Managing Export Complexity: the Role of Service Outsourcing

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Abstract

This study investigates the determinants of service outsourcing, and professional and business services in particular, an industry that accounts for half of the growth of the total service sector. Drawing on the insights of a model of the boundary of the firm based on adaptation costs and diminishing return to management, I argue that an increase in coordination complexity (i.e. more inputs in the production process) leads firms to outsource a higher share of their total costs and to focus on their core competences. Since country-specific service inputs are needed to export to a particular country (e.g. a specific advertisement campaign), I proxy coordination complexity with the number of export destination markets and I find support for the theory using an extensive dataset of French firms. Over time, firms that export to more countries increase the amount of purchased business services. The finding is quantitatively very significant and robust to firm size, export intensity, internal production, and many other determinants of outsourcing proposed in the literature. The firm-level evidence also contributes to opening the black box of fixed export costs and to establishing a new causal link between globalization and structural transformation exploiting exogenous demand shifters.

Keywords: Adaptation, Coordination Complexity, Core competencies, Firm Boundaries, Firm Capabilities, Fixed Export Costs, Professional and Business Services, Structural Transformation.

JEL codes: D23, F10, L22, L23, L24, L84

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1 Introduction

Firms have become more specialized over time. As a consequence, more and more processes and components have been handed over to external specialists, contributing to the growth of outsourcing. Although this is a sensible statement there is no systematic analysis on the trend of domestic outsourcing, as pointed out by Antràs and Helpman (2004). However, a clearer picture emerges when outsourcing is narrowed to the contracting out of services, and business services in particular. Over the past few decades, firms have purchased more and more services from external providers; namely accounting, engineering, legal services but also security, maintenance, janitorial services just to cite few. These services are classified within Professional and Business Services (PBS), and this sector has experienced a dramatic increase. In France, the share of PBS in total GDP was 5.4% in 1970, while the same share was 14.7% in 2007; this almost threefold increase accounts for 47% of the growth of the entire service sector.[1] The pattern is by no means specific to the French economy, a very similar picture holds true for the U.S., the U.K., and many other developed countries.[2] Moreover final demand plays a very marginal role in this rise. The PBS sector is in fact unusual in this regard: in 2005 roughly 94% of its output was used by firms, either as intermediate inputs or in the form of investment, highlighting the primary role played by firms.[3] Understanding what determines the firm's decision to contract out its service inputs is therefore key to explain the causes of the rise of this sector and of services in general.

Despite many studies having focused on service off-shoring, the vast majority of services is actually contracted out domestically.[4] In 2005, business services purchased internationally by French firms accounted for just 7% of the total output of this sector. The small role still played by international trade in services justifies the focus on the firm boundary dimension. Mainly for data limitations, I do not intend to distinguish between domestic and international outsourcing; but since the vast majority of the service inputs is outsourced domestically, what I observe in the data almost coincides with domestic outsourcing. Moreover most of the literature has focused on the consequences of service outsourcing.[5] With few exceptions (e.g. Abraham and Taylor, 1996), very little attention has been devoted to the determinants of service outsourcing. The goal of this paper is to analyze the key forces that affect the firm's decision to contract out its service inputs, and in doing so I unveil new systematic evidence about domestic service outsourcing using an extensive dataset of French firms. In particular, I find that an increase in the number of export destination countries has a strong positive effect on the share of purchased business services in total costs, even after controlling for firm size, export intensity, internal production, and for many other determinants of outsourcing proposed in the literature. The finding sheds

[1] Data from the EU KLEMS database.

[2] In a recent paper for the U.S., Berlingieri (2013), I show that this increase in vertical specialization has a sizeable impact on the reallocation of labour across sectors, with business services outsourcing alone accounting for 14% of the total increase of the service sector and 16% of the fall in manufacturing.

[3] Data from the OECD Input-Output database.

[4] On service off-shoring see, among others, Görg et al. (2008), Amiti and Wei (2009), and Jensen and Kletzer (2010).

[5] For instance, Siegel and Griliches (1992), Fixler and Siegel (1999), ten Raa and Wolff (2001), using industry level data for the U.S., find that TFP growth in the manufacturing sector is positively related to service outsourcing.

new light on the micro mechanisms that underpin the large share of services embedded in gross exports (see Figure 3).

In order to rationalize these facts, a model of the boundaries of the firm is needed. The Grossman-Hart-Moore property-rights model, well-established in the trade literature thanks to Antràs (2003), draws the boundary of the firm on the basis of which party owns the asset. But asset ownership is less important in the case of services. Therefore this paper embraces a vision of the firm where the residual rights are mainly in terms of control over the decisions to be taken, and not over the assets. I do so by adopting a Transaction Cost Economics (TCE) and moral hazard view of the firm that stresses the importance of ex-post inefficiencies and of monitoring the actions of the agents. Ex-post adaptation will be at centre stage and the residual rights of control are interpreted as the decision rights to choose the best action in the interest of the organization as a whole.[6]

The contribution of the paper is to incorporate the cost of integration as originally stressed by Ronald Coase. In his celebrated article of 1937, Coase argues that a firm is a method of *coordinating* production that is alternative to the market; and the reason why firms exist is because there are costs associated with using the price coordination mechanism. I adopt coordination complexity as the main ingredient of the trade-off between market and internal transactions, in the spirit of Becker and Murphy (1992). Ideally all tasks would be coordinated in the market, as the price provides everything "participants need to know to be able to take the right action" (Hayek, 1945, p. 527), and a transaction can be carried out independently from all the others. Unfortunately the way each single input is produced (which can be the most efficient when the input is produced independently) might not fit the overall firm's production process and some adaptation is needed ex-post. It is in this setting that the internal hierarchy overcomes the market: the manager has the ability to steer and coordinate the actions of the employees to implement the best action when adaptation is needed. As in the work of Bajari and Tadelis (2001), the integration decision is driven by the trade-off between the ex-ante price and the ex-post adaptation costs. If the input is purchased from the market, the ex-ante cost will be low thanks to the high-powered incentives, but the ex-post cost that has to be sustained when adaptation is needed will be very high. On the other hand, producing in-house by employing the supplier reaches precisely the opposite result: the cost will be high because the employee has to be compensated for taking an action that is not ideal for his own task, but the extra ex-post cost when intervention is needed will be low, thanks to better coordination and authority. This implies that more volatile inputs that need higher adaptation are more likely to be produced in-house, a prediction for which I find strong support in the data.

Then why is not all production carried on by one big firm? TCE rules out the possibility of a firm growing indefinitely assuming that selective intervention is severely limited: a firm cannot simply outsource the production of tasks ex-ante to capture the benefits of higher incentives and then internalize the modifications in case adaptation is needed. I propose an extra reason based on the limits that bounded rationality imposes on the managerial ability to coordinate production. As noticed by Winter (1988), bounded rationality is at the heart of TCE. But the

[6]See Costinot et al. (2011) for an example of a TCE setting applied to production outsourcing.

TCE literature has mainly appealed to bounded rationality to justify the existence of contract incompleteness.[7] In this paper I adopt bounded rationality to highlight the limits of coordination following Crémer et al. (2007). Even allowing for the possibility of selective intervention, the action of the manager still suffers from diminishing returns. Intuitively, if the manager has to coordinate more tasks, she will inevitably become less effective in carrying out the needed adaptation, and the cost of internal production will rise.

The literature has so far analyzed transactions independently, "a series of separable make-or-buy decisions", as pointed out by Williamson in his Nobel Prize Lecture.[8] In the present setting tasks will be interdependent: the inclusion of a new task hinders the performance of others. Inside the firm, coordination takes place through communication and the manager will choose the optimal communication code to deal with the problems she faces. Adding a new task implies that the words used to communicate (which are limited in number given bounded rationality) will have to be more generic, making it harder to diagnose all other tasks identified by the same word.[9] Therefore integration costs depend on the number and type of activities already produced by the firm. This brings about the definition of coordination complexity put forward in this paper: the higher the number of tasks that the manager has to supervise, the lower the frequency of each of them and hence the higher the complexity of the environment. In this respect, integration costs decrease when the firm reduces the number of tasks internally produced.

I propose one possible driver of coordination complexity: the internationalization decision of the firm. And I will mainly, but not exclusively, focus on the the service inputs that a manufacturing firm needs to produce its products. The main reason for this choice is that fixed export costs are often characterized as the service inputs needed to export to a particular country; hence exporting to more destination countries implies that more inputs are needed (e.g.: a different advertising campaign for each destination market).[10] Each of these country-specific service inputs is a low probability event from the point of view of the manager of the manufacturing firm; and if a firm exports to more countries the probability of each event will decrease, which translates into a more complex business environment. The model will then predict that the share of outsourced inputs in total costs increases because coordinating these infrequent tasks in-house would require a very costly communication code. I therefore proxy the firm's coordination complexity with the number of export destination countries.[11]

[7] Yet, in an insightful early paper, Williamson (1967) resorts to the bounded rationality to build a hierarchical model of the firm where the size is limited due to the managerial loss of control.

[8] "Transaction Cost Economics: The Natural Progression", 2009.

[9] Note that the design of a common communication code does not only capture the mere cost of passing a message but also the larger cognitive cost of interpreting and understanding that message; hence there is a tight relationship with the cognitive skills a manager is endowed with.

[10] In motivating the presence of some fixed costs to exporting, Melitz (2003) asserts that a firm must inform foreign buyers about its product, learn about the foreign market, research the foreign regulatory environment etc... These tasks correspond to advertising, market and legal research, and they are all supplied by the professional and business industry. Das et al. (2007) and Morales et al. (2014) put forward very similar arguments. Among others, Eaton et al. (2011) and Helpman et al. (2008) adopt settings that feature country-specific fixed export costs.

[11] This choice is very much in line with the most common definition of complexity in systems theory, where complexity arises through connectivity and the inter-relationships of a system's constituent elements.

The model endogenizes the fixed export costs of a standard trade model with heterogeneous firms like Melitz (2003), pinning down what drives the decision of producing these tasks in-house or outsourcing them. When the importance of adaptation goes to zero, the model simplifies to a standard case, as in Melitz (2003), with the only twist that the tasks related to the fixed costs are entirely outsourced to external suppliers. In the general setting, on the other hand, the ability of the manager also affects the fixed part of export costs, which are lower for a firm with a better manager. This mechanism offers further insights on the role of managerial skills in international trade and its impact on the results.

I empirically test the model using a panel of French firms over the period 1996-2007 and a more detailed survey on service outsourcing available in 2005. Over the entire period I observe purchases of selected business service inputs from other firms, like purchases of studies, IT services, advertisement etc...; while in 2005 I can observe 35 specific types of service inputs. I find that coordination complexity, measured as the number of export destination countries, has a strongly positive and significant effect on the share of purchased business services. The result holds on both the cross-sectional and the within-firm variation, and it is extremely robust to internal production and to the inclusion of alternative determinants of outsourcing proposed in the literature, including firm size, and capital, skill and contract intensities. I also find that outsourcing of services is not driven by the trade intensive margin, so I provide direct evidence for the widespread assumption that service inputs are a fixed export cost component. I contribute to opening the black box of fixed export costs by showing the precise service inputs a firm needs when exporting, and show that firms tend to acquire these key inputs by outsourcing them to external providers, rather then producing them in-house. I also shed some light on the nature of these costs, showing that a sizable part are sunk, rather than fixed costs incurred each period.

Moreover, drawing on the insights of the multi-product literature and assuming product specific fixed export cost, I find that an increase in the number of exported products as well as its interaction with the number of destination countries lead to a higher share of outsourced services.[12] I also find the same overall results when I analyze the outsourcing of non-core activities. The model does not differentiate the inputs; therefore there is no 'a priori' clear distinction between a service or a non-service task, apart from the intuitive assumption that, for manufacturing firms, the importance of adaptation will be higher for the primary good inputs. Coordination complexity has again a positive and even stronger impact on outsourcing, showing that the results generalize to other types of inputs as well.

Finally, I investigate the causal effect of globalization on structural transformation through the outsourcing of business services. I propose a set of firm-level instruments that exploit the information on the product space of the firm and rely on exogenous demand shocks as shifters, ruling out reverse causality or other endogeneity problems. The new channel I put forward is not only present but it is also quantitatively very significant. The causal effect of globalization explains more than two-thirds of the increase in business service outsourcing observed in the sample. The model offers a precise explanation for why the OLS estimates are downward biased,

[12] Bernard et al. (2011) argue that product-specific fixed costs capture the market research, advertising, and regulation costs that need to be incurred when exporting a product.

mainly due to the fact that the unobserved level of managerial skills implies more in-sourcing and a higher number of destination countries at the same time.

This paper is related to the recent literature on firm organization and vertical hierarchies (e.g.: Garicano, 2000; Garicano and Rossi-Hansberg, 2006; Caliendo and Rossi-Hansberg, 2012). I assume a very simple type of hierarchy: only two layers with a manager who directs and coordinates her employees. Instead of analyzing the vertical dimension of the firm, I look at the horizontal one and take the boundary of the firm explicitly into account to investigate whether a task is produced internally or outsourced. Since those papers do not explicitly draw the boundary of the firm, there is nothing that imposes that problem solvers, who have the knowledge to solve exceptional problems, should be employed directly by the firm.[13] By taking the horizontal dimension explicitly into account, I can explain why Caliendo et al. (2012) do not find empirical support for all theoretical predictions of their model (e.g. rate of expansion of higher layers), and show how outsourcing allows firms to be more flexible, smoothing the transition between different number of layers.

The paper is organized as follows. In the next section, I provide evidence for the aggregate trend in service outsourcing observed in recent years. Section 3 reviews some of the key contributions in the literature of service outsourcing, while the following section presents the model. In Section 5, I test the main predictions of the model using firm-level data from France and in the following section I provide detailed evidence on fixed export costs. Section 7 discusses alternative mechanisms by comparing outsourcing with internal production and Section 8 concludes. Some extensions to the baseline model, the description of the data and some extra results are contained in the Appendix.

2 Evidence on Service Outsourcing

Firms have become more specialized over time. As a consequence, more and more processes and components have been handed over to external specialists, contributing to the growth of outsourcing.[14] Although this is a sensible statement, the evidence is quite scattered. Using the Compustat Industry Segment database, Fan and Lang (2000) report some indirect evidence on the increase of specialization; in fact, between 1979 and 1997 the number of publicly traded non-finance firms that operate in a single segment have steadily increased over time. Unfortunately, as pointed out by Antràs and Helpman (2004), there is no systematic analysis on the trend of domestic outsourcing. However, it is possible to get stronger evidence if outsourcing

[13] In fact Garicano and Rossi-Hansberg (2012), using a very similar setting, talk more generally about "referral markets".

