices and endogenize the firm's ownership decision. An important determinant of the ownership decision at equilibrium, in these models, is the thickness of the market.
Grossman and Helpman (2002) consider the choice between vertical integration and outsourcing at the domestic level. There are three types of firms on the market, vertically integrated firms, specialized final good producers and specialized input suppliers. Outsourcing implies fixed cost of search. Before establishing a transaction, specialized firms need to search and find a suitable partner depending on the technological compatibility. The firm's choice depends on the traditional trade-off between the inefficiency, related to vertical integration, and transaction costs and search frictions, associated with outsourcing. The interaction between firms is twofold. The profit of a specialized firm increases with the number of specialized firms of the other type and decreases with the number of specialized firms of the same type. A rise in the number of specialized supplier will increase the probability of a match and reduces the search costs for a specialized final good producer raising thus its profit. However, an increase of the number of specialized final good producers will reduces the probability of a match and the profits

of each one of them. At equilibrium, the ownership decision will depend on the thickness of the market, the elasticity of substitution and the distribution of the bargaining power.

Grossman and Helpman (2005) consider the choice between domestic and international outsourcing. The contribution of this model is the endogenization of the location decision in equilibrium. However it does not treat the ownership decision, vertical integration being ruled out of the model. Similarly to Grossman and Helpman (2002), outsourcing requires a search for a suitable partner. Final good producers are located in the North while specialized suppliers are located both in the North and the South. Parties bargain in two steps; first, they bargain over the RSI required to customize the input to the need of the final good producer and second, they bargain over the price and the quantity of the input. Customization costs depend on the technological distance[2] between the two parties. Furthermore, the degree of contract incompleteness differs across countries. In fact, the model assumes that only a fraction, different from one country to another, of the supplier's investment is verifiable by court. The model shows that market thickness, represented by the number of suppliers, enhances outsourcing in a certain location. Final good producers prefer to search for partners in a thicker market to increase the likelihood of finding a closer input supplier. By choosing to search in a certain location, final good producers raise the demand for suppliers' services and thus the suppliers profit in this location as well as their willingness to enter the market. Market thickness has, thus, a feedback effect but this effect is limited by the wage response.

The location choice depends also on customizing technologies, search technologies and the quality of the legal system. Customizing technologies, represented by the use of computer-aided design for example, and search technologies, represented by the use of information and communication technologies (ICT), have the same impact on the

[2]The distance between the supplier expertise and the final good producer requirements.

outsourcing location. A uniform improvement of these technologies will not affect the location choice at equilibrium. Nevertheless, a disproportionate improvement in one location will result in a shift of outsourcing toward this location. The technological catch-up, a larger use of computers and ICTs or a larger internet coverage ratio, in certain emerging and developing countries may, hence, explain the boost of production delocalization toward these countries.

An improvement of the legal system, or of the contracting environment has a more complicated impact on the location decision. The improvement of the legal system in one country, represented by an increase of the verifiable fraction of the supplier investment, enlarges the profitability of outsourcing in that location but also affects the demand for labor and thus the wages in that location. More precisely, Grossman and Helpman (2005) show that a similar improvement of the contracting environment in both countries will raise outsourcing in the North on the depend of the South. An improvement of the legal system in the North, from an initial low level, will increase outsourcing in the North. However, if this improvement occurs at an initially significant level it may cause a shift of outsourcing toward the South. Finally, an improvement of the legal system, in the South, may or may not increase international outsourcing. From these models we can deduce the following testable hypotheses:

-Larger countries, having a thicker market, will attract more outsourcing.

-A higher level of customizing technologies and search technologies in a certain country will attract more outsourcing toward this country.

-Holding everything, especially wages, constant, a better contractual environment in a certain location should increase outsourcing in this location.

Grossman and Helpman (2003) build on the framework elaborated by Grossman and Helpman (2002, 2005) to analyze the choice between vertical FDI and international outsourcing. This model considers only the ownership decision while the location decision is exogenously imposed. Just as Grossman and Helpman (2002), firms face the trade-off between governance costs, higher under FDI, and transaction costs, higher un-

der outsourcing. The degree of contract incompleteness depends on the quality of the legal system of the exporting country. Specialized final good producers prefer to engage in a relationship with the closest supplier, in term of expertise. Both final good producers and independent suppliers have no outside option and they will split equally the rent generated by the relationship. At equilibrium, the prevalence of one mode of organization over the other will depend on the size of the industry, the quality of the legal system, the productivity advantage of specialized producers and the relative wage of the exporting country.

More precisely, an increase in the size of the industry, represented by the fraction of aggregated spending addressed to this industry, favors the prevalence of outsourcing over vertical FDI. The increase of the demand for final goods will increase the number of final good producers and thus the demand for suppliers' services. Consequently, the entry by independent suppliers will increase, and each final good producer will find more easily a relatively close supplier.

The prevalence of outsourcing is also enhanced by the quality of the legal system as well as by the efficiency advantage of specialized firms. However, it declines with the relative wage of the southern (exporting) country. The rise of the southern relative wage represents a fall of the world income relative to entry costs of intermediate producers as well as an increase in the cost of product design. The implication of these effects is a reduction of the profitability of independent suppliers. The number of specialized suppliers will thus fall and the distance, in expertise terms, between a final good producer and the closest supplier will grow.

From the Grossman and Helpman (2003) model we are able to extract the following testable hypotheses:

-Relatively low wage countries will attract more outsourcing than FDI.

-Firms in large industries will favor outsourcing over vertical integration.

Antras and Helpman (2004) present an interesting framework for the analysis of the internationalization decision. They endogeneize simultaneously the organization and location decision. In their model, final good producers, located in the North, face four choices of production: vertical integration, outsourcing at home, vertical FDI or international outsourcing. Moreover, firms are heterogenous in terms of their productivity. The production of the final good requires two inputs, headquarter services and manufacturing components. The first input can only be produced in the North by the final good producer while the manufacturing component can be produced either in the North or the South through vertical integration or outsourcing. Contracts are incomplete both in the case of outsourcing and integration. Nevertheless, under outsourcing the final good producer has no outside option while under integration it has the possibility, in case of disagreement, of firing the hired manager and seizing a fraction of the production.[3] This fraction differs across countries and is higher in the North. In other words, the final good producer has a higher bargaining power, and thus is able to appropriate a higher fraction of the revenues, under integration than under outsourcing. Additionally his bargaining power is higher when integration takes place in the North.