[14] The definition of outsourcing is standard; in Helpman's (2006) words: "outsourcing means the acquisition of an intermediate input or service from an unaffiliated supplier". This paper will not deal with the choice of the location in which outsourcing is carried out; that is, I will not distinguish between domestic and international outsourcing. The main reason is data limitation but at the same time this paper focuses on service outsourcing for which international outsourcing still plays a relatively little role. For instance Yuskavage et al. (2006) point out that, although the importance of imported services has risen in recent years, their magnitude is still very low, accounting for just 2.7% of total PBS in the U.S. in 2004. Similarly, Amiti and Wei (2009) find that the same share is 2.2% in 2000 and is even lower for other types of services. What this paper will try to shed light on is why firms that are more engaged in trade will have higher shares of domestic service outsourcing.

is narrowed to the contracting out of services, and business services in particular. Over the past few decades, firms have purchased more and more services from external providers; namely accounting, engineering, legal services but also security, maintenance, janitorial services just to cite few. This section provides evidence for the aggregate rise of service outsourcing over time.

2.1 Industry Level Data

The main reason why the rise of service outsourcing is widely acknowledged is that many of the services that have been intensively contracted out are classified within Professional and Business Services (PBS), and this sector has experienced a dramatic increase over the past few decades. In France, the share of PBS in total employment was 5.4% in 1970, while the same share was 14.7% in 2007, almost a threefold increase. To give a sense to the magnitude of these numbers, consider that the employment share of the total service sector (including the government) has experienced an increase of 20 percentage point, rising from 65.3% in 1970 to 85.2% in 2007, as displayed in Figure 4 (left-hand side axis). This is a well-known fact in the structural transformation literature but what has not been sufficiently appreciated is that PBS account for a very large share of this increase. Figure 4 also shows the total growth of the service sector and its components (right-hand side axis). PBS have increased their share in total employment by 9.4 percentage points, accounting for 47.2% of the total growth of the entire service sector, the biggest contribution among all industries. Adding Finance, Real Estate and Health Care, these four industries account for almost the entire increase of the service sector in total employment.[15]

The striking rise of PBS would not be sufficient per se to justify an increase in outsourcing. In fact this rise could be driven by final demand. But the PBS sector is quite unusual in this regard: in 2005 roughly 94% of its output was used by firms, either as intermediate inputs or in the form of investment, highlighting the primary role played by firms in this rise. One of the implications of these characteristics is that the remarkable growth in the share of PBS is reflected in a parallel change of the input-output structure of the economy; a fact that has been overlooked in the literature despite the widespread use of input-output data. One way to show this change is looking at the horizontal sum of the coefficients in the total requirements table, usually referred to as forward linkage. This is a measure of the interconnection of a sector to all other sectors through the supply of intermediate inputs. Figure 5 shows, for some selected industries, the evolution of the forward linkage divided by the total number of sectors. The figure confirms that PBS have experienced a sharp increase in their forward linkage, overcoming sectors with a traditionally high forward linkage like transportation. PBS have in fact become the sector with the highest influence on the rest of the economy, considerably higher than the influence of the average or median sector. In light of the insights provided by Acemoglu et al.

[15]The pattern is by no means specific to the French economy, a very similar picture holds true for the U.S., the U.K., and many other developed countries. In a related paper for the U.S., Berlingieri (2013), I show that this increase in vertical specialization has a sizable impact on the reallocation of labor across sectors, with business services outsourcing alone accounting for 14% of the total increase of the service sector and 16% of the fall in manufacturing. In ongoing research, Berlingieri and Ngai (2014) show that the same pattern holds true for most OECD countries and we investigate the impact of these changes on aggregate productivity.

(2012), the sharp rise of the PBS forward linkage implies that this sector has greatly increased its influence on the rest of the economy. This fact highlights once more the importance of PBS and why it is key to investigate the reasons that led firms to outsource a higher share of these inputs.

The identification of outsourcing with PBS is quite common in the literature.[16] Yet this assumption could be a source of concern given that industry level data do not clearly distinguish the boundary of the firm, and some of the increase could come from transactions between establishments of the same firm. In a related paper for the U.S., Berlingieri (2013), I show that the amount of purchased business services that are reported in the input-output tables are a reliable measure of outsourcing. In fact I control for headquarter establishments and note that the share of internal production remains remarkably constant over time. In any case, in this paper, I overcome these issues looking directly at micro-data, where I can observe business services directly purchased by firms. The downside is that I observe a more limited range of services over the period, with more detailed information available in 2005 only.

2.2 Anecdotal Evidence and the Determinants of Service Outsourcing

The evidence on the rise of service outsourcing outlined in the previous section brings about an immediate question: why have firms increasingly contracted out services? And in particular what are the determinants of PBS outsourcing? In order to answer these questions it is insightful to look at some anecdotal evidence first.

An interest case is the experience of Ducati. This firm has been growing very rapidly in recent years, more than tripling the number of bikes produced and expanding to many new markets. Ducati today exports to more than 61 countries. Yet, this success has come with growing pains; among them, inefficiencies in coordinating the production of user manuals and technical documentation, which had to be translated in all the languages of the destination markets. Ducati has therefore decided to contract out its document management to Xerox, which claims to have reduced printing and publishing costs by roughly 20%, together with paper consumption and energy costs. Lowering the costs was certainly a key objective but what managers at Ducati had in mind when they took this decision is probably better represented by the advertisement campaign built on this case. A motorcyclist on a Ducati bike is awkwardly trying to deliver documents inside an office, and the ad goes: "We focus on translating and delivering Ducati's global publications...Which leaves Ducati free to focus on building amazing bike". Another possibly more important objective was therefore to avoid the costs of coordinating all of these peripherical tasks that were stealing the very precious time of managers. Also because the managers could not even monitor the quality of the produced services because they could not certainly learn more than 60 different languages.

It is also interesting to note that most service providers like Accenture, KPMG, IBM, McKinsey, Xerox etc... are large multinationals with offices in many countries in the world. This offers a simple explanation for why most of these services are outsourced domestically rather

[16] Among others, see Abraham and Taylor (1996), Fixler and Siegel (1999), ten Raa and Wolff (2001) and Abramovsky and Griffith (2006).

than internationally. It is likely that these services are "traded" within the borders of these large multinationals. If, for instance, a French firm decides to enter the U.S. market, it is probably going to acquire the service inputs needed like marketing or accounting from the French subsidiary of firms like Accenture or KPMG.

3 A Sketch of the Existing Literature

3.1 Service Outsourcing Literature

Abraham and Taylor (1996) is one of the the very few papers that investigate the determinants of service outsourcing. The authors posit that three main factors may affect the firm's decision to contract out; namely: wage cost savings, the volatility of output demand, and the external provider's specialized skills. The latter consideration refers to the need to access the knowledge and technology provided by the external provider; this comes from the fact that it might not be optimal for a firm to invest in these competencies while an external provider can enjoy economies of scale and amortize the sunk costs of these investments across several clients. Although focused on parts and component production rather than service outsourcing, Bartel et al. (2009) expand this explanation and provide a model in which the probability of outsourcing production is positively related to the firm's expectation of technological change. Investing in a new technology implies some fixed costs; the faster technological change, the shorter the life-span of a new technology, and the less time firms have to amortize their sunk costs. Therefore firms outsource in order to avoid the fixed costs and, at the same time, to access the latest technology possessed by the external providers, which can enjoy economies of scale and spread the fixed costs over a larger demand.

Despite being certainly important, none of these mechanisms can clearly explain why firms that export to more countries, which are usually large firms, outsource a higher share of their costs. Moreover some of the determinants outlined in the previous section have been overlooked, or at least not stressed as the business literature on the other hand does. In particular, the case of Ducati highlights the importance of core competencies and of the managerial challenges that are intrinsically connected with a firm's growth, which often leads to inefficiencies due to complex coordination. Some of these ideas can be found in the Resource-based view of the firm (Penrose, 1959; Wernerfelt, 1984; Prahalad and Hamel, 1990). For instance Quinn and Hilmer (1994) stress that core competencies are skill and knowledge sets and that are usually limited in number: "As work becomes more complex...managers find they cannot be best in every activity in the value chain...they are unable to match the performance of their more focused competitors or suppliers. Each skill set requires intensity and management dedication that cannot tolerate dilution." In linking core competencies to the firm's strategic decision of outsourcing, they also emphasize the role of internal transaction costs and the managerial challenges of producing in-house. These internal transaction costs can be very high and they conclude that: "One of the great gains of outsourcing is the decrease in executive time for managing peripheral activities - freeing top management to focus more on the core of its business."

3.2 The Boundaries of the Firm

Most of the literature on the theory of the firm draws the boundary of the firm on the basis of which party owns the asset. But asset ownership is less important in the case of services. For instance, service outsourcing is not very much related to capital intensity, in fact the strong correlation unveiled by Antràs (2003) for good inputs does not hold for services, as shown in Figure 6. This is quite intuitive given that services are not capital intensive and there is no reason why the final-good producer should contribute with capital. If anything the production of services is human and knowledge intensive, and the contribution should be in terms of knowledge. But in reality it is quite often the opposite, it is the service provider who has the knowledge on that particular service and a company outsources the service precisely to access that knowledge.

This view is shared by, among others, Rajan and Zingales (2001) who claim that: "as physical assets become less important and give way to human capital, the boundaries of the corporation defined in terms of the ownership of physical assets are becoming less meaningful".[17] The service sector is precisely where "the distinction between ownership and control is important." And services impose a much tighter relationship in the case of integration, which is essentially an employment relationship. This paper therefore embraces a vision of the firm where the residual rights are mainly in terms of control over the decisions to be taken by the firm, and not over the assets; that is, the authority that gives one of the two parties the right to decide the course of action.

4 The Model

The model adopts a moral hazard and TCE view of the firm, which stresses the importance of ex-post inefficiencies and specificity even without specific investments. Ex-post adaptation will be at centre stage and the residual rights of control are interpreted as the decision rights to choose the best action in the interest of the organization as a whole. At the same time, the contribution of this paper is to bring back to centre stage the cost of integration as originally stressed by Coase: inside the firm it is the manager who directs and co-ordinates production but there are diminishing returns to management, a given set of activities can hinder the performance of others. Gibbons (2005) stresses the need to explore the complexity of coordination, and the limits that bounded rationality consequently places on firm size and scope. This paper contributes in that direction by modeling integration costs in terms of coordination, following Crémer et al. (2007). Inside the firm coordination takes place through communication, highlighting the importance of knowledge and bounded rationality. In fact, the design of a common code captures not only the mere communication costs of passing a message but also the larger cognitive costs of interpreting and understanding that message.

[17] In searching a definition for what a firm is, Holmström (1999) adds: "and yet the boundary question is in my view about the distribution of activities: what do firms do rather than what do they own?"

4.1 Buyer and Suppliers

I start with describing the fixed part of the production costs, whilst I postpone the analysis of the variable costs and revenues to Section 4.6. As common in the trade literature (e.g.: Eaton et al., 2011; Helpman et al., 2008), I assume that a country-specific input is needed to export to a given destination. It is essentially an Armington assumption on the nature of fixed export costs, for which I will find strong empirical support in the data. In particular, a firm that exports to N countries must source N inputs, one for each destination country.[18] The firm has a simple two-layer hierarchical structure that is fixed: a manager and a certain number of employees. The manager cares about the firm's overall profits and has to decide how to source the inputs. Each input is produced by an agent, and the manager has to make the choice between producing the input in-house by employing the agent directly, or sourcing it from the agent as an external supplier. Moreover there is a trade-off in the way each input is produced. If an agent is focused on producing a certain input i, he will take a very specific action to minimize the cost of producing that particular input, but in this way the input might not fit the overall firm's production process and a coordination cost has to be paid to adapt it. An example could be the production of an accounting software; it can be designed either in a very specific way, with the only objective of recording the transactions of a single product, or in a more flexible way such that it can accommodate the bookkeeping for other products and be linked to the enterprise resource planning system of the firm. In the spirit of Dessein and Santos (2006), I assume a quadratic coordination cost that the manager has to incur if the input is very far from the firm's overall production process.[19]

The production fixed costs that the firm has to incur in order to export to a measure N of countries are given by:

$$F = \int_0^N P(i)di + \delta \int_0^N (a(i) - \hat{\theta}^c)^2 di + M(t, N, K) \tag{1}$$

where $P(i)$ is the price paid by the firm for input i, and $a(i)$ is the action taken by agent i (employee or external supplier) in order to produce input i. The coordination cost $(a(i) - \hat{\theta}^c)^2$ depends on the distance between the action $a(i)$ and $\hat{\theta}^c$, the coordinating action that would best fit the overall firm's production process. The parameter δ captures the importance of adapting each input to the overall firm's need, hence $\delta(a(i) - \hat{\theta}^c)^2$ is the total coordination and adaptation cost for input i. In the baseline version of the model, I take $\hat{\theta}^c$ as a constant, a parameter that characterizes the firm. In Appendix A.1, I propose an extension to the model where the firm is characterized by the actual average action across all inputs ($\bar{a}$). This approach better captures the need of coordinating around the average action that characterizes the firm, introduces extra interesting interdependences across the inputs, and is closer to the TCE idea

[18] To use calculus and keep the notation simple, I actually write the model in continuum and assume a measure N of inputs. All the qualitative results hold in the possibly more realistic discrete version of the model.

[19] Note, however, that I use a different terminology compared to Dessein and Santos (2006). They use adaptation to mean adapting to the specific local conditions of each task, instead I use adaptation in the classical TCE sense: ex-post coordinated adaptation under hierarchy (e.g. Tadelis and Williamsonn, 2012).

of ex-post adaptation, given that the mean will depend on the actual realizations of the input conditions (defined below). The picture that emerges from the extended model is very rich, the firm is characterized by the actual inputs that it needs, and the decision of adding another input (exporting to another country) potentially affects the way in which all other inputs are produced.

Finally $M(t, N, K)$ is the total communication and monitoring costs that the manager has to pay when she decides to employ the agents directly to produce the inputs in-house. These costs are a function of the total number of inputs needed N, the number of employees t, and K, the cognitive ability of the manager.[20] Since each employee produces a single input, t captures both the number of employees and the number of inputs internally produced. The manager has to pay these costs in order to communicate with her employees and to monitor their actions, which is going to be key in order to be able to steer production inside the firm. Unfortunately the manager is boundedly rational, in the sense that her ability to communicate is going to limited by the maximum number of words she can learn, as in Crémer et al. (2007). Since the firm is identified with the manager who runs it, K is also a source of heterogeneity across firms and in a general equilibrium setting it could be interpreted as the productivity draw of the firm, as in Melitz (2003).