Production costs are lower in the South because of the low wages while fixed costs of organization are lower in North, the case of home sourcing, because of the geographical proximity between parties. However, fixed organization costs differs across modes of organization. Vertical integration requires large organizational costs and results in governance inefficiencies. Thus, regardless of the location of the manufacturing component production, fixed organizational costs are higher under vertical integration. The assumed hierarchy (in increasing order) of fixed organizational costs is the following: outsourcing in the North, vertical integration in the North, outsourcing in the South and vertical FDI in the South.

At equilibrium, the internationalization strategy is determined, at the firm level, by the productivity, at the sectoral level, by the difference in inputs's intensity and at the coun-

[3]Both independent and integrated suppliers have no outside option.

try level, by the difference in production and organizational costs. Antras and Helpman (2004) show that in sectors intensive in manufacturing components vertical integration is never optimal. Firms, according to their productivity, outsource domestically (in the North) or internationally (in the South). Given that fixed costs are higher under international outsourcing, high productive firms will outsource in the South while low productive ones will outsource in the North. The prevalence of international outsourcing over domestic one is raised by the wage advantage (lower wage) of the southern country as well as by a fall of trade costs for intermediate inputs. A higher dispersion of firm's productivity, representing a higher degree of heterogeneity between firms, enlarges the fraction of firms outsourcing in the South.

In sectors intensive in headquarter services, low productive firms will source domestically while more productive one will import the manufacturing component. In each location, more productive firms integrate while less productive firms outsource. In other word, the most productive firms will import input through vertical FDI while the least productive ones will outsource in the home country. Among the firms with intermediate levels of productivity, the more productive ones outsource in the South and the less productive ones integrate in the North.

In headquarter services intensive sectors; a decline in the southern wage, or of trade costs, favors foreign sourcing and this effect if disproportionably larger on international outsourcing relative to vertical FDI. Moreover, when domestic sourcing falls, the decrease of vertical integration is disproportionably larger than that of domestic outsourcing. In fact, a reduction of the southern wage will not be sufficient to induce least productive firms, outsourcing in the North, to source from the South. However, it will induce some firms integrated in the North to switch to international outsourcing. A higher productivity dispersion will increase foreign sourcing and favor the prevalence of vertical FDI over international outsourcing. It will also raise the relative prevalence of domestic integration over domestic outsourcing. This effect of productivity dispersion is similar to the one shown in Melitz (2003) and Helpman et al. (2004). Moreover, a

higher headquarter services intensity favors home sourcing over international one and favors the prevalence of integration over outsourcing.
From the Antras and Helpman (2004) model we extract the following testable hypotheses:
-Vertical FDI requires higher fixed organizational and search costs than international outsourcing.
-The pattern of firms' choice follows the pattern of organization costs; Most productive firms engage in vertical FDI and less productive ones engage in international outsourcing and the least productive ones outsource domestically.
-A higher degree of firms' heterogeneity favors the prevalence of vertical FDI over international outsourcing.
-Intensity in headquarter services favors the prevalence of vertical FDI.
-Lower wages in the exporting country favor the prevalence of international outsourcing.

3 Data Description

3.1 The Framework of the Analysis

Our analysis is based on a data set extracted from the "International Intra-group exchanges" ("Enquête sur les Échanges Intra-Groupe") a survey conducted by the French ministry of economy via the SESSI (Service Des Etudes Statistiques Industrielles).
In the light of the modern developments of the economic activity and the need to account and analyze the growing internationalization of production, represented by FDI and international trade, the French ministry of economy has realized, in 1999, the "International Intra-group exchanges" survey in order to have a clear picture of the organization and of the structure of international trade by French firms. One of the main objectives of the survey was to analyze the strategy of French firms, and especially French

groups, toward globalization and how this strategy is affecting the organization of their international trade transactions.

This investigation resulted in a unique data set of 4305 individual firms located in France controlled by 2023 international and industrial groups. This data set covers, on average, 55% of the French imports and 61% of the French exports. Their are 218 countries toward which these firms export and 182 one from which they import. Moreover, French located affiliates trade mostly with other European countries as well as the U.S.[4]

Given the aim of the study, the framework of the investigation has been narrowed to groups that are industrial and international at the same time. Commercial groups have been evicted because their trade structure does not reflect the impact of globalization on the organization of the production process. A group is defined as industrial if it controls[5] at least one industrial affiliate, wherever it is located. It is defined as international if it controls at least one affiliate located outside of France. The framework of the analysis has been limited to affiliates for which the group has a majority control as well as to these belonging to a joint-venture.

Each firm, present in the sample, has to provide for each of its international trade transactions the value of the transaction, the classification of the imported or exported product (following the 4 digits CPA classification) as well as the country of origin (imports) or destination (exports). For each transaction, firms have also to precise the organization mode. In fact, they report the share of the transaction traded with an affiliated firm located abroad, the share traded with partners and the share traded with third parties or independent suppliers. The survey considers as partnership: technological

[4]For example, Germany counts for almost 20% of the imports (in terms of number of transaction), Italy for more than 10%, Belgium and the U.K. for 9% each. Exports are less concentrated. Germany counts for the highest share of French exports but this share is of 7% and Belgium, Italy and the U.K. account for 6% each.