For each input i, there is a market with price taker suppliers and a large pool of entrants. The agents in the market i maximize:

$$\pi^s(i) = P(i) - (a(i) - \theta(i))^2 - f \tag{2}$$

where $a(i)$ is the action that they take to produce input i, and $\theta(i)$ is the *input condition*, the best way to produce input i. This is essentially the simplest and cheapest way to produce input i separately, without taking in consideration the externalities on coordination costs. $\theta(i)$ is a random variable with mean $\hat{\theta}_i$ and variance σ^2. Each input i is therefore characterized by a known distribution with different mean but same variance for all inputs, and the realizations of the input conditions are independent across inputs. Moreover $\theta(i)$ is private information to agent i, and we shall see how this information will be communicated or not, depending on whether the agent is an employee or an independent supplier. The action $a(i)$ is also in general non-contractible (e.g. effort) in the market, while the monitoring activity of the manager will allow her to control the actual action implemented.[21] There is a fixed cost f to produce each input, which can be interpreted as the knowledge cost that the supplier has to pay to learn how to produce input i in its ideal conditions. As in Caliendo and Rossi-Hansberg (2012) and Caliendo et al. (2012), the cost of knowledge is proportional to the wage, which I normalize to one.[22] Implementing an action different from $\theta(i)$, then imposes an extra learning cost proportional to the euclidean distance of the action. Finally each market i is ex-ante competitive, so that

[20] More precisely it is a measure N and t of inputs and employees, respectively. Abusing of terminology I use number and measure interchangeably.

[21] In an extension of the model, I also allow for contractible actions in the market (a court can enforce the action) and show that all the qualitative results of the model still apply. See Appendix A.2.

[22] They assume that learning requires teachers in the schooling sector that earn a certain wage. Alternatively all costs can be interpreted in terms of unit of labor, and hence each supplier employees a team of workers.

$E[\pi^s(i)] = 0$ in equilibrium.

4.2 Firm Boundaries, Contracts and Timing

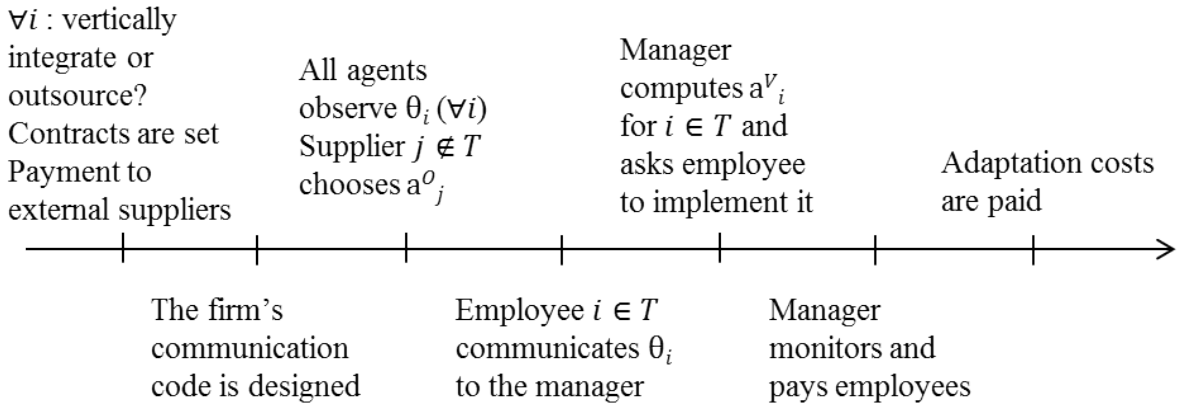
The manager can invest in a communication technology that allows her to understand the input conditions and monitor the actions. In this context, the definition of the boundaries of the firm are based on the decision to modify the communication technology in order to monitor the actions for input i or not. The definition of integration is not based on the ownership of the asset as in PRT, but it is closer to an employment decision. If the manager decides to produce input i in-house, she will employ the agent in charge of it and will design the communication technology in order to understand the information regarding the input condition $\theta(i)$, and to monitor the action of the employee ex-post. This approach fits well the present study given that the inputs are mainly business services, for which physical assets play a relatively small role and the decision of the firm is really whether to employ specialists in-house or not (e.g. having an internal accountant or purchase the accounting services from KPMG).

At time zero, the manager offers a contract, which, in general, is characterized by the tuple $\{P(i), a(i)\}$. To avoid confusion I index the set of inputs produced internally (T) by i, and the outsourced ones by j. In the case of outsourcing, the manager cannot contract on $a(j)$ because she has not invested in the monitoring technology and the action is also not enforceable in court (this assumption will be relaxed in Appendix A.2). In maximizing his profits according to equation (2), the supplier therefore sets $a^o(j) = \theta(j)$ once the input condition is realized. The manager has no way to avoid this action because she has not invested in the monitoring technology, and even if she could (e.g. in case a court could enforce a particular action), she would not be able to improve much in terms of coordination because she would not know the actual realization of the input condition (no communication). The best that the manager can do in this situation is to simply offer $P^o(j) = f$. Therefore, in the case of outsourcing, the contract is characterized by a fixed price: the market gives high-powered incentives to the independent supplier.

On the other hand, in the case of integration (employment), the manager can contract on $a(i)$ thanks to monitoring. She will tell the employee to implement a certain action $a^v(i)$ and will pay him: $P^v(i) = f + (a^v(i) - \theta(i))^2$. Therefore employment is characterized by what Bajari and Tadelis (2001) refer to as C+ contract, a contract that pays a fixed fee plus any cost the agent might incur in producing the input. This is the closest situation to an actual employment contract: the manager has the power and authority to tell the employee what to do but she compensates him of any cost, providing soft-power incentives.

As it will be clearer in the next sub-section, the make or buy decision is driven by the trade-off between the benefits of a better ex post coordination in-house and the costs of investing in the communication technology. In fact by employing the agent directly the manager can learn the actual realization of the input condition and hence achieve a better coordination ex post by internalizing the (negative) externality that the agent's action has on the rest of the organization. At the same time the manager has to compensate the employee so that he will

Figure 1: The timing



be willing to perform an action that is not strictly optimal for the specific input on its own. Outsourcing, on the other hand, reaches precisely the opposite result: the market offers high power incentives through a fixed price, which will give the incentive to the external supplier to take the cost-minimizing action for that particular input. Outsourcing allows the organization to source that particular input at the ex-ante minimum price. This is of course the best thing to do when the importance of adaptation (δ) is low or when setting up a common communication code is very costly. The drawback is of course very high coordination costs in case adaptation is needed.

Figure 1 clarifies the timing and the details of the game. At the beginning of the period the manager decides for each input whether to source it from an external supplier or to produce it internally by employing the agent. The contracts are set and the external suppliers are immediately paid given that the price is fixed and does not depend on the action taken by the agent ($P^o(j) = f$). The employee on the other hand will be paid after the input condition is realized and he has implemented the agreed action. Once the set of inputs produced internally is decided, the manager designs the communication code that serves two purposes: understanding the messages of the employees when they communicate their input conditions, and monitoring their actions ex-post to check they have performed what they were told to do.

After the code is designed, all agents (both external suppliers and employees) observe their input conditions. At that point the external suppliers take their optimal action, which, given their payoff in (2) and the fact that they have received a fixed price, is clearly going to be: $a^{o*}(j) = \theta(j)$. On the other hand, the employees communicate their input conditions to the manager, who can understand them since the communication code has been designed precisely to interpret the messages for that specific set of inputs (I will describe the communication technology in more detail in Subsection 4.4).

The manager has not designed the communication code to understand the messages related to the input conditions of the outsourced inputs. Communication is therefore not possible under outsourcing, and any message from the external suppliers is pure noise for the manager.[23]

[23]Even if the manager could infer something, we would not be able to influence the action taken by the external supplier.

This is clearly an extreme case but it reflects the fact that internal communication within the firm is usually more effective compared to communication with external suppliers, because the incentives are more aligned. For instance in a full strategic communication setting, Alonso et al. (2008) show that even allowing for some degree of horizontal communication, vertical communication is always more effective. Moreover the present setting resembles the hard but costly communication proposed by Dewatripont and Tirole (2005).

Once the manager has learned the input conditions, she is in the position to compute the optimal actions for all inputs. In doing so, she minimizes the costs of producing each input as well as the coordination costs in case of adaptation. Essentially the manager is capable of achieving coordination at a lower cost because she can internalize the negative externality that each input imposes on the rest of the organization. The manager then tells each employee what to do, monitors them and ensures that they implement precisely what requested. Finally coordination and adaptation costs are paid. The optimal internal actions are obtained in the next subsection.

4.3 Optimal actions

The problem is solved by backward induction. Once input conditions are revealed, the manager chooses the action $a^v(i)$ for each input internally produced ($\forall i \in T$) in order to minimize total costs. Assuming that a measure t of inputs is internally produced by an equal measure of employees, the problem of the manager is the following one:

$$\min_{\{a^v(i)\}} Nf + \int_0^t (a^v(i) - \theta(i))^2 di + \delta \int_0^t (a^v(i) - \hat{\theta}^c)^2 di + E\left[\delta \int_t^N (a^o(j) - \hat{\theta}^c)^2 dj\right] \tag{3}$$

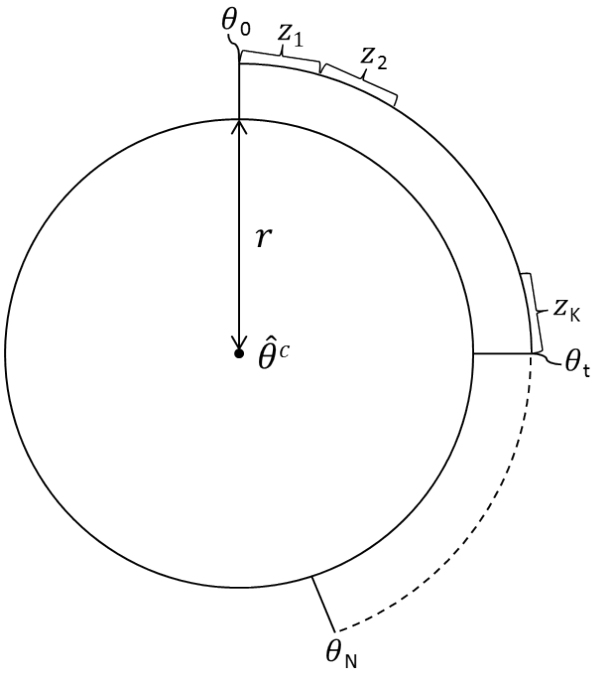
It is easy to show that the optimal action is a weighted average of input condition and the coordinating action:

$$a^{v*}(i) = \frac{1}{1+\delta}\theta(i) + \frac{\delta}{1+\delta}\hat{\theta}^c \tag{4}$$

The manager internalizes the externality that each input imposes on coordination costs when adaptation is needed. Therefore the optimal action will lie somewhere in between the action that minimizes the production costs of the specific input and the coordinating action that best fits the overall firm's production process and minimizes coordination costs in case of adaptation. In this simple baseline model, the optimal action for input i does not depend on the actions for other inputs. The interaction across inputs will only come from the communication costs; on the other hand, in the extension of Appendix A.1, the optimal action for each input will depend on all other internal actions, providing full interaction across inputs.

Since the external suppliers take an action $a^{o*}(j) = \theta(j)$ (minimizing costs for that particular input), and exploiting the fact that all input conditions are independently drawn from distributions with the same variance, it is fairly easy to show that the expected fixed costs at

Figure 2: A Simple Representation



time zero are:

$$E[F] = Nf + \left[\frac{\delta}{1+\delta}t + \delta(N-t)\right]\sigma^2 + \\ + \frac{\delta}{1+\delta}\int_0^t (\hat{\theta}(i) - \hat{\theta}^c)^2 di + \delta\int_t^N (\hat{\theta}(j) - \hat{\theta}^c)^2 dj + M(t, N, K) \quad (5)$$

A simple way of representing the problem is to assume that all input conditions lie on a circle and that the coordination action $\hat{\theta}^c$ is at the center (Figure 2). Each input condition is a point on the circle that has a length of measure $\bar{N}$, which can be interpreted as the maximum measure of countries the firm can export to (i.e. number of countries in the world). In this way the distance between the coordination action and the means of the input conditions is the same for all inputs and is simply pinned down by the length of the circle ($r = \bar{N}/2\pi$). Note also that the employees have the incentive to truthfully communicate their input conditions because the actions they will be assigned to perform will depend on the input conditions they have communicated. If an employee deviates and communicates a different input condition, his assigned action will reflect that and not the actual input condition. The manager will monitor the action implemented by the employee so he will have to do precisely what requested.[24] If the actual input condition is different from what the employee has communicated, the total compensation will not cover the actual costs incurred by the employee and he will be worse off.[25]

[24] Otherwise he gets punished. For instance he could be fired and receive a zero wage.

[25] This holds in this setting because the cost incurred by the employee, that is the distance between $a^v(i)$ and $\theta(i)$, will always be higher than the compensation received, which is proportional to the distance between $a^v(i)$ and the communicated θ ($\frac{\delta}{1+\delta}r$). Note that in this setting the quadratic terms of Equation (3) are interpreted as the Euclidean distances.

Under this simple representation, the expected costs at time zero can be further simplified as follows:

$$E[F] = Nf + \left[\frac{\delta}{1+\delta}t + \delta(N-t)\right](\sigma^2 + r^2) + M(t, N, K) \tag{6}$$

This expression shows very clearly the trade-off between outsourcing and integration. The second term is decreasing in t and captures the benefits of integration: by coordinating the actions in-house the manager is able to steer production, internalize the externalities, and achieve a lower coordination costs. On the other hand, by producing more inputs in-house, the communication costs (third term) intuitively rise. In this simple baseline model, the returns to in-sourcing do not depend on t, and the communication/monitoring costs do not depend on the importance of adaptation δ and the variance of the input conditions σ^2. Therefore even without specifying much of the nature of the communication costs, I can state the first Proposition of the paper.