[5]Control rate at least equal to 50%.

alliances, licensing agreements, franchise and subcontracting agreements. We are thus able to identify three modes of organization for the offshored production: vertical integration (associated to intra-group trade), partnerships (associated to trade with partners) and arm's length transactions (associated to trade with independent suppliers). Since each firm reports separately each of its transactions, their are several observations per firm. More than half of the transaction are entirely realized with third parties, almost 30% are entirely realized within the group and only 4% of the transactions are partially or entirely realized with partners. In this paper we focus on firms in manufacturing sectors since our objective is the study of the international organization of the production process. When we limit the sample to manufacturing affiliates, from which we exclude natural resources sectors,[6] we are left with 2790 affiliates and 230086 observations.
Figure 1 illustrates the offshoring structure in our sample. It shows, that French firms imports their inputs mostly from Northern countries.[7] It shows also that the dominant mode of organization is outsourcing[8] regardless of the location.

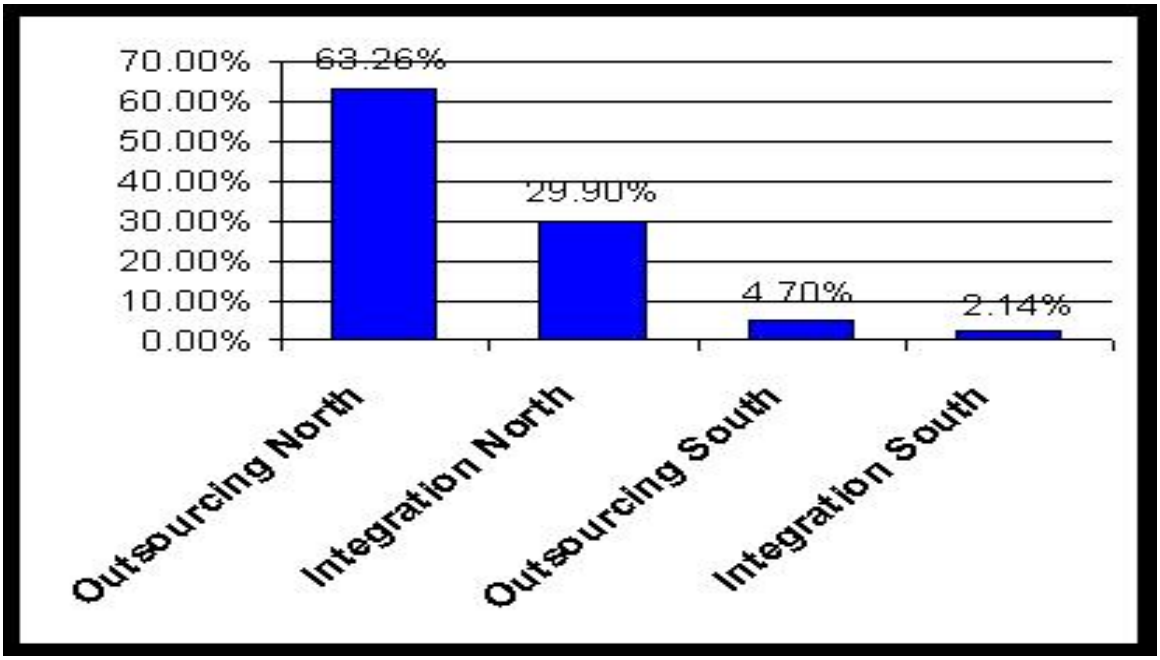
We have completed our data with information on the productive activity of firms. This information is extracted from the firm annual survey "Enquête Annuelle d'Entreprise (EAE)" realized by the French ministry of industry. It is exhaustive, obligatory and concerns all firms with more than twenty employees. The "EAE" survey provides data on the productive activity of firms such as output, sales, value-added, number of employees, stock of capital, investment and use of intermediates. This data allows us to estimate the total factor productivity (TFP) of firms and to construct several control variables such as scale and to identify the sector of main activity. Moreover, we have constructed several industry and country level variables using the OECD statistical sources and the World Bank development databases.

[6] Antras (2003) considers that the patterns of ownership in natural resources sectors may be determined by factors such as national sovereignty.

[7] The distinction between the North and the South follows the World Bank definition of developed and developing countries.

[8] Outsourcing combines trade with partners and with independent suppliers.

Figure 1: The Offshoring Structure



3.2 Descriptive Statistics of Intra-Firm Trade

The "International Intra-group exchanges" survey focuses on the determinants, motivations and evolution of intra-group trade. This allows us to present a descriptive analysis of intra-group trade which is very interesting for a more complete comprehension of vertical specialization.

Concerning the decision to trade within the group or to outsource, the results of the survey show that, for the majority of the firms, this decision is taken at the headquarter level and not at the firm level.

Concerning the choice of intra-group trade, the survey presents a series of 22 moti-

Table 1: Decision of Intra-Group Trade

At which level the decision to trade within the group is taken:	
At the firm level	32.79%
At a higher level within the group	52.45%
At another level within the group	4.02%
At a joint level	10.74%

vations that push the firms to prefer intra-group trade over outsourcing. The answers of the firms go from "Perfectly agree" to "No object". In table 2, we present, for each motivation, the percentage of firms choosing a certain possibility of answer. Table 2 shows that the control of the production process plays an important role in the choice of intra-group trade. In fact, for 63% of the firms, the control of the quality of the production is a motivation to supply within the group. The control of the marketing strategies and of the after-sale service is a valid argument in favor of intra-group trade for almost 54% of the firms. Table 2 shows also that another important matter for firms is organization; 66% of them prefer intra-group trade in order to reduce organizational costs and 60% of the firms choose internalization in order to be supplied with more stability and at lower costs.

Table 3 presents incentives for intra-group imports On the imports' side, table 3 points toward international disintegration of the production process by French firms. In fact, intra-group imports are not motivated by quality upgrading neither by capacity adjustment. Only 16% of the imports have a higher technological level than the production of the group in France and only 8% have a higher quality. They are essentially destined to complement the firms'production in France. For more than 80%, intra-group imports are goods that are not produced by the group in France.