Proposition 1: If the communication costs increase in t ($\frac{\partial M(t,N,K)}{\partial t} > 0$), the expected profits $E[\pi] = -E[F]$ are supermodular in t, σ^2, δ. Hence, the optimal number (measure) of inputs produced in-house t^* increases with the importance of adaptation (δ) and the variance of the input conditions (σ^2): $\frac{\partial t^*}{\partial \delta} > 0$ and $\frac{\partial t^*}{\partial \sigma^2} > 0$

Corollary 1: the complementarity with the variance of input conditions disappears when the importance of adaptation goes to zero.

$$\lim_{\delta \to 0} \frac{\partial^2 E[\pi]}{\partial t \partial \sigma^2} = \lim_{\delta \to 0} \frac{\delta^2}{1+\delta} = 0 \tag{7}$$

The proof is immediate and follows standard results on supermodularity.[26] The intuition is also quite straightforward. If adaptation is not very important, there is clearly no reason to produce the inputs in-house because it is true that the manager can achieve better coordination but this is needed only in case of adaptation and is costly due to communication costs.[27] If the conditions are very volatile, a situation in which the firm does not really know what it gets or inputs are not very homogeneous, the firm will find it optimal to in-source more in order to reduce the risk of having an input that will be very costly to coordinate because very far from $\hat{\theta}^c$. Intuitively Corollary 1 further specifies that this effect disappears when adaptation is not very important. These results are quite general because rely on a very simple and easily satisfied assumption, namely that the communication costs increase in the number of inputs internally produced.

[26] See for instance Milgrom and Roberts (1995).

[27] An interesting extension to the model would be to have an heterogeneous adaptation need across inputs, say $\delta(i)$, which could be interpreted as the probability of adaptation for that particular input. In this case it is intuitive that the first inputs to be outsourced would be the ones with very low adaptation probabilities, that is the inputs that are fairly homogeneous or that are very far from the core competency of the firm, so that the firm has no need to adapt them to its own production process.

4.4 Communication and Monitoring Costs

The manager has to communicate with all employees to learn their input conditions and then monitoring their actions. Therefore the total monitoring costs are given by: $M(t, N, K) = \int_0^t D(x, N, K)dx$, where $D(x, N, K)$ is the total diagnosis cost that the manager has to pay to understand the message and monitor each employee. Following Crémer et al. (2007), the manager is boundedly rational and can learn K words at most. Each word allows the manager to identify and recognize a certain set of input conditions, which is referred to as the breath of the word. The more general the word is (wider breadth), the higher is the diagnosis cost that the manager has to incur in order to understand the content of the message. I simply assume that the diagnosis cost for each word is linear in its breadth. Therefore the total expected diagnosis cost is given by: $D(x, N, K) = \sum_{k=1}^{K} p(z_k^*)z_k^*$, where z_k^* is the optimal breadth of word k and $p(z_k^*)$ is its probability. The words are of course not overlapping, that is, each of them refers to different sets of events to minimize the costs.

In the simple setting of the present model, all the inputs are needed in equal proportions (the production technology is Leontief), hence the manager will face the same probability of communicating with each employee. Essentially the manager has to communicate with all employees and therefore she will encounter all the input conditions with equal probability. In the simple representation of Figure 2, each input condition lies on a point of the circle, and the manager will therefore face an overall uniform distribution of events. Each input condition is in fact equally likely and the overall distribution of input conditions that the manager encounters is an uniform on the interval $[0, N]$, where N is again the measure of total input needed or, in the empirical interpretation, the total number of countries the firm is exporting to.[28]

The manager will design an optimal code to minimize the total expected diagnosis cost given the inputs that are produced internally. She will solve the following problem:

$$\min_{\{z_k\}_{k=1}^K} \sum_{k=1}^{K} p(z_k)z_k \quad s.t. \quad \sum_{k=1}^{K} z_k = x \tag{8}$$

where $p(z_k) = \frac{z_k}{N}$ due to the fact that the underlying events are uniformly distributed. In this setting the solution to the problem is very simple and all the words have the exact same breath: $z_k^* = z_h^* = \frac{x}{K}$, $\forall l, h$. Therefore the total expected diagnosis cost for each employee is given by: $D(x, N, K) = \frac{x^2}{KN}$. And the total communication costs are defined as follows:

$$M(t, N, K) = \frac{t^3}{3KN} \tag{9}$$

The costs are intuitively decreasing in the cognitive ability of the manager K and depend on the set of inputs that are internally produced. Adding more inputs raises the costs for all other inputs already internally produced because the manager has to change the code, and make all words more imprecise in order to accommodate the new set of input conditions. Clearly

[28] Appendix A.3 shows that the main results of the paper holds in a more general setting, providing a constraint on a generic monitoring function.

Proposition 1 continues to hold in this setting. Finally, since the optimal actions refer to the same underlying set of input conditions, the communication technology also allows the manager to monitor the actions of the employees (for simplicity I assume that the cost is paid only once for both activities).

4.5 The Optimal Outsourcing Share and the Effect of Globalization

Assuming the previous form of communication/monitoring costs, it is easy to solve the problem that the manager faces at time zero and find the optimal measure of inputs internally produced. A simple minimization of the expected costs in (6) with the communication costs as in (9), gives the optimal share of inputs internally produced:

$$\frac{t^*}{N} = \delta\sqrt{\frac{K\psi^2}{(1+\delta)N}} \qquad \textit{where: } \psi^2 = \sigma^2 + r^2 \tag{10}$$

When the firm outsources a positive share of its inputs the fixed cost function becomes:[29]

$$E[F] = \overbrace{\left(f+\delta\psi^2\right)(N-t^*)}^{F_O} + \overbrace{\left[f+\frac{3+\delta}{3(1+\delta)}\delta\psi^2\right]t^*}^{F_I} = fN + \delta\psi^2 N - \frac{2}{3}\frac{\delta^3\psi^3}{(1+\delta)}\sqrt{\frac{KN}{(1+\delta)}} \tag{11}$$

where F_O is the part of the fixed costs that is outsourced, and the share of outsourcing in total fixed costs (O_{sh}) can be defined as: $O_{sh} = E[F_O/F]$. It is interesting to note that the total expected fixed costs of the firm are decreasing in the manager's skill (K) and increasing in the importance of adaptation (δ).

I can then state the two main propositions of the paper, which will be tested in the empirical section.

Proposition 2: If the number (measure) of destination countries increases, $N \uparrow$, the optimal share of outsourced inputs increases. This also implies that the elasticity of the share of outsourcing in total fixed cost with respect to N is positive:

$$\frac{\partial}{\partial N}\left(1-\frac{t^*}{N}\right) = \frac{1}{2}\frac{t^*}{N}\frac{1}{N} > 0 \Longrightarrow \varepsilon_{O_{sh},N} > 0 \tag{12}$$

Corollary 2: the share of outsourced inputs is concave in N:

$$\frac{\partial^2}{\partial N^2}\left(1-\frac{t^*}{N}\right) = -\frac{3}{4}\frac{t^*}{N}\frac{1}{N^2} < 0 \Longrightarrow \frac{\partial^2 O_{sh}}{\partial N^2} < 0 \tag{13}$$

Proposition 3: If the variance of the input conditions or the importance of adaptation increase, $\sigma^2 \uparrow$ or $\delta \uparrow$, the optimal share of outsourced inputs decreases. This also implies that

[29] If $t^* = N$ the expected fixed costs are: $E[F] = fN + \frac{\delta}{1+\delta}\psi^2 N + \frac{N^2}{3K}$

the elasticity of the share of outsourcing in total fixed cost with respect to σ^2 or δ is negative:

$$\frac{\partial}{\partial \sigma^2}\left(1-\frac{t^*}{N}\right) = -\frac{1}{2}\frac{t^*}{N}\frac{1}{\sigma^2+r^2} < 0 \Longrightarrow \varepsilon_{O_{sh},\sigma^2} < 0 \tag{14a}$$

$$\frac{\partial}{\partial \delta}\left(1-\frac{t^*}{N}\right) = -\frac{1}{2\delta}\frac{t^*}{N}\frac{2+\delta}{1+\delta} < 0 \Longrightarrow \varepsilon_{O_{sh},\delta} < 0 \tag{14b}$$

Corollary 3: Everything else constant, a manager with higher cognitive ability (K - measure of skill) outsources a smaller share of inputs and the elasticity of the share of outsourcing in total fixed cost with respect to K is negative:

$$\frac{\partial}{\partial K}\left(1-\frac{t^*}{N}\right) = -\frac{1}{2}\frac{t^*}{N}\frac{1}{K} < 0 \Longrightarrow \varepsilon_{O_{sh},K} < 0 \tag{15}$$

The proofs of both propositions follow immediately from the expressions for the optimal share of inputs internally produced and the expected costs. The first part of the propositions is straightforward, the second part requires simple but tedious algebra.

Proposition 2 gives the main effect of interest that will be extensively investigated in the empirical part of the paper. When the number of destination countries increases, so does the number of inputs needed to reach those destinations, making the coordination of these inputs more and more complex. The reason is that the manager has to design a code that needs to accommodate a larger set of different events, all arising with a very small probability. This makes communication inside the firm very costly. The coordination benefits are still present and the absolute number of inputs internally produced still increases, but their share in the total number of inputs decreases. The reason is that the manager, facing too high communication costs, finds it optimal to outsource to get the benefits of a low ex-ante price. Moreover Corollary 2 shows that the relationship between the optimal share of outsourced inputs and the number of destination countries is non-linear, and concave in particular.

4.6 Profit Maximization and the Impact of Managerial Skills

I have so far focused on the cost of producing the fixed components of the exporting activity and whether they are produced in-house or outsourced depending on the number of destination markets reached by the firm. It is interesting to see what happens when also the variable part of the cost function is specified together with the revenues generated by the firm. Especially because this will allow me to investigate the impact of managerial skills on the total number of export destinations chosen by the firm and on the share of outsourced costs.

I do this in a standard trade model with heterogeneous firms, as in Melitz (2003). There is a continuum of firms, each characterized by the ability of its manager, K. After entering the market of a particular differentiated good, the manger realizes her level of skills for that market, which is drawn from an exogenous common distribution. The ability of the manager represents the productivity level of the firm and affects the variable costs of producing a quantity q of the good, q/K, expressed in labor units (wage is normalized to one). Consumers in each country maximize a standard CES utility function, characterized by an elasticity of substitution $\epsilon =$

$1/(1-\rho) > 1$. These preferences generate a total expenditure on each good equal to $R(p/P)^{1-\epsilon}$, where R denotes aggregate expenditure and P the aggregate price index. In maximizing the variable profits, each manager chooses the standard constant-markup pricing rule: $p = 1/\rho K$. This yields total variable profit in the domestic market equal to $(1-\rho)R(\rho K P)^{\rho/(1-\rho)}$.

There is a continuum of export destinations, and the variable trade cost to export to a certain country i takes the standard form of an "iceberg" transportation cost. If one unit of any differentiated good is shipped to country i, only a fraction $1/\tau(i)$ arrives. All countries are symmetric and face an equal distribution of variable trade costs.[30] This implies that all countries will feature the same aggregate expenditure and price index. The total expected profit of a firm that exports to N destination markets is then defined as follows:

$$E[\pi] = (1-\rho)R\left(\rho K P\right)^{\frac{\rho}{1-\rho}} \int_0^N \left(\frac{1}{\tau(i)}\right)^{\frac{\rho}{1-\rho}} di - fN - \delta\psi^2 N + \frac{2}{3}\frac{\delta^3\psi^3}{(1+\delta)^{\frac{3}{2}}} K^{\frac{1}{2}} N^{\frac{1}{2}} \tag{16}$$

where countries are ranked with respect to the their variable trade cost $\tau(i)$.

Note that when the importance of adaptation goes to zero ($\delta \to 0$) the expression for the total fixed cost simplifies to a standard case, as in Melitz (2003), with the only twist that the fixed part is entirely outsourced by the firm to domestic suppliers. In the present settings instead, the ability of the manager also affects the fixed part of export costs, which are lower for a firm with a better manager. At the margin, exporting to an extra country is more costly because this implies a higher coordination complexity for the manager. Therefore the manager, depending on her ability, chooses the optimal number of destination markets by maximizing the total profits in Equation (16). The optimal number of destination countries N^* is pinned down by the following implicit function:

$$(1-\rho)\left(\rho K P\right)^{\frac{\rho}{1-\rho}} \left(\frac{1}{\tau(N^*)}\right)^{\frac{\rho}{1-\rho}} - f - \delta\psi^2 + \frac{1}{3}\frac{\delta^3\psi^3}{(1+\delta)^{\frac{3}{2}}} K^{\frac{1}{2}} (N^*)^{-\frac{1}{2}} = 0 \tag{17}$$

At this stage I can state the last proposition of the model that relates the number of destination countries to the ability of the manager.

Proposition 4: A manager with higher cognitive ability (K - measure of skill) export to a higher number of destination markets. The effect is more than proportional ($\varepsilon_{N^*,K} > 1$) if and only if the elasticity of variable trade costs with respect to the country ranking, $\varepsilon_{\tau(N),N}$, is smaller than one:

$$\varepsilon_{N^*,K} > 0 \tag{18a}$$

$$\varepsilon_{N^*,K} > 1 \iff \varepsilon_{\tau(N^*),N^*} < 1 \tag{18b}$$

Proof: Total differentiating Equation (17) it is easy to show that $\varepsilon_{N^*,K} > 0$ and that $\varepsilon_{N^*,K} > 1$ if and only if $\varepsilon_{\tau(N^*),N^*} < 1$.

[30] Consider the variable trade cost being proportional to the distance to a destination market. Then all countries face the same distribution of variable trade costs if they all lie at equal distance, as in the case of coiuntries equally spaced along a unit circle.

The intuition for the proof is also quite straightforward. Not only is a better manager able to produce at a lower marginal cost and hence sell more, but she is also more capable of managing the extra complexity associated with exporting to more destination countries. The increase in the number of destination countries will be higher the lower the increase in variable trade costs. In the present setting, the solution intuitively depends on how fast the variable trade cost rise with exporting to an extra country. If the elasticity is smaller than one, the marginal increase in variable profit is dis-proportionally higher than the marginal increase in fixed cost due to higher coordination complexity. It is interesting to note that this is generally the case if variable trade costs are proportional to distance, in fact the elasticity of variable trade cost with respect to distance is generally smaller than one, as found by Chen and Novy (2011).

5 Econometric Evidence from France

5.1 Data

The model is tested using firm level data from France for the period 1996-2007. I rely on four main data sources. First, the Enquête annuelle d'Entreprise (EAE) that collects balance sheet data on all French firms with more than 20 employees and a sample of smaller firms. Second, the Déclaration annuelle de données sociales (DADS) that collects employment data on all firms with paid employees; the data used are aggregated at the establishment level. Third, transaction level import-export data come from the French Customs; these data have been used among others by Eaton et al. (2004). Finally, the service outsourcing data contained in the EAE are integrated with the Enquête Recours aux Services par l'Industrie (ERSI), a survey of firms with more than 20 employees and the census of firms with more than 250 employees that collects detailed information about service outsourcing policies for the year 2005. The analysis will mainly focus on manufacturing firms (NACE Rev1.1 D category).

Table 1 reports summary statistics for the main variables in 2005, separately by export status. The EAE mainly contains large firms, so, not surprisingly, the majority of firms in the sample are exporters.[31] As well known from the trade literature, exporters are larger, and more capital and skilled intensive. The average exporter in the sample exports 14.7 products to 13.5 destination countries, which sometimes share the same language, in fact the number of destination languages is 9.5. Moreover exporters outsource more professional and business services. Considering the baseline definition of business services (PBS Out. Sh. in Costs - 1) exporters spend the equivalent of 4.7% of their total costs in business services purchased from the market, compared to 3.8% for non-exporters.[32] In the baseline definition business services outsourcing includes: purchases of studies, expenses related to the purchase of IT services, and advertisement. I also propose alternative measures in which I add non-capital expenditures on software purchases (measure 2), and capital expenditures on software purchases and investment

[31] The firms in the sample account for 87.5% of the total turnover of the French manufacturing sector in 2005 (aggregate data from Eurostat).

[32] Note that exporters also produce more services in-house: HQ Intensity is in fact higher.

Table 1: Summary Statistics by Export Status - 2005

	Nonexporters			Exporters		
	Mean	Median	N	Mean	Median	N
Employment	44.6	30	5,220	158.4	48	16,453
Turnover	7,107	3,331	5,076	47,257	8,577	16,360
Total Exports	0	0	5,307	13,575	793	16,497
Num. Countries	0	0	5,307	13.5	7	16,497
Num. Products	0	0	5,307	14.7	7	16,497
Num. Languages	0	0	5,307	9.44	7	16,497
K/L Ratio	52.8	23.5	5,057	99.1	43.4	16,336
S/U Ratio	0.65	0.26	4,984	1.12	0.42	15,961
Professionals Sh.	0.074	0.045	5,049	0.13	0.086	16,171
HQ Intensity	0.035	0	5,031	0.069	0	16,306
PBS Out. Sh. in Costs - 1	0.034	0.0045	4,800	0.047	0.013	15,951
PBS Out. Sh. in Costs - 1b	0.023	0.0037	4,800	0.034	0.01	15,951
PBS Out. Sh. in Costs - 2	0.034	0.0046	4,800	0.047	0.014	15,951
PBS Out. Sh. in Costs - 3	0.034	0.0049	4,934	0.048	0.015	16,241

Note: Turnover, total exports, and K/L ratio are measured in thousands of €. Full sample.

in R&D (measure 3).[33] More precise variable definitions and the procedure employed to clean the data are described in Appendix B.

Table 2 shows the change over time for the main variables of interest. On average firms have increased their share of outsourced services in total costs by 10%, from a share of 3.86% in 1996 up to 4.25% in 2007. The average firm has increased the number of export destination countries from 7.9 in 1996 to 10 in 2007, equivalent to a 27.5% increase.

Table 2: Change in Outsourcing Shares and Destination Countries

	1996	2007	Change
PBS Out. Sh. in Costs - 1	0.0386	0.0425	10.10%
PBS Out. Sh. in Costs - 2	0.0386	0.0426	10.36%
PBS Out. Sh. in Costs - 3	0.0397	0.0432	8.82%
Num. Countries	7.8787	10.0427	27.47%

5.2 The Impact of Coordination Complexity on PBS Outsourcing

By averaging across all firms exporting to a certain number of markets in all years, Figure 7 shows that the share of purchased business service on sales is positively and significantly related to the number of export destination countries, the main measure of coordination complexity used in the analysis. The simple intuition is that the higher the number of countries a firm is exporting to, the more complex its business environment is going to be. This is very much in line with

[33]The latter measure is probably the less reliable because it is not possible to completely rule out the possibility that part of the R&D investment is actually performed in-house.

the most common definition of complexity in systems theory, where complexity arises through connectivity and the inter-relationships of a system's constituent elements. In the present case, the higher the number of connections (destination countries), the higher coordination complexity is going to be, because exporting requires more inputs. Designing a communication code for all these infrequent events is very costly and therefore, according to Proposition 2, the share of outsourced inputs in total costs increases.

The simple correlation for the average firm is confirmed when the full panel of firm-level data is analyzed. I run the following simple regression:

$$OUT_{it} = \beta_0 + \beta_1 NC_{it} + \delta + \epsilon_{it} \tag{19}$$

where OUT_{it} is the share of purchased business services over total cost for firm i at time t, NC_{it} is the number of export destination countries, and δ is a set of fixed effects. Proposition 2 predicts that β_1 should have a positive sign. In the baseline regression, business services are measured as the sum of: purchases of studies, expenses related to the purchase of IT services, and advertisement. Table 3 shows the results of the regressions. Column (1) shows that the export status of the firm is positively and significantly related to the share of purchased business services, that is, the extensive margin of trade is positively related to service outsourcing. Column (2) shows that coordination complexity, measured as the number of export destination countries, has a strongly positive and significant effect on the share of purchased business services. Therefore, among exporters, the firms that export to more countries tend to outsource a higher proportion of services. This hitherto unknown systematic pattern is actually fairly intuitive and goes well with the existing literature on international trade. The fixed export costs are often characterized as the specific service inputs needed to export to a particular country; hence exporting to more destination countries implies that more inputs are needed (e.g.: a different advertising campaign for each destination market).[34] Each of these country-specific service inputs is a low probability event from the point of view of the manager of the manufacturing firm; and if a firm exports to more countries, each of these events becomes even less frequent, which results into a more complex business environment. The model predicts that the share of outsourced inputs in total costs increases because the firm has no incentive to invest in the communication technology to produce these inputs in-house: the presence of these very infrequent inputs makes communication and monitoring very costly.

The main focus of the analysis is the increase in outsourcing of business services over time and an obvious worry is that firms differ across a variety of other dimensions. Hence from columns (3) onwards I add firm fixed effects to focus on the within firm variation and control for unobserved time-invariant firm characteristics. Another worry is that industry specific shocks that occur in some periods in some industries might affect the results, hence from column (5)

[34]In motivating the presence of some fixed costs to exporting, Melitz (2003) asserts that a firm must inform foreign buyers about its product, learn about the foreign market, research the foreign regulatory environment etc... These tasks correspond to advertising, market and legal research, and they are all supplied by the professional and business industry. Das et al. (2007) and Morales et al. (2014) put forward very similar arguments. Among others, Eaton et al. (2011) and Helpman et al. (2008) adopt settings that feature country-specific fixed export costs.

Table 3: Purchased Business Services and Coordination Complexity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Var.	Out. 1	Out. 1	Out. 1	Out. 1	Out. 1	Out. 2	Out. 3	Out. 1
Exporter	0.554***		0.098***					
	(0.020)		(0.017)					
NC		0.185***		0.083***	0.086***	0.087***	0.078***	0.086***
		(0.008)		(0.010)	(0.010)	(0.010)	(0.010)	(0.022)
Observations	235,182	184,556	235,182	184,556	184,556	184,864	186,725	184,556
Num. of firms	39,500	31,212	39,500	31,212	31,212	31,246	31,380	31,212
Year FE	Yes	Yes	Yes	Yes				
Industry FE	Yes	Yes						
Industry-Year FE					Yes	Yes	Yes	Yes
Firm FE			Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Industry

Note: The dependent variable is the share of purchased services over total costs measured in logs. In columns (1)-(5) and (8) business services are measured as the sum of purchases of studies, expenses related to the purchase of IT services, and advertisement. Column (6) adds non-capital expenditures on software purchases. Columns (7) adds capital expenditures on software purchases and investment in R&D. Data are for period 1996-2007. Clustered standard errors in parentheses; (*, **. ***) indicate 10, 5, and 1 percent significance levels.

onwards I control for a full set of interacted industry-by-year fixed effects. By focusing on the within variation the magnitude of the results is smaller but becoming an exporter or increasing the number of export destination is still highly related to more business services outsourcing.[35] The effect is also quantitatively important. Considering the coefficient in column 5 and the variation shown in Table 2, for the average firm in the sample, the increase in the number of destination countries explains almost a quarter of the increase in the share of outsourced services over the period. The following columns show that very little changes when I modify the measure of outsourcing by adding non-capital expenditures on software purchases (column 6), and capital expenditures on software purchases and investment in R&D (column 7). Finally column (8) shows that the result is still highly significant even after clustering standard errors at the industry level and performing the full degrees of freedom adjustment due to non-nested panels within clusters (firms that change industry).

The literature on firm boundaries has proposed many other potentially time-varying determinants that could affect outsourcing, other than the proposed proxy for coordination complexity. I therefore modify the basic regression to include other controls, I run the following regression:

$$OUT_{it} = \alpha_i + \beta_1 NC_{it} + \boldsymbol{W_{it}'}\boldsymbol{\beta_2} + \delta_{jt} + \epsilon_{it} \tag{20}$$

where OUT_{it} and NC_{it} are defined as before, $\boldsymbol{W_{it}}$ is a vector of controls, α_i are firm fixed effects, and δ_{jt} are the full interaction of industry and year fixed effects. The first interesting question to ask is whether outsourcing of services is a fixed cost component as assumed so far, or it also entails tasks related to variable costs. In the latter case outsourcing of business services would be also affected by the export intensive margin. I therefore include total exports in the regression.

[35] A simple reason for the smaller magnitude could be the classic attenuation bias from measurement error, see Angrist and Pischke (2008).

As column (2) of Table 4 shows, the intensive margin does not in fact drive the purchase of business services. Hence the common assumption that business services are a fixed export cost component seems to hold in the data. I will further investigate this issue in Section 6.

Table 4 also shows the baseline results after the inclusion of several controls common in the vertical integration literature: capital intensity, human-capital intensity, and a measure of scale economies (total number of employees) as in Antràs (2003); a measure firm-level contract intensity in the spirit of Nunn (2007); and a measure of headquarter intensity as proposed by Antràs and Helpman (2004, 2008). The effect of coordination complexity remains robust and stable to the inclusion of all controls. Most importantly column (6) includes a measure of internal production of services. The model predicts that when the number of infrequent tasks increases, these will be outsourced. It is therefore important to verify that this increase in the need of service inputs is not driven by an overall re-focus of the firm towards service activity, which would imply a parallel increase in the internal production of services. Controlling for internal production is not easy, even with micro-level data, because it is hard to observe the tasks internally produced by firms. In a related paper for the U.S., Berlingieri (2013), I show that this alternative story does not hold in the data at the aggregate manufacturing industry level, after controlling for business services produced in-house. I adopt a similar strategy here and control for the share of revenues generated by establishments of the firm that are classified within services, which is essentially equivalent to controlling for the revenue share of headquarters. In this specification I include establishments producing any type of services, not only business services. As column (6) shows the results are very robust to this measure of internal production.

Table 4: Purchased Business Services and Coordination Complexity - Covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Exporter	0.098***								
	(0.017)								
NC		0.086***	0.082***	0.083***	0.086***	0.086***	0.080***	0.085***	0.089***
		(0.010)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.013)	(0.013)
Exports			0.003	0.003	0.001	0.002	-0.001	-0.000	0.000
			(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Capital Intensity				0.030***	0.028**	0.028**	0.035***	0.024*	0.022
				(0.011)	(0.012)	(0.012)	(0.013)	(0.014)	(0.014)
Skill Intensity					0.047***	0.046***	0.051***	0.051***	0.051***
					(0.010)	(0.010)	(0.010)	(0.011)	(0.012)
HQ Intensity						-0.052	-0.054	-0.047	-0.054
						(0.037)	(0.037)	(0.039)	(0.039)
Scale							0.081***	0.066***	0.065***
							(0.022)	(0.023)	(0.024)
Num imp. products								0.014*	0.019**
								(0.008)	(0.009)
Contract Intensity									0.015**
									(0.006)
Observations	235,182	184,556	184,556	183,487	174,908	174,682	174,682	150,874	144,927
Number of firms	39,500	31,212	31,212	31,073	30,172	30,159	30,159	26,091	25,339
R-sq W	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fixed effects	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr

Note: The dependent variable is the share of purchased services over total costs. All variables are in logs apart from HQ Intensity. Data are for period 1996-2007. Firm-clustered standard errors in parentheses; (*, **. ***) indicate 10, 5, and 1 percent significance levels.

Some of the other controls are also worth discussing. It is interesting to note that the firm

scale and the total number of imported goods are positive and significant, even though not very robust. Both variables could be interpreted as alternative measures of managerial complexity. Capital intensity is positive, although not always significant. This implies that firms that increase their capital stock are more likely to outsource business services. Moreover the positive and significant effect of the contract intensity variable can be interpreted as another support, albeit indirect, to the complexity and core-competencies story. The variable is constructed using the information about firms' imports. The firm-level contract intensity is therefore a weighted average of the contract intensity of all firm imports, where the measure of contract intensity is taken from Rauch (1999), analogously to Nunn (2007), and the weights are the shares of each product in the total firm imports. Under a standard TCE interpretation, as also pointed out by Corcos et al. (2013), a firm in-sources more contract intensive inputs. Given that all of the observed imports are goods, the positive impact on service outsourcing can be rationalized by arguing that a manufacturing firm with more contract intensive inputs focuses on its core-competencies by producing more goods in-house and outsourcing more of the non-core services.

5.2.1 Alternative Measures of Complexity

The multi-product literature assumes the presence of product-specific export fixed costs, and again these are arguably mainly made up by service inputs. For instance Bernard et al. (2011) justify the presence of product-specific fixed costs arguing that they capture the research, advertising, and regulation costs to supply each product to a certain destination. Therefore also an increase in the number of products could entail an increase in the number of service inputs needed, and consequently an increase in coordination complexity. Table 5 shows the results when also the number of products and the interaction between number of products and countries (demeaned) are added. There is indeed a positive and significant relationship between the number of exported products and the share of service outsourcing. The magnitude is smaller compared to the number of destination countries. This result is in line with the fact that the fixed costs to export to a new destination are higher than those needed to export a new product, and that the market-specific entry costs drop fast with the number of products, as shown by Arkolakis et al. (2014). As expected, the interaction between the two variables is positive as well.