Table 2: Intra-group Trade Motivations

	Perfectly agree	Agree	Does not agree	Does not agree at all	No object
Lesser sensibility to conjuncture uncertainties	12.75%	36.20%	12.48%	7.62%	30.95%
Lesser sensibility to exchange rates'changes	13.04%	24.11%	14.94%	12%	35.91%
Lesser sensibility to raw materials' prices	7.98%	23.39%	17.91%	13.54%	37.18%
Ability to plan exportation in advance	9.53%	30.05%	15.41%	8.84%	36.17%
Stability of supply	18.40%	43.36%	7.97%	4.11%	26.17%
To increase exportation	17.29%	32.04%	12.49%	5.6%	32.57%
To minimize supply's price	20.44%	38.37%	12.60%	4.37%	24.21%
To avoid complicated contracts	16.11%	34.29%	12.05%	5.68%	31.86%
Better flexibility to adjust quantities	10.56%	37.25%	19.43%	8.75%	24.01%
Better flexibility to adjust prices	15.32%	44.59%	15.04%	5.53%	19.53%
To reduce organization costs	20.06%	45.98%	13.96%	4.58%	15.68%
Easier financing	21.52%	34.79%	11.34%	5.39%	26.95%
To dissociate components production and assembling	6.07%	16.57%	10.42%	6.40%	60.54%
Economy of scale	28.94%	35.09%	4.31%	2.4%	29.26%
To easily control the quality of products	22.59%	40.96%	11.14%	4.39%	20.92%
To avoid imitation of products	14.20%	24.90%	13.14%	6.9%	41.47%
To Maximize the profitability of marketing expenses	8.65%	23.15%	12.03%	6.88%	49.30%
To control marketing strategies	23.40%	35.46%	5.47%	3.14%	32.53%
To avoid protectionist barriers	4.88%	18.63%	13.67%	7.88%	54.96%
To access a distribution network	8.57%	23.17%	15.38%	9.98%	43.05%
To get closer to the clients	23.75%	33.67%	10.64%	5.46%	26.49%
To control the quality of after-sale services	18.37%	35.52%	9.82%	4.60%	31.69%

4 Methodology and Results

In this section we present the econometric methodology that we follow to test the hypotheses presented earlier. We also present and comment the empirical results. We are interested by the offshoring strategy, thus we do not analyze domestic sourcing neither the choice between domestic and international sourcing. We consider three modes of offshoring; FDI, Partnerships and Outsourcing. We assume that a transaction is realized under FDI if 50% or more of its value is imported from affiliated firms. Similarly,

Table 3: Incentives for Intra-group Imports

The firm imports products from firms within the group because	Yes	NO
The group does not produce the same products in France	81.48%	18.52%
The group does not have the necessary capacity in France to satisfy the demand	54.13%	45.83%
Those imports incorporate higher R&D and innovation than the goods produced by the group in France	16.11%	83.89%
Those imports have higher quality than the goods produced by the group in France	7.77%	92.23%
Those imports result from the competition between the affiliates of the group	27.20%	72.80%
The firm is a logistical platform for the region	42.86%	57.14%

we assume that a transaction is organized by a Partnership (outsourcing) if 50% or more of its value is imported from a partner (third party).

4.1 The Structure of Fixed Organization Costs

Each mode of vertical specialization requires a fixed cost of organization that represents costs of governance, monitoring, contract enforcing as well as search costs. These costs differ between modes of organization as well as between locations. Vertical integration requires higher governance costs while outsourcing requires search costs. Domestic sourcing, regardless of the mode of organization, is assumed to necessitate lower organization costs than foreign sourcing. The hierarchy of fixed costs is very important because it determines the pattern of vertical specialization according to firm's productivity. We associate fixed costs with firm's fixed assets and in order to determine the structure of organization costs we have compared firm's fixed assets according to their offshoring strategy.

Table 4 shows that, contrary to Antras and Helpman (2004) assumption, FDI requires

Table 4: The Structure of Organization Costs

Offshoring Mode	Average Fixed Assest
FDI	1316236
Partnership	5374626
Outsourcing	2109267

the smallest amount of fixed organizational costs while Partnership requires the highest amount. The differences between the fixed costs associated to each mode of offshoring are statistically significant at the 1% level.[9] This result confirms the figure in table 2 where 66% of the firms link the choice of intra-group trade to the reduction of organization costs. Partnerships necessitate higher fixed cost than arm's length transactions. While both modes of organization requires search costs for a suitable partner we can assume that costs of governance and monitoring are higher in the case of Partnerships.

4.2 The Choice of Offshoring Strategies: A Multinomial Logit Estimation

We have analyzed the choice of offshoring strategies by estimating a multinomial logit model. Each firm faces three different choices to organize its international trade transactions. A multinomial logit model allows the simultaneous estimation of these three choices. More precisely the specification of the multinomial logit model is as follows:

$$Prob(Y_i = j) = P_{ij} = \frac{e^{\beta_j' x_i}}{\sum_{k=1}^{3} e^{\beta_j' x_i}} \quad j = 0, 1, ...j$$

P_{ij} is the probability that the dependant variable, the choice of an offshoring startegy, takes the value j at the ith observation. As mentioned earlier, j can be vertical

[9]The statistical difference is based on a mean difference test.

integration($j = 1$), Partnership ($j = 2$) or Outsourcing ($j = 3$). x_i is the vector of explanatory variables (the same as in the Probit estimation) at the firm, the sector and the country level.

However, the model is unidentified in the sense that there are more than one solution to β_1, β_2 and β_3 that lead to the same probabilities for Y_1,...Y_3. The identification of the model imposes that one of the choices is defined as a base group and its β set to zero.Thus the remaining coefficients would measure the relative change with respect to the base group. We first set outsourcing as our base group. Thus we have:

$$\frac{Prob(Y_i = j)}{Prob(Y_i = 3)} = e^{\beta_j' x_i}$$

In other words, we interpret the point estimates of the multinomial logit as changes,induced by a change in the explanatory variables, in the probability of a choice with respect to the base group. This means that the choice j (FDI, Partnership) will be more or less likely relative to the base group (Outsourcing). Secondly, we set FDI as our base group in order to have the relative likelihood of Partnerships compared to FDI depending on the independent variables.