The proxy of coordination complexity defined as the number of destination countries is appealing for its simplicity. At the same time it is a rather crude measure, I therefore propose few other possible ways of measuring complexity. Arguably the majority of the fixed export costs could be related to handling transactions in a different language (translating labels, instructions, advertising campaigns, different legal system etc...).[36] Instead of counting the number of countries I therefore count the number of different languages. More generally, as shown by Morales et al. (2014) in their extended gravity framework, the fixed costs of exporting could be related to the standard gravity variables like common language, continent, and legal system. I therefore give countries a weight of 1 if they share all of the previous characteristics with France

[36]The gravity literature has shown that sharing a common language is a trade facilitator. A different language can also capture deeper cultural barriers.

Table 5: PBS Outsourcing and Number of Products

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
NC	0.086***	0.068***	0.082***	0.080***	0.081***	0.084***	0.083***	0.078***	0.081***	0.084***
	(0.010)	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.014)	(0.014)
NP		0.028***	0.038***	0.036***	0.036***	0.036***	0.037***	0.034***	0.032***	0.031***
		(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)
NC#NP			0.029***	0.030***	0.030***	0.030***	0.030***	0.027***	0.027***	0.028***
			(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Exports				0.003	0.002	0.001	0.001	-0.001	0.000	0.001
				(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)
Capital Intensity					0.031***	0.029**	0.029**	0.035***	0.024*	0.022
					(0.011)	(0.012)	(0.012)	(0.012)	(0.014)	(0.014)
Skill Intensity						0.047***	0.046***	0.050***	0.050***	0.050***
						(0.010)	(0.010)	(0.010)	(0.011)	(0.012)
HQ Intensity							-0.058	-0.059	-0.051	-0.059
							(0.037)	(0.037)	(0.038)	(0.039)
Scale								0.064***	0.051**	0.049**
								(0.022)	(0.023)	(0.024)
Num imp. products									0.008	0.013
									(0.008)	(0.009)
Contract Intensity										0.015**
										(0.006)
Observations	184,556	184,556	184,556	184,556	183,487	174,908	174,682	174,682	150,874	144,927
Number of firms	31,212	31,212	31,212	31,212	31,073	30,172	30,159	30,159	26,091	25,339
R-sq W	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fixed effects	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr

Note: The dependent variable is the share of purchased services over total costs. All variables are in logs and interaction variables are demeaned. See notes in Table 4.

Table 6: Alternative Measures of Coordination Complexity

	(1)	(2)	(3)	(4)	(5)	(6)
Exports	0.003	0.010	0.004	0.007	0.006	0.004
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
NC	0.135***					
	(0.016)					
Num Languages		0.113***				
		(0.014)				
NC (Gravity)			0.123***			
			(0.016)			
NC (WB Doing Business)				0.100***		
				(0.014)		
NC (WB Doing Business - Trade)					0.100***	
					(0.014)	
NC (Complexity)						0.143***
						(0.016)
Observations	176,492	176,492	176,492	176,492	176,492	176,492
Number of firms	30,438	30,438	30,438	30,438	30,438	30,438
R-sq W	0.01	0.01	0.01	0.01	0.01	0.01
Fixed effects	Firm	Firm	Firm	Firm	Firm	Firm
	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr

Note: The dependent variable is the share of purchased services over total costs. All columns also include the following regressors: K/L, S/L, HQ Intensity, and Scale. Regressors are standardized. Only exporters are included in the sample. See also notes in Table 4.

(e.g. Belgium), up to a weight of 4 if they share none (e.g. the U.S.). Along a similar way of thinking, I propose other two measures in which I weight countries by their ranking in the Ease of Doing Business of the Work Bank: the first using the overall ranking and second using the specific ranking related to ease of trading across borders. Finally, I weight countries with the measure of network complexity proposed by Hausmann and Hidalgo (2011). In this case not only does coordination complexity include the number of export destination countries of a firm, but it also takes into account the complexity of the destination country itself. According to Hausmann and Hidalgo's definition, a country is more complex if it is more differentiated in the product space and at the same time it produces products that few other countries can make. They propose a theory where in order to produce a product a country needs to have all the necessary capabilities, hence very few countries will make products that require a lot of capabilities.

Table 6 displays the results. The regressors are not in logs but they have been standardized in order to compare them more easily. Capital, skill and HQ intensities are also included in the regressions but not displayed. Column (1) essentially corresponds to column (6) in Table 4. The gravity related measures in columns (2) and (3) give very similar results. The measures obtained weighting countries by their ease of doing business are still very robust but have a somewhat smaller magnitude. The intuition might come from the fact that these measures give a lot of weight to small developing countries. Even though fixed costs might be higher along some dimensions, they are actually lower along others. For instance the goods exported to those countries might be of lower quality, or less differentiated, hence less advertising is needed in order to penetrate the market.[37] In this respect it is interesting to note that the magnitude increases when countries are weighted according to the measure of complexity proposed by Hausmann and Hidalgo (2011). Complex countries are generally more advanced (their measure is correlated with income per capita) and the evidence seems to suggest that exporting to those countries is more difficult: more service inputs are required and firms tend to outsource them.

5.2.2 Selection into Exporting and other Robustness Checks

The results in the previous sections are obtained with variables in logs, hence they only include exporters and firms that do outsource at least some of their service inputs. On the one hand, this makes firms more comparable because they are likely to be more similar across other dimensions. On the other hand, selection might be an issue. Unfortunately the sample I have is not well suited to analyze this issue, for two main reasons. First, including mainly large firms, the survey is highly skewed towards exporters; hence non-exporters might not be fully representative for the population of firms. Second, the EAE dataset has the serious drawback of not distinguishing between zeros and missing values. Even though I try to solve this issue by imputing missing values (see Appendix B.3), I cannot rule out the possibility that firms reporting zero outsourced services are in fact firms that simply did not fill that section of the survey. Measurement error

[37] An interesting avenue for future research is to test whether the form of fixed costs proposed by Arkolakis (2010) holds in the data. His interpretation in terms of marketing costs could be fairly easily tested with direct measures of advertising costs.

is therefore likely to be present and might affect the results. Despite these warnings, I re-obtain all the results without taking logs, and the exact same picture emerges. For instance Table 7 replicates the results of Table 4 without taking logs of the regressors but standardizing the variables to compare them more easily. Coordination complexity measured as the number of destination countries is still positive and highly significant in all specifications. Moreover the overall trade extensive margin (being an exporter) is also positive and highly significant in all specifications, while the trade intensive marking remains insignificant. A very similar picture holds true when I also include firms that do not outsource services (or that do not report it).

Table 7: PBS Outsourcing and Coordination Complexity with Non-Exporters

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Exporter	0.042***	0.035***	0.035***	0.035***	0.035***	0.034***	0.035***	0.035***	0.035***	0.040***
	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.011)
NC		0.141***	0.141***	0.137***	0.137***	0.130***	0.130***	0.128***	0.121***	0.120***
		(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)
Exports			0.003	0.004	0.004	-0.001	-0.001	0.003	-0.002	0.001
			(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.015)	(0.015)	(0.014)
TFP				-0.001	-0.001	0.002	0.002	0.001	0.001	0.002
				(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Capital Intensity					-0.001	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***
					(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Skill Intensity						0.004	0.004	0.004	0.005	0.008
						(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
HQ Intensity							-0.004	-0.004	-0.004	-0.003
							(0.005)	(0.005)	(0.005)	(0.005)
Scale								0.025*	0.019	0.018
								(0.014)	(0.014)	(0.013)
Num imp. products									0.027**	0.032***
									(0.011)	(0.011)
Contract Intensity										0.002
										(0.008)
Observations	235,182	235,182	235,182	224,565	224,565	215,425	215,141	215,141	215,141	161,311
Number of firms	39,500	39,500	39,500	37,614	37,614	36,606	36,582	36,582	36,582	27,947
R-sq W	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fixed effects	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr

Note: The dependent variable is the share of purchased services over total costs in logs. All other variables are standardized. See also notes in Table 4.

Finally the baseline result is very robust across many specifications and controls. For instance the same picture holds true when purchased services are weighted by total sales instead of total costs. Moreover the EAE survey also contains a measure of outsourcing of non-core activities. The model does not differentiate inputs; therefore there is no 'a priori' clear distinction between a service or a non-service input, apart from the intuitive assumption that for manufacturing firms the importance of adaptation will be higher for the primary good inputs (hence, by Proposition 1, they will be more likely to be produced in-house compared to services). There are although manufacturing firms whose activity has almost completely shifted towards services, which have essentially become their core competencies (Nike and P&G are two leading examples). In this respect a measure of outsourcing of non-core activities is possibly even more in line with the model. Managerial complexity, measured as the number of export destination countries, has again a positive and even stronger impact on outsourcing, when this alternative definition is considered.[38]

[38]Table C.1 in the Appendix shows the results. An interpretation of this result is that most of these non-core activities are actually services given that only manufacturing firms are analyzed, the two measures of outsourcing could be therefore quite similar (see the definitions in Appendix B.2).

5.3 Input Volatility and Managerial Skills: Evidence on Proposition 3

It is harder to provide empirical evidence on the other predictions of the model, since parameters such as the variance of the input conditions and the importance of adaptation are not easy to capture empirically. Still, the richness of the data allows me to provide good empirical counterparts of these parameters and present results that support the theory.

The predictions of Proposition 3 simply further qualify what already stated in Proposition 1, hence the intuition is precisely the same. An increase in the volatility of the inputs will result in a higher share of in-sourcing because the manager does not know what she gets from the external supplier, and this might result in a very costly ex-post coordination. And if the importance of adaptation is higher it is clearly optimal to in-source more, because that gives more weight to the ex-post coordination for which the internal production is better than the market.

The volatility of input conditions is intuitively related to the degree of homogeneity of the input. Ideally I would use some direct measure of differentiation, as for instance provided by Rauch (1999), but unfortunately this is not available for services. A first way to capture this concept is to look at a measure of dispersion across inputs, rather than specific for each single input. This might capture the overall volatility of inputs, which is not far from the prediction of the model since I have assumed the same variance for all inputs.[39] Given that a country-specific task needs to be solved to export to a given destination, the overall input volatility can be measured with the dispersion of export shares across destinations. I therefore proxy input volatility with one minus the Herfindahl-Hirschman index of export shares, also known as the Gini-Simpson diversity index. This is admittedly an imperfect measure of the homogeneity of each single service input. Still, when I add this measure of export dispersion to the previous regressions the results are in line with what predicted by the model, as Table 8 shows. The elasticity of the share of outsourcing with respect to export dispersion is negative, although marginally significant and not robust to all controls, especially when the sample is restricted to firms that both import and export (last two columns of the table).

Table 8: Purchased Business Services and Input Volatility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
NC	0.086***	0.082***	0.096***	0.098***	0.101***	0.101***	0.094***	0.096***	0.101***
	(0.010)	(0.011)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.016)	(0.016)
Exports		0.003	0.002	0.002	0.000	0.000	-0.002	-0.001	-0.001
		(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Export Dispersion			-0.048	-0.053*	-0.054*	-0.054*	-0.051*	-0.042	-0.045
			(0.029)	(0.030)	(0.030)	(0.030)	(0.030)	(0.032)	(0.033)
Observations	184,556	184,556	184,556	183,487	174,908	174,682	174,682	150,874	144,927
Number of firms	31,212	31,212	31,212	31,073	30,172	30,159	30,159	26,091	25,339
R-sq W	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fixed effects	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr

Note: The dependent variable is the share of purchased services over total costs. All variables are in logs apart from HQ Intensity. Columns from 4 to 9 contain the exact same controls of Table 4. Data are for period 1996-2007. Firm-clustered standard errors in parentheses; (*, **. ***) indicate 10, 5, and 1 percent significance levels.

A better way to capture the volatility of the input conditions is to look directly at the

[39]The model can be extended to a input-specific variance $\sigma(i)$.

characteristics of the service inputs. I can answer this question drawing on the extra information contained in the ERSI survey, which provides data on service outsourcing policies at the firm-service level. In particular the survey asks firms whether they outsource any of 34 detailed types of services. Most of them are classified in the Professional and Business Services industry, but there are also some transportation, financial and real estate services. Unfortunately the survey is available in 2005 only and for a smaller sample of firms. In fact it includes all firms with more than 250 employees but just a sample of smaller firms for a total of 4,745 manufacturing firms (after the data cleaning procedure described in Appendix B.3), compared to 24,117 firms in the EAE in 2005.[40]

I capture the characteristics of each service by analyzing the market in which it is produced. In particular I compute the Gini-Simpson diversity index for the 4-digit industries that produce each type of service. As argued by Sutton (1991), if a product is more homogeneous, the toughness of price competition should be expected to be high and the market to be more concentrated, other things equal (in particular controlling for sunk costs). In other words, in a less concentrated market the service type is going to be less homogeneous and firms are more likely to need to re-adapt the service ex-post. I proxy the service firms' market shares using the share of total labor costs in each industry from the DADS data. Alternatively I use actual market shares using the EAE survey for the service sector; in this case I do not have the entire population of firms and I can calculate the dispersion index only for a sub-sample of service types (27 out of 34). In any case the two measures are highly correlated, and results are very robust to both definitions. The advantage of using the second measure is that I can control for average sunk costs in the industry, which I proxy with the average capital stock.[41] Using the EAE survey I can also capture dispersion of the market with the shape parameter of the Pareto distribution, as in Helpman et al. (2004).

The dependent variable is now a binary variable that takes value equal to one if the service input s is outsourced by firm i. The regression specification is as follows:

$$OUT^*_{is} = \beta_0 + \beta_1 NC_i + \boldsymbol{W'_{it}}\boldsymbol{\beta_2} + \beta_3 Disp_s + \delta_j + \delta_c + \epsilon_{is} \tag{21}$$

where $Disp_s$ is a measure of dispersion for service s, δ_j and δ_c are industry and aggregate service category fixed effects, and OUT^*_{is} is a latent variable such that:

$$OUT_{is} = \begin{cases} 1 & \text{if } OUT^*_{is} > 0 \\ 0 & \text{otherwise} \end{cases} \tag{22}$$

Table 9 reports the results of the exercise using OLS (columns 1-3), a Probit model (columns 4-6), or a Logit model (columns 7-9). Beyond those displayed, the set of control variables $\boldsymbol{W_{it}}$ also includes capital, skill and HQ intensities. As expected, the dispersion of the service sector is negative, strongly significant and extremely robust to the inclusion of other controls.

[40] The firms in the ERSI sample account for 50% of the total turnover of the French manufacturing sector in 2005 (aggregate data from Eurostat).

[41] Ideally I would control for measures of endogenous sunk costs as well, such as advertising and R&D expenditures. Unfortunately for service industries almost no firm reports these measures.

Table 9: Purchased Business Services and Input Volatility - ERSI

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Exporter	0.021***	0.022***	0.022***	0.022***	0.022***	0.022***	0.023***	0.023***	0.022***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
NC	0.051***	0.058***	0.058***	0.055***	0.062***	0.060***	0.055***	0.061***	0.059***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
Exports	0.004*	0.005	0.005	0.009*	0.020	0.019	0.014	0.044*	0.044*
	(0.002)	(0.003)	(0.003)	(0.005)	(0.015)	(0.014)	(0.009)	(0.026)	(0.025)
Serv. Disp. (DADS)	-0.112***			-0.228***			-0.235***		
	(0.001)			(0.002)			(0.002)		
Serv. Disp. (EAE)		-0.099***			-0.120***			-0.122***	
		(0.001)			(0.001)			(0.001)	
Serv. Disp. (Pareto)			-0.036***			-0.037***			-0.037***
			(0.001)			(0.001)			(0.001)
Serv. Capital		0.010***	0.051***		0.017***	0.052***		0.015***	0.053***
		(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)
Observations	136,401	101,200	101,200	136,401	101,200	101,200	136,401	101,200	101,200
Pseudo R-sqr	0.07	0.08	0.04	0.07	0.06	0.03	0.07	0.06	0.03
Fixed effects	Ind	Ind	Ind	Ind	Ind	Ind	Ind	Ind	Ind
	Serv Cat	Serv Cat	Serv Cat	Serv Cat	Serv Cat	Serv Cat	Serv Cat	Serv Cat	Serv Cat

Note: The dependent variable a binary variable that takes the value of 1 if firm i is outsourcing service s. Columns 1-3 are obtained with OLS, columns 4-6 with a Probit Model, and columns 7-9 with a Logit Model. All columns also include Capital, Skill and HQ intensities; all variables are standardized. Data are for year 2005. Firm-clustered standard errors in parentheses; (*, **. ***) indicate 10, 5, and 1 percent significance levels. Marginal effects evaluated at the mean.

Therefore the results seem to confirm that services that are more differentiated and more likely to need adaptation ex-post are in-sourced more frequently. The regressions includes the firm level variables previously analyzed. The number of export destination countries has once again a positive, robust and stable effect on service outsourcing.

Finally I can provide evidence on the role of managerial skills. Corollary 3 states that everything else constant, and in particular controlling for the number of destination markets, a better manager implies a higher share of in-sourcing because she is good at handling the ex-post coordination. It is hard to control for managerial skills, also because in the data I don't have information at the worker level. Still I can control for the overall managerial inputs into the firm taking the share of top managers in total number of employees. Albeit quite crude, this measure captures the share of employees that are fully dedicated to coordinating roles. A higher share of top managers implies that the firm needs to economize less on managerial inputs and more tasks can be performed in-house.[42]

The results are reported in Table 10. As expected the sign of managerial skills is negative, although not very precisely measured. In particular when a full set of industry-by-year fixed effects are included, the p-value is between 0.1 and 0.2. An alternative way to control for the level of managerial skills would be to proxy it with the firm's productivity. TFP is clearly an imperfect proxy, it is a residual so it captures many other things beyond managerial skills. Tables 7 shows that essentially TFP has almost no effect on service outsourcing. In the absence of a better measure of managerial skills, in the next section I instrument for the number of destination countries and show that the OLS estimates for coordination complexity are downward biased,

[42]The version of DADS I have is aggregated at the establishment level, which is more convenient for data-access related reason. But the DADS dataset is in principle available at the worker level, which would allow me to control for wages. I am planning to ask for this extended version at the renewal of my data license.

Table 10: Purchased Business Services and Managerial Skills

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NC	0.085***	0.085***	0.084***	0.079***	0.086***	0.086***	0.086***	0.080***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Exports	0.000	0.000	0.001	-0.002	0.001	0.001	0.001	-0.001
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Top Managers	-0.393	-0.431*	-0.439*	-0.347	-0.373	-0.412	-0.420*	-0.328
	(0.251)	(0.252)	(0.252)	(0.254)	(0.252)	(0.252)	(0.252)	(0.254)
Observations	174,760	174,104	173,878	173,878	174,760	174,104	173,878	173,878
Number of firms	30,110	30,008	29,995	29,995	30,110	30,008	29,995	29,995
R-sq W	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fixed effects	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	ind, yr	ind, yr	ind, yr	ind, yr	ind#yr	ind#yr	ind#yr	ind#yr

Note: The dependent variable is the share of purchased services over total costs. All variables are in logs apart from HQ Intensity. Columns 1-4 and 5-8 contain the exact sequence of controls of columns 4-7 in Table 4, with the only difference that top mangers are excluded from the measure of Skill Intensity. Data are for period 1996-2007. Firm-clustered standard errors in parentheses; (*, **. ***) indicate 10, 5, and 1 percent significance levels.

as predicted by the theory.

5.4 Endogeneity: Is Reverse Causality a Problem?

Despite controlling for unobserved time-invariant firm characteristics and industry specific time shocks, a full causal interpretation of the previous results might remain problematic. A potential concern is reverse causality: firms might decide to outsource for reasons unrelated with exporting, as a result of that they become more productive and this allows them to become exporters. Given the positive relationship between outsourcing and productivity often found in the literature, this possibility is certainly a concern. Moreover I do not have a good measure of managerial skills, and this can introduce a standard omitted variable bias in the results.

A first way of investigating the issue of reverse causality is looking at this channel directly. I perform the analysis at the end of Section 6, where using the ERSI survey I can test whether the same inputs outsourced to start exporting are also the ones that generate the highest productivity gains (Table 15). A second way is finding a plausible instrument. In the ideal setting I would want an exogenous shock that makes exporting suddenly easier and more attractive; as a consequence firms start exporting (or will export to more destination countries), and I would like to observe whether they change their sourcing behavior at home, for services in particular. Not having such a shock for France over the past fifteen years, I propose two alternatives. First, I look at the export destination growth for the US. The growth in destination countries for US firms can be related to the export opportunities of French firms, but at the same time unrelated to their productivity gains due to outsourcing. Second, I look at shocks to demand that are plausibly exogenous to French firms. If the demand for French products increases globally, French firms will find exporting more attractive. The 'China shock' and the EU enlargement seem the obvious choice.

I instrument the increase in the number of destination countries with the plausibly exogenous increase in the number of country-product varieties exported by the US or imported by China

and the new EU members. This approach is close in spirit to one of the instrumental variables proposed by Bloom et al. (2011), and resembles the "shift-share" IV strategy used in the labor literature (e.g. Bartik, 1991; Card, 2001). Since I have firm and industry-year fixed effects in all regressions I need an instrument that varies at the firm level. To achieve that I exploit the information on the products exported by each firm. I define the number of destination markets of a firm in the initial year as the number of markets reached by the firm's most successful product. Then I keep the firm's product space fixed and calculate the increase in the number of destination markets for each product with the increase in the number of countries where the US exports that particular product, or the number of countries that supply that particular product to China or the new EU members. In all cases, in the country count I exclude France, the EU15 or the Eurozone countries (as of 2001). In any year, the number of destination countries is given by the number of destination markets of the most successful product in that year.

The instrument is constructed as follows:

$$IV\_NC_{i,t,x} = \max_{p \in P_{i,t_0}} \left\{ NC_{p,t_0} + \Delta NC^{x}_{p,t} \right\} \tag{23}$$

where p is a product exported by firm i, and P_{i,t_0} is the full set of products exported by that firm in 1996 or the first year in which it exports. NC_{p,t_0} is the number of countries where firm i exports product p in the initial year, and $\Delta NC^{X}_{p,t}$ is the increase between year t_0 and year t in the number of export destinations of the US or in import sources of China or of new EU members for product p (hence $x \in \{$*US-Exports, China-Imports, newEUmembers-Imports*$\}$). For each x, I construct three instruments depending on the countries that I exclude in computing ΔNC: France (exFRA), the Eurozone countries as of 2001 (exEZ12), and the EU15 countries (exEU15).[43] I impose $IV\_NC_{i,t,x} >= 0$, hence more precisely my instrument is defined as: $\hat{IV}\_NC_{i,t,x} = \max\{IV\_NC_{i,t,x}, 0\}$. Since I only include exporters in the regressions by taking logs of all variables, whenever the constructed instrument is zero in a given year, the firm will be dropped in that particular year (even if it is in fact an exporter). But results virtually do not change if I do not drop those firms by imposing $IV\_NC_{i,t} > 0$.

Table 11 shows the results of the exercise. Coordination complexity measured as the number of destination countries is again positive and very significant across all specifications. It also reassuring to see that the magnitude of the effect does not change much depending on the instrument used, and all of them are very strong as the F statistics from the first stage show. In Table 12, I perform a more demanding exercise where I only consider the change (hence the growth since all variable are in logs) between three years before and three years after the EU enlargement that took place in 2004. The model is therefore estimated in first differences between 2001 and 2007. The effect is still present and the magnitude is again very similar and robust to all the controls used in the regression.

Interestingly the previous OLS regressions were strongly underestimating the effect of inter-

[43]The Eurozone countries in 2001 were: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. The EU15 group include the previous countries and Denmark, Sweden, and the United Kingdom.

Table 11: Instrumental Variable Estimation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
IV	US-Exp exEU15	US-Exp exEZ12	US-Exp exFRA	China-Imp exEU15	China-Imp exEZ12	China-Imp exFRA	newEU-Imp exEU15	newEU-Imp exEZ12	newEU-Imp exFRA
NC	0.549***	0.557***	0.565***	0.475***	0.452***	0.505***	0.390***	0.376***	0.398***
	(0.162)	(0.158)	(0.160)	(0.153)	(0.152)	(0.144)	(0.131)	(0.131)	(0.129)
Exports	-0.100***	-0.103***	-0.103***	-0.085**	-0.080**	-0.092***	-0.065**	-0.062**	-0.066**
	(0.035)	(0.034)	(0.034)	(0.033)	(0.033)	(0.031)	(0.028)	(0.028)	(0.028)
Capital Intensity	0.035***	0.034***	0.034***	0.031**	0.032**	0.032**	0.032***	0.033***	0.033***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.012)
Skill Intensity	0.039***	0.039***	0.037***	0.043***	0.043***	0.041***	0.043***	0.043***	0.043***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
HQ Intensity	-0.074*	-0.076**	-0.077**	-0.076**	-0.070*	-0.081**	-0.074**	-0.073*	-0.075**
	(0.039)	(0.039)	(0.039)	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)
Scale	-0.002	-0.002	-0.005	0.003	0.009	-0.001	0.023	0.026	0.021
	(0.038)	(0.038)	(0.038)	(0.037)	(0.037)	(0.035)	(0.034)	(0.034)	(0.034)
Observations	160,887	160,799	160,917	164,546	164,638	164,960	166,092	165,659	165,764
Number of firms	24,061	24,058	24,055	24,386	24,383	24,412	24,539	24,514	24,523
F-stat	320.8	336.2	330.7	348.7	357.1	402.3	488.9	483.2	502.5
Fixed effects	Firm ind#yr	Firm ind#yr	Firm ind#yr	Firm ind#yr	Firm ind#yr	Firm ind#yr	Firm ind#yr	Firm ind#yr	Firm ind#yr

Note: See notes in Table 6. The F-stat is the Kleibergen and Paap (2006) Wald rk F statistic provided by the Baum et al.'s (2010) xtivreg2 Stata command.

Table 12: IV Estimation - New EU member countries: 2001-2007 change (growth)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ IV	newEU exEU15	newEU exEU15	newEU exEU15	newEU exEU15	newEU exEU15	newEU exEU15	newEU exEZ12	newEU exFRA
Δ NC	0.296**	0.413**	0.410**	0.489***	0.449**	0.432**	0.450**	0.475***
	(0.121)	(0.191)	(0.200)	(0.185)	(0.191)	(0.199)	(0.192)	(0.183)
Δ Exports		-0.074	-0.076	-0.094*	-0.084	-0.084	-0.088*	-0.095*
		(0.052)	(0.054)	(0.051)	(0.052)	(0.052)	(0.051)	(0.049)
Δ Capital Intensity			0.056	0.073*	0.071*	0.076**	0.076**	0.077**
			(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
Δ Skill Intensity				0.080**	0.075*	0.080**	0.080**	0.079*
				(0.039)	(0.039)	(0.040)	(0.041)	(0.041)
Δ HQ Intensity					0.018	0.015	0.013	0.010
					(0.063)	(0.062)	(0.060)	(0.060)
Δ Scale						0.060	0.057	0.053
						(0.057)	(0.057)	(0.058)
Observations	9,234	9,234	9,180	8,494	8,381	8,381	8,380	8,383
F-stat	165.3	164.8	172.3	126.7	133.2	108.8	110.1	107.4

Note: The dependent variable is the growth of the share of outsourcing in total costs (log-change) between 2001 and 2007. All controls are also in log-changes. Standard errors are clustered at the 2 digit industry level. The F-stat is the Kleibergen and Paap (2006) Wald rk F statistic.

est. There could be several explanations for this result. But one in particular comes straight from the model. Firms with managers with higher ability will tend to produce more in-house, everything else constant (Corollary 3). Moreover from Proposition 4 we know that firms that export to more destinations are more likely to employ better managers. Combining the two reasons, firms that export to multiple destinations are more likely to produce inputs in-house, everything else constant. If they had to export to many destinations, less productive firms would tend to outsource a much higher proportion of their inputs, because they would not be able to compete with external specialized suppliers. In reality these firms export to much fewer markets, if any at all. Hence if the number of destination countries could be randomly assigned to firms, the effect on outsourcing would be much stronger.

Considering the coefficients of the previous two tables, the average increase in the number of destination countries explains between 66% and 100% of the increase in the share of outsourced services over the period. The new channel between globalization and structural transformation that I propose is not only present but it is also quantitatively very significant. The causal effect of globalization explains over two-thirds of the increase in domestic service outsourcing observed in the sample.

One reason why the overall effect might be partially overstated is that the average effect might not be representative for the entire distribution of firms, due to the presence of non-linearities, as the next section shows.