We have associated the choice of each mode of offshoring to a set of variables reflecting firm heterogeneity, industry and country characteristics:

- Total factor productivity (TFP); this variable represents firm heterogeneity. We estimate TFP using the semiparametric estimation proposed by Olley and Pakes (Olley and Pakes, 1996).[10] ***We expect the pattern of firms' productivity to follow the structure of organizational costs. However, we assume that the productivity may be affected by the offshoring strategy, thus as robustness check we use a two years lag of TFP as explanatory variable***

- Scale: This variable is another measure of firm heterogeneity. We measure scale

[10]We estimate TFP separately for each sector using the entire "EAE" data set. The purpose of the O&P methodology is to overcome the selection and simultaneity problems faced by the econometrician when estimating productivity.

by the number of employees. Larger firm have the possibility to spread the fixed costs of organization on a larger scale and thus maintain a competitive average cost of production.

- Headquarter Services Intensity: We associate headquarter services with the R&D activity. This variable is measured as the ratio of R&D expenditures to total production at the two digit industry level.[11] In this variable, the sectoral classification is related to the main activity of the importing firms. R&D expenditures at the sectoral level are taken from the OECD Science and Technology Statistics database[12] and total production is calculated using the "EAE" data set.
  We expect R&D intensity at the Firm's level to increase the prevalence of international vertical integration.

- Input Specificity: We associate input specificity with R&D intensity. Input specificity represents the RSI required for the production of the input and indicates the extent of transaction costs associated with the transaction. This variable is measured similarly to the headquarter services intensity however it is calculated at the level of the imported input's industry.
  A higher input specificity increases transaction costs as well as the severity of hold-up problems. We thus expect R&D intensity at the input's level to favor FDI.

- Capital intensity: this variable is measured as the ratio of capital (fixed asset) stocks to total employment at the three digit sectoral level. Capital stocks and total employment are calculated using the "EAE" data set. We define two capital intensity variables, one at the imported input's industry level and one at the firm's industry level. Capital intensity at the firm level may be interpreted as another measure of Headquarter services intensity.

[11] We also measured R&D intensity as the ratio of R&D expenditures to value added but the results are very similar across these two measures.

[12] R&D expenditure are only available at the two digit industry classification.

We expect capital intensity at the Firm's industry level to increase FDI, and following Antras (2003) we expect capital intensity at the input's industry level to favor FDI as well.

- Capital Endowment: this variable is measured at level of the exporting country and corresponds to the ratio of capital stock to the labor force. We have obtained data on the labor force and fixed capital formation from the World Bank data base. We construct measures of capital stock following the perpetually inventory method using data on fixed capital formation from 1960. We have assumed an annual depreciation rate of 15%. To approximate the value of the capital stock at the beginning of the time series we have assumed a 5% pre-sample growth rate of the capital stock.
  Following Antras (2003) we expect capital endowment to favor FDI.

- Market Thickness: We measure market thickness by the employment level in manufacturing industries in each country. We construct the market thickness variable using data on employment from the World Bank data base.
  Market Thickness represents the easiness to find a suitable supplier, we thus expect this variable to have a positif impact on Partnerships and Outsourcing.

- ICT: this variable corresponds to the per capita expenditures on information and communication technologies at the exporting country level. It is obtained from the World Bank data base and represents the state of search technologies in the exporting country.
  A good level of search technologies reduces search costs, we thus expect this variable to favor Partnerships and Outsourcing.

- Internet Diffusion: This variable corresponds to the number of internet users per 1000 people in the exporting country. It is obtained from the World Bank data base. It is another measure of search technologies, we expect it to have a similar effect as the ICT variable.

- Industry Size: This variable represents the relative significance of the firm's industry. According to Grossman and Helpman (2002, 2003) the size of the firm's industry may have two opposite effects on the organization choice. A larger downstream industry increases the demand for suppliers's services and thus induces the entry by specialized supplier and creates a thicker upstream market. However, a larger downstream industry means a larger number of final good producers searching for suitable suppliers which makes it harder and more costly for each one of them. In the theoretical framework, with two countries, the size of the downstream industry is measured at the level of the importing country. In the real world, it is more concrete to assume that demand for suppliers' services depends on the global size of the downstream industry and not only on its size in France. We construct the measure of the industry size using the "Trade and Production" data base of the CEPII.[13] This data set presents, for each manufacturing industry following the 2-digits ISIC classification, the total output in each of the 183 countries it covers. We aggregate the output of each industry over all the countries, we have also aggregated the output over all industries and countries to create a measure of world total manufacturing production. We then construct our measure of industry size as the share of the worldwide industry output in the total worldwide manufacturing output.

- Wage: this variable corresponds to the average industrial wage in each exporting country. Data on wages are from the Rama and Artecona (2002) database. Wages represent production costs in the exporting country. Lower wages, in a certain location, favor international sourcing from this location. Antras and Helpman (2004) show that lower wages increase the prevalence of international outsourcing over vertical FDI. However, given the structure of fixed costs, ***we expect lower wages to favor the relative prevalence of FDI.***

- Rule of Law: this variable represents the quality of the legal system in the export-

[13] A detailed presentation of this data base is available in Mayer and Zignago (2005).

ing country. It corresponds to the "Rule of Law" variable from the Kaufmann et al. (2003) governance database for the year 1999. A better legal system reduces the transaction costs related to contract enforcement and reduces risks related to the hold-up problem.
We expect a better legal system to favor Partnerships and Outsourcing compared to FDI.

- GDP per capita: this variable is from the World Bank database and is added as a control variable.

- Distance: this is also a control variable which represents the distance between France and the exporting country. For each firm, we have its location at the regional level.[14] We have thus calculated the distance as the great circle distance between the main city of the exporting country and the main city of the firm's region. The countries' geographical coordinates are from the CEPII's "Trade and Production" database[15] and those of the French regions ("departement") are from Crozet et al. (2004).

Results of the multinomial logit estimation are presented in table 5.The first (fourth) column compares FDI to Outsourcing, the second (fifth) column compares Partnership to Outsourcing while the third (sixth) column compares Partnership to FDI.

The multinomial logit estimation shows clearly that the pattern of firm heterogeneity follows the structure of fixed costs. Productivity and scale reduce the probability of vertical integration relatively to outsourcing, moreover they enhance the probability of establishing partnerships in comparison to outsourcing and FDI. The pattern of firm

[14]The regional level corresponds to the Nuts 3 classification. Each region corresponds to a French "departement".

[15]We have chosen New York as the main city the US, Toronto for Canada and Frankfurt for Germany.

heterogeneity is confirmed in the third and sixth columns which show that measures of firm heterogeneity (TFP and scale) favor the choice of partnership in comparison to FDI. To summarize, table 5 shows that more productive firms and larger ones offshore their production through partnerships, firms with intermediate levels of productivity and scale establish arm's length transaction with independent suppliers and relatively small and low productive firms offshore through from vertical integration.

The second point we consider is related to the intensity in headquarter services and to input specificity. The transaction costs theory predicts that when input specificity is significant transaction costs related to outsourcing are high and vertical integration is more efficient to organize production. The property rights theory put forward that when the transaction is intensive in the final good producer's specific investment vertical integration is optimal. Our results confirm both these hypotheses. Both our measures of headquarter services intensity and input specificity favor FDI in comparison to outsourcing as well as partnerships. Interestingly, both measures increase the relative probability of outsourcing compared to that of partnerships. This result means that, in headquarter intensive industries, when firms do not integrate they do not establish long term and contractually complex relationships. They prefer to source from independent suppliers probably awaiting for the establishment of an affiliate in the exporting country.
Moreover, the capital intensity at the firm level, which we have considered as an another measure of headquarter services, have the similar effect as the headquarter services variable. It increases the relative probability of vertical integration in comparison to outsourcing as well as partnerships and it favor outsourcing relatively to partnerships.

Regarding the assumptions of the Antras (2003) model related to the capital intensity of imported inputs and the relative abundance in capital of the exporting country, our

results contradicts these hypotheses. More precisely, table 5 shows that capital intensive inputs are traded through arm's length transaction, especially with independent suppliers. The variable representing capital intensity at the input level reduces the probability of vertical integration relative to that of outsourcing and partnerships. Moreover, the relative capital abundance of the exporting countries also reduces the relative probability of vertical FDI. The results of the Antras (2003) models depends on the transferability of investment decision assumption. Antras (2003) analyzes the case where the bargaining power of the supplier is weak and where the final good producer bears the totality of the investment costs of its supplier. Jabbour (2006) provides an empirical analysis of the transferability of investment decision assumption based on data from French manufacturing industries and shows that this assumption is valid only in industries sensitive to input specificity, especially the ones intensive in R&D expenditures. When input specificity is not significant the hold-up problem does not occur because the supplier can always sell the input to a third party and, thus, will always realize an optimal level of investment. Capital intensive inputs are not necessary specific assets, for this reason final good producers do not need to engage in investment cost-sharing with their suppliers in these industries and thus vertical integration is not optimal for the offshoring of these inputs.

Another significant element of the organizational choice of offshored production is the market thickness in the exporting country. Market thickness will determine the search effort required by each final good producer to find a suitable partner. When the search costs are very high, vertical integration is optimal. Our results confirm this assumption. In countries with thicker markets, firms prefer the establishment of contractual relationships. The market thickness variable reduces the relative probability of vertical FDI in comparison to outsourcing as well as partnerships. However, the market thickness variable has no significant impact on the choice between outsourcing and partnerships, since both mode of organization require the search for a suitable partner.

The quality of the search technologies also affect the choice of offshoring modes similarly to the market thickness. A higher level of search technologies reduces the search costs and decreases the necessity of vertical integration. We have represented the search technologies by two country specific variables, the internet diffusion and the investment in ICTs. Interestingly, these two variables have not the exact same effect. The internet diffusion variable favor the relative probability of outsourcing in comparison to vertical FDI as well as partnerships while having no significant effect on the choice between FDI and partnerships. The ICT variable increases the probability of Partnerships relatively to that of FDI and of outsourcing while having no significant impact on the choice between FDI and outsourcing. The internet diffusion variable represents a basic level of information technologies while the investment in ICTs represents the effort made to upgrade and improve the available information and communication technologies. The fact that investment in ICTs favor partnerships suggest that this mode of offshoring gives place to an exchange of information and technology as well as monitoring and control. Relationships between parent companies and their affiliates also give place to flows of information and technology, however these flows are easier to channel between integrated firms and depend, to a lesser extent, on the technological state of the host country. Arm's length relationships with independent suppliers do not seem to engage the firms in information and technology transfer. Moreover, if outsourcing corresponds to relatively short term relationships (in comparison to partnership) it requires recurrent search and matching process which my explain its sensitivity to the basic levels of search technologies.

The size of the downstream industry favors long term relationships, vertical integration and partnership, relatively to outsourcing. Nevertheless, it enhances the probability of partnerships in comparison to FDI. This result may be explained by the double effect of the size of the downstream industry on search costs. A large number of final good producers increases the entry by specialized suppliers as well as the competition for their services. Each final good producer, in a large industry, prefer to establish a long

term relationship to avoid recurrent high search costs, on the other hand the entry by specialized suppliers enhances the attractiveness of partnerships compared to vertical integration.

The quality of the legal system matters only in the case of partnerships. As expected, it favors partnership relatively to vertical integration. However, the fact that the quality of legal system favors partnership over outsourcing and does not affect the choice between FDI and outsourcing suggests that partnerships are associated with more complex contractual agreements than outsourcing. Note that the quality of the legal system has two opposite effects on the choice of FDI. One one hand, a better legal system means a lower level of contract incompleteness and thus reduces the probability of FDI. On the other hand, the quality of the legal system is an indicator of the quality of the institutions and of the governance in the exporting country, in this sense a higher level of the legal quality will increase the attractiveness of the country for FDI inflows.
According to our expectation and given the structure of fixed costs and the pattern of firm heterogeneity, the wage level in the exporting country has a negative effect on the relative probability of vertical FDI. This results means that when foreign production costs decrease, a larger share of domestic firms are able to incur the offshoring costs and to switch from domestic sourcing to foreign sourcing. Since these firms are less productive than the ones engaged in offshoring, they will switch to the least expensive mode of organization, vertical FDI.

4.3 The Relative Prevalence of Offshoring Modes

In this section we investigate the relative prevalence of the offshoring modes. Our main interest is the impact of the extent of firm heterogeneity on the relative prevalence of the the different modes of organization. Helpman et al. (2004) associate the degree of heterogeneity with the dispersion of firm's productivity. We calculate productivity

Table 5: The Choice of Offshoring Strategies: A Multinomial Logit Estimation

	Base Group: Outsourcing		Base Group:FDI	Base Group: Outsourcing		Base Group:FDI
	(FDI)	(Partnership)	(Partnership)	(FDI)	(Partnership)	(Partnership)
TFP	–0.257***	1.30***	1.56***			
	(0.043)	(0.113)	(0.118)			
TFP (Lagged)				–0.08*	1.29***	1.37***
				(0.044)	(0.12)	(0.124)
Firm Scale	–0.067***	0.564***	0.632***	–0.055***	0.58***	0.636***
	(0.007)	(0.017)	(0.018)	(0.007)	(0.018)	(0.018)
GDP per capita	0.859***	–0.943***	–1.8***	0.858***	–1.059***	–1.91***
	(0.11)	(0.21)	(0.22)	(0.11)	(0.214)	(0.023)
Market Thickness	–0.127***	–0.034	0.093***	–0.13***	–0.014	0.116***
	(0.009)	(0.022)	(0.023)	(0.009)	(0.023)	(0.024)
Wage	–0.183***	–0.335***	–0.152**	–0.21***	–0.369***	-0.161**
	(0.035)	(0.067)	(0.072)	(0.036)	(0.069)	(0.75)
Rule of Law	–0.028	0.373*	0.4**	0.32	0.382**	0.35
	(0.099)	(0.196)	(0.21)	(0.103)	(0.202)	(0.216)
Distance	0.127***	0.241***	0.114***	0.125***	0.254***	0.128***
	(0.012)	(0.027)	(0.029)	(0.012)	(0.029)	(0.03)
ICT	0.013	0.492***	0.478***	–0.36	0.449***	0.485***
	(0.057)	(0.11)	(0.115)	(0.059)	(0.11)	(0.119)
Internet Diffusion	–0.086***	–0.125**	–0.039	–0.072**	–0.139**	-0.067
	(0.029)	(0.061)	(0.065)	(0.029)	(0.064)	(0.068)
Headquarter Intensity	0.176***	–0.155***	–0.331***	0.166***	–0.176***	–0.34***
	(0.009)	(0.023)	(0.025)	(0.009)	(0.024)	(0.025)
Input Specificity	0.148***	–0.008	–0.156***	0.143***	–0.026	–0.169***
	(0.009)	(0.022)	(0.023)	(0.009)	(0.023)	(0.24)
Capital Endowment	–0.599***	0.585***	1.184***	–0.549***	0.824***	1.37***
	(0.064)	(0.13)	(0.138)	(0.065)	(0.133)	(0.142)
Capital Intensity	–0.196***	–0.047	0.149***	–0.217***	–0.096**	0.121***
(Product level)	(0.015)	(0.039)	(0.041)	(0.016)	(0.041)	(0.043)
Capital Intensity	0.065***	–0.303***	–0.368***	0.077***	–0.26***	-0.338***
(Firm level)	(0.017)	(0.044)	(0.046)	(0.017)	(0.047)	(0.049)
Industry Size	0.133***	0.653***	0.52***	0.147***	0.59***	0.446***
	(0.014)	(0.037)	(0.039)	(0.014)	(0.039)	(0.040)
No. of obs	67182	67182	67182	62815	62815	62815
Log Likelihood	-41173.71	-41173.71	-41173.71	-38882.88	-38882.88	-38882.88
Pseudo R2	0.048	0.048	0.048	0.046	0.046	0.046

All independent variable are in natural logarithm. ***, ** and * represent respectively statistical significance at the 1%, 5% and 10% levels.

dispersion as the standard deviation of the productivity distribution in each industry, following the 4 digits French classification. We obtain the standard deviation of the pro-

ductivity distribution from the "EAE" data set.
According to the theory, Melitz (2003), Helpman et al. (2004), Antras and Helpman (2004), the extent of firms heterogeneity should enlarge the prevalence of the mode of offshoring adopted by high productive firms and reduce the prevalence of the one chosen by the least productive firms. In the light of our earlier results ***we expect the productivity dispersion to enhance the prevalence of partnership and to reduce the prevalence of FDI.***

We aggregate the transactions' value by country and industry. The industry corresponds to the main activity of the final good producer, the French importing firm, and follows the 4 digits French classification. We define the relative prevalence as the ratio of one mode of organization over the other. Since our main interest in on the effect of the extent of firm heterogeneity, we focus on the relative prevalence in accordance with the pattern of firms's productivity. In other words, we have focused on the relative prevalence of outsourcing over FDI and that of partnerships over outsourcing.
In addition to the productivity dispersion, we add country and industry characteristics, such as capital endowment at the country level, headquarter services intensity and capital intensity at the industry level. Following Yeaple (2006), we also add the average firm size as well as the ratio of value-added to sales in each 4 digits industry to the set of explanatory variables. One of the problems of this analysis is the presence of zeros, the absence of a certain mode of organization in a pair of country-industry. To minimize the creation of missing values, we choose, as a denominator of the ratios, the most frequent mode of organization, outsourcing. Moreover, instead of estimating a linear regression by taking the logarithm of the dependent variable, and thus eliminating the zeros, we estimate our specification using a Poisson regression (Silva and Tenreyro, 2003; Yeaple, 2006).
Table 6 presents the result of the Poisson estimation. In the first and third columns the dependent variable is the ratio of FDI over outsourcing in each pair of country and

Table 6: The Relative Prevalence of Offshoring modes

	$(\frac{FDI}{Outsourcing})$	$(\frac{Partnership}{Outsourcing})$	$(\frac{FDI}{Outsourcing})$	$(\frac{Partnership}{Outsourcing})$
Productivity Dispersion	–0.196***	7.575***		
	(0.053)	(0.107)		
Productivity Dispersion(Lagged)			–1.420***	8.73***
			(0.050)	(0.138)
Headquarter Intensity	0.402***	–0.222***	0.417***	–0.117***
	(0.006)	(0.009)	(0.006)	(0.012)
Capital Endowment	–0.270***	–0.61***	–0.271***	–0.633***
	(0.005)	(0.012)	(0.005)	(0.012)
Capital Intensity	–0.128***	–1.18***	–0.049***	-1.79***
	(0.012)	(0.042)	(0.012)	(0.046)
Value Added Ratio	0.029	6.85***	–0.492***	7.447***
	(0.024)	(0.112)	(0.027)	(0.105)
Mean Scale	0.768***	0.925***	0.853***	1.15***
	(0.007)	(0.02)	(0.007)	(0.02)
No. of obs	4081	4081	3871	3871
Log Likelihood	-110984.65	-15475.16	-109301.58	-14181.62
Pseudo R2	0.11	0.31	0.118	0.32

All independent variable, except for the Productivity dispersion, are in natural logarithm. ***, ** and * represent respectively statistical significance at the 1%, 5% and 10% levels.

industry while the dependent variable in the second and fourth section is the ratio of partnership over outsourcing. Table 6 shows, as expected, that the dispersion of productivity enlarges the prevalence of partnership and reduces that of FDI. The other results corroborate our previous findings. Headquarter services intensity and capital intensity (at the firm level) favor the prevalence of FDI over outsourcing and that of outsourcing over partnerships. Further capital endowment at the country level boosts the relative prevalence of outsourcing.

5 Conclusion

This paper presents an empirical analysis of the offshoring strategy by French manufacturing firms. Offshoring corresponds to the delocalization of certain steps of the production process to a foreign country. This delocalization can take place within the boundaries of the firm, through FDI, or at arm's length, with independent suppliers. Offshoring can also be organized by certain "Hybrid" forms of organization such as the establishment of long term partnerships.
The growing significance of offshoring in international trade flows (Feenstra, 1998; Campa and Goldberg, 1997) has pushed the emergence of a theoretical literature analyzing the internationalization strategy at the firm level. This theoretical literature combines elements of the international trade literature with elements from the firm's theory in the purpose of drawing a framework allowing the endogenization of the internationalization strategy (location and organization) at equilibrium. In this paper, we focus on theoretical models based on the property rights and transaction costs theories of the firm (Williamson, 1975; Grossman and Hart, 1986), more precisely the Grossman and Helpman (2002, 2003, 2005), Antras (2003) and the Antras and Helpman (2004) models. On the basis of the conclusions of these models, we define a certain number of testable hypotheses and we empirically investigate their validity.

We study the offshoring strategy by applying a multinomial logit model as well a Poisson estimation of the relative prevalence of the organization modes. We mainly focus on firm heterogeneity as a determinant of the offshoring strategy. We also emphasize the role of country characteristics, such as the wage, capital endowment and market thickness, the role of industry characteristics such as the size, intensity in capital or in headquarter services, and the role of input specificities. Our results partially confirm the conclusion of the Antras and Helpman (2004) model regarding firm heterogeneity. In fact, we find that the pattern of firm heterogeneity, represented by the productivity and scale, follows the structure of organizational fixed costs. However, and to the con-

trary to the Antras and Helpman (2004) assumptions, our data show that contractual relationships requires higher organizational costs than vertical integration and that organizational costs are higher under partnerships in comparison to outsourcing.
The results from the Probit and Multinomial logit estimations show that most productive and large firms engage in partnerships, low productive and low scale ones vertically integrate while firms with intermediate levels of productivity and scale outsource from independent suppliers. Moreover, the within sector heterogeneity, represented by the dispersion of the productivity distribution, enhances the prevalence of partnerships and reduces that of vertical integration.

Our estimations validate another assumption of the Antras and Helpman (2004) model, the one related to the intensity in headquarter services. In accordance with the property rights theory, Antras and Helpman (2004) show that the intensity in headquarter services raises the prevalence of vertical integration. We have associated headquarter services to the R&D and capital intensities at the level of the firm's industry. Our results show that headquarter services' intensity increases the probability of organizing international trade through FDI as well as the relative prevalence of FDI.
However we provide results contradicting the conclusion of the Antras (2003) model concerning the effect of the exporting country's capital abundance and input's capital intensity on the structure of international trade. We find that capital intensive inputs are imported under contractual form of organization and that the relative capital abundance, at the exporting country level, increases the probability and the prevalence of contractual agreements and reduces that of vertical integration.

Regarding the impact of market thickness, our results confirm the assumption by Grossman and Helpman (2002). The thickness of the market represents the availability of specialized suppliers and the extent of search costs required for a specialized final good producer to find a suitable supplier. In thicker markets search costs are reduced

and firms prefer contractual agreements. Our variables of market thickness and search costs favor the probability of adopting contractual agreements. Moreover, final good producers in large industries prefer partnerships over outsourcing in order to avoid recurrent competition for suppliers' services.

Given the scarcity of the empirical evidence on internationalization and vertical specialization, this paper offers a significant contribution to the growing literature on this subject. The empirical analysis is based on a large set of firms and allows the clear definition of organizational modes and to control for determining elements at the firm, industry and country levels. The main contribution is to present empirical answers to the assumptions presented by the theoretical literature. As mentioned earlier, in this paper we focus on theoretical models based on the property rights theory of the firm, yet the literature on internationalization includes also theoretical contributions based on alternative theories of the firm. A natural extension of this work will be to present empirical investigation of these alternative theories and to confront their validity in the explanation of the internationalization strategy.

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