5.5 Non-linear Effects: Evidence on Corollary 2

A further interesting question to answer is whether the effect of coordination complexity on the share of outsourcing exhibits a non-linear behavior. Proposition 4 predicts that the relationship should be concave, that is, the increase in outsourcing should flatten when the number of destination countries is large. This is precisely what happens, as Figure 8 shows.[44]

Multiple interpretations can be put forward to explain this fact. In the model, when the number of overall inputs goes up, the probability that the manager needs to understand the input condition for each one of them becomes smaller and smaller. Setting up a communication code for such a high number of very rare events (all equally likely) is going to be very costly. So the manager increases the number of inputs internally produced at a much lower speed compared to the increase in the number of overall inputs needed. At some point the number of in-house produced inputs hardly increases and if the denominator keeps rising the overall share will become smaller and smaller till converging to zero. In the model the slope essentially goes to zero only when also the share of internally produced inputs goes to zero (even though with a lower order). In the data the slope is zero (even though not significant) when the share of internal production is still positive. The reason is of course due to the fact that inputs are homogeneous in the model while they are not in the data. It might be that the firm is outsourcing all of the service inputs needed to export but it is still of course producing in-house all the other core activities. One way to capture this effect in the model would be to have some heterogeneity in

[44] This effect is also confirmed by the negative sign on the square of the number of countries. The results of the regression are not reported but available on request.

the importance of adaptation (e.g.: different probabilities of adaptation). In such case, the core activities would intuitively have a higher probability of adaptation and hence would be more likely to be produced in-house.

A different explanation is that the distribution of events might change. If the service inputs are not truly country-specific, but some of them are common across countries in a differential way (e.g.: translation is shared across the countries with the same language, while transportation services are shared across all countries), then it is possible that some inputs are recurring with a higher and higher probability. In this situation the firm needs the input in different proportions and the uniform distribution of events would not apply anymore. Since some inputs become more and more frequent, the firm will find it optimal to produce them in-house because a code designed to communicate those events is quite cheap. The firm essentially specializes in the production of export-related services as it exports to more and more countries, and the share of service outsourcing might even decrease.

As Figures 8 shows, the data are very noisy for firms that export to a very high number of countries. In fact it is not possible to sign the slope, because the confidence interval allows for both positive and negative slopes. So it is hard to disentangle the two stories in the data.

6 An Anatomy of Fixed Export Costs

This section is devoted to opening the black box of fixed export costs, by providing evidence on their timing and nature. Related to the timing, an interesting question is whether service export costs are more of a fixed or sunk nature. In the former case the costs have to be paid every period, while in the latter they are paid once for all when a firm enters a new market. In their quantitative exercise Morales et al. (2014) find that fixed costs are somewhat larger. This contrasts with the results of Das et al. (2007), who find the opposite. Both papers obtain estimates of these costs from structural models, while here I can provide direct evidence on the nature of export costs (or at least part of them) from the data. To the best of my knowledge this is the first paper that addresses this issue directly, and I do so through a simple analysis on the timing of the incurrence of these costs. First I analyze the effect of the lead and lag of the number of export destination countries. Then for each firm I define three dummy variables that identify: a) the year after entering a new market; b) the year of entrance; and c) the year before entering a new market. The first variable is the lag of the second, while the third is the lead of the second. One would expect the costs that are sunk in nature to be paid before entering and being related to the number of countries that will be entered, regardless the number of countries that the firm exits.

This is precisely what happens, as Table 13 shows. Not only do firms appear to increase their purchases of services also in the year before entrance but the number of export destination countries at year $t+1$ is the variable with the largest magnitude, significantly larger than the effect of the number of export destination countries at year $t-1$ (column 1).[45] Moreover I

[45]It is harder to disentangle whether the cost paid in the year of entrance are fixed or sunk. Although not displayed, the regressions also includes exports, scale, capital, skill and HQ intensities as regressors.

build two sets of the aforementioned dummy variables, depending whether a firm is also exiting countries or not: in the 'gross' case I simply set the variable to one if a firm enters a country regardless of exit; in the 'net' case, on the other hand, I define entry only if the number of entered countries is higher than the number of exited countries (hence the variable is zero if a firm enters a country and exits another country at the same time). It turns out that the magnitude of the coefficient is higher in the 'gross' case, hence the evidence points to costs that are sunk in nature since exit does not seem to matter much. This statement is confirmed when I analyze re-entry. I define three dummy variables as before but for cases in which firms re-entry countries in which they had already exported in the past. When they re-entry these countries without simultaneously entering other countries, the costs does not seem to move at all, if anything the share of outsourcing is decreasing. In columns (5)-(8), I run the same regressions but the regressors are standardized and not in logs, hence non-exporters are included and I can add a dummy variable for exporters. This shows how the results are not driven by selection into exporting, and they are actually even stronger.

Table 13: The Timing of Service Outsourcing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exporter					0.031***	0.026***	0.033***	0.027***
					(0.010)	(0.010)	(0.009)	(0.010)
NC (t-1)	0.020**				0.019			
	(0.010)				(0.015)			
NC (t)	0.047***				0.061***			
	(0.012)				(0.016)			
NC (t+1)	0.049***				0.075***			
	(0.011)				(0.015)			
Country Entry (t-1, gross)		0.020**				0.017***		
		(0.010)				(0.005)		
Country Entry (t, gross)		0.022**				0.015***		
		(0.011)				(0.005)		
Country Entry (t+1, gross)		0.020**				0.013***		
		(0.010)				(0.005)		
Country Entry (t-1, net)			0.002				0.006*	
			(0.007)				(0.003)	
Country Entry (t, net)			0.005				0.005	
			(0.008)				(0.003)	
Country Entry (t+1, net)			0.001				0.002	
			(0.007)				(0.003)	
Country Re-entry (t-1, only)				-0.001				-0.002
				(0.011)				(0.003)
Country Re-entry (t, only)				-0.018*				-0.007**
				(0.011)				(0.003)
Country Re-entry (t+1, only)				-0.013				-0.004
				(0.010)				(0.003)
Observations	135,401	127,831	127,831	108,944	170,701	156,962	156,962	132,726
Number of firms	23,141	23,676	23,676	21,416	30,269	28,562	28,562	25,727
R-sq W	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fixed effects	Firm ind#yr	Firm ind#yr	Firm ind#yr	Firm ind#yr	Firm ind#yr	Firm ind#yr	Firm ind#yr	Firm ind#yr

Note: The dependent variable is the share of purchased services over total costs. All columns also include the following regressors: exports, K/L, S/L, HQ Intensity, and scale. See also notes in Table 4.

It is informative to analyze cases in which costs are more likely to be variable in nature rather than fixed or sunk. For instance I look at employment outsourcing, that is, the use of temporary work from employment agencies. It is likely that firms use these services when they have some

capacity constraints and decide to expand in a more flexible way, for instance to meet peaks of demand. Table 14 provide strong evidence in this direction. In the baseline regression (column 1) it is now the intensive margin of trade to be positive and significant, and not the number of destination countries. This result supports the idea that temporary employment is not used to produce country-specific inputs. Looking at the timing, it is now the net entry that matters and the costs are mostly incurred in the year of entrance and not before, in full contrast with the previous results. Hence this type of labor input is likely to be related to variable costs, rather than country specific entry costs. Very similar evidence applies for industrial outsourcing, the outsourcing of goods and components rather than services. It is the trade intensive margin that is positive and strongly significant, the number of countries is also positive but not significant.

Table 14: Employment and Industrial Outsourcing

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Var.	Empl	Empl	Empl	Ind	Ind	Ind
NC	-0.009			0.016		
	(0.010)			(0.010)		
Exports	0.010**	0.011***	0.010**	0.028***	0.032***	0.032***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Capital Intensity	0.056***	0.065***	0.065***	0.014	0.008	0.008
	(0.011)	(0.014)	(0.014)	(0.012)	(0.017)	(0.017)
Skill Intensity	-0.051***	-0.037***	-0.037***	0.032***	0.019	0.019
	(0.011)	(0.013)	(0.013)	(0.010)	(0.012)	(0.012)
HQ Intensity	-0.257***	-0.247***	-0.248***	-0.311***	-0.367***	-0.367***
	(0.038)	(0.045)	(0.045)	(0.046)	(0.058)	(0.058)
Scale	0.101***	0.111***	0.110***	-0.133***	-0.166***	-0.166***
	(0.022)	(0.028)	(0.028)	(0.025)	(0.032)	(0.032)
Country Entry (t-1, gross)		-0.008			-0.008	
		(0.009)			(0.009)	
Country Entry (t, gross)		0.000			-0.010	
		(0.010)			(0.010)	
Country Entry (t+1, gross)		0.000			-0.008	
		(0.009)			(0.010)	
Country Entry (t-1, net)			0.009			-0.004
			(0.006)			(0.007)
Country Entry (t, net)			0.014*			-0.006
			(0.007)			(0.008)
Country Entry (t+1, net)			0.009			0.003
			(0.007)			(0.007)
Observations	142,809	107,449	107,449	135,767	99,526	99,526
Number of firms	26,510	21,468	21,468	26,080	20,468	20,468
R-sq W	0.04	0.03	0.03	0.01	0.01	0.01
Fixed effects	Firm	Firm	Firm	Firm	Firm	Firm
	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr

Note: See notes in Table 6.

In order to open the black box of fixed/sunk export costs it is interesting to investigate which are the specific service inputs that a firm needs in order to export to new countries. I can answer this question again drawing on the extra information contained in the ERSI survey. I run a set of separate Probit regressions for each service type to see which one is mostly related to the number of destination countries. Table 15 reports the marginal effects at the mean for

Table 15: The Anatomy of Service Inputs

Service Type		Out. 1			TFP	
Num.	Description	NC	Exports	Obs.	Out	Obs.
5.1	Advertising	0.089***	-0.014**	3,884	-0.009	3,820
2.1	R&D	0.052***	0.006	3,890	0.004	3,826
1.1	IT Consulting	0.042***	0.002	3,897	0.015	3,833
4.9	Insurance	0.034***	-0.004	3,892	-0.010	3,828
4.4	Legal Services	0.029***	-0.001	3,893	0.001	3,829
3.3	Packaging	0.027***	0.001	3,890	0.034	3,826
3.1	Transportation	0.022***	-0.000	3,894	-0.058	3,830
4.1	Translation	0.022**	0.019***	3,889	0.048	3,825
1.2	IT Maintenance	0.021*	0.007	3,890	-0.012	3,826
6.6	Refuse collection	0.017**	-0.002	3,892	-0.098**	3,828
4.2	Training	0.016*	0.001	3,894	0.040	3,830
4.6	Recruitment	0.013	0.006	3,890	0.034	3,826
4.3	Business Consulting	0.012	-0.006	3,889	-0.009	3,825
4.10	Leasing	0.011	-0.009	3,890	-0.023	3,826
6.4	Security	0.011	0.002	3,893	0.005	3,829
6.7	Real estate	0.010	-0.008	3,891	-0.033	3,827
3.5	Chartering	0.009	0.010*	3,892	0.020	3,828
4.11	Debt recovery	0.006	-0.002	3,888	-0.123***	3,824
5.2	After-sales Services	0.006	-0.003	3,880	0.055	3,816
4.5	Accounting	0.002	0.006	3,893	0.026	3,829
4.8	Brokerage	0.002	0.002	3,869	0.001	3,823
6.3	Cleaning	0.002	0.002	3,893	0.020	3,829
7.2	Personal services	0.002	-0.001*	3,339	-0.057	3,821
2.2	Technical studies	0.001	0.014**	3,873	0.044	3,810
4.7	Temporary work	-0.000	0.005	3,893	0.136***	3,829
6.5	Sewage	0.000	0.001	3,890	0.003	3,826
1.3	Data processing	-0.001	-0.002	3,890	0.011	3,826
6.1	Machinery Maint.	-0.002	0.001	3,893	0.016	3,829
6.2	Buildings Maint.	-0.006	0.012**	3,892	0.073***	3,828
7.1	Catering	-0.009	0.015**	3,884	0.047	3,821
6.8	Machinery Renting	-0.011	0.003	3,893	-0.000	3,829
3.2	Warehousing	-0.018	0.038***	3,892	0.051	3,828

Note: Data from the 2005 ERSI Survey. See Appendix B for the precise definition of service types. The table reports the marginal effects at the mean for number of countries and total exports. The last two columns report the results of separate OLS regressions where the firm's TFP is regressed on the outsourcing binary variable for each service type. All regressions include K/L, S/L, HQ Intensity and scale as controls. All regressors are in logs, and only exporting firms are included. Standard errors are clustered at the NES36 (Nomenclature Economique de Synthèse - Niveau 2) industry level used to stratify the sample of firms; (*, **. ***) indicate 10, 5, and 1 percent significance levels.

the number of destination countries and total exports (all regressions also include capital, skill, HQ intensities, and scale as controls.). It turns out that advertising, R&D and IT consulting are the service inputs most highly related to an increase of export destination countries, while the intensive margin of trade again plays no role. These inputs were already contained in the outsourcing variable used in the previous section, so it is reassuring to see that the results are confirmed with this more detailed survey for a cross-section of firms. Other service inputs that are key in order to export to new countries are: insurance, legal services, translation and quite intuitively transportation and packaging. Results change very marginally if I use a logit or a linear probability model.

Finally, the detailed data allow me to investigate the issue of reverse causality directly. In particular I can test whether the same inputs outsourced to start exporting are also the ones that generate the highest productivity gains. The last two columns of Table 15 report the results, where I run separate OLS regressions for each service type to see whether outsourcing of that particular service has an impact on the firm's TFP. The table shows that there is no correspondence between the outsourcing of service inputs needed to export to new countries and an increase in the firm's TFP, the reverse causality channel does not seem to be there.

7 Alternative Mechanisms

An alternative explanation for the rise in service outsourcing is that manufacturing firms are simply becoming more service oriented. An overall increase in the production of services might increase the need for service inputs, that in turn leads to more outsourcing. This could lead to a parallel increase of services produced internally and services purchased from the market. Controlling for internal production is therefore key in the analysis to rule out the possibility that service outsourcing is driven by manufacturing firms simply becoming "service firms". I propose six other measures of internal production and the base result is robust to all of them, as shown in Table 16. Column (1) displays the same regression of column (6) in Table 4, where I capture internal service production with the share of revenues generated by establishments classified in services (often the headquarters). In column (2), the definition of internal production of services is very similar but the headquarter share is computed in terms of employment and not revenues. The following two regressions employ similar definitions but instead of using the shares of all service establishments they only include the establishments classified in business service industries (for instance they exclude transportation, retail, wholesale etc...).[46] Columns (5) and (6) use respectively the share of total salaries and of total employment accounted in establishments classified as headquarters by the firm itself.

All these measures have the common problem that they do not account for services produced inside production establishments. This is a measurement issue is also present for the economy as a whole: when a manager sits in the back of a production site performing accounting, billing, marketing and other services, all this service activity goes completely undetected in industry

[46] Whenever the shares in terms of employment are used (columns 2 and 4), year 2007 is dropped due to missing data.

Table 16: Alternative Measures of Internal Production of Services

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
NC	0.086***	0.080***	0.086***	0.080***	0.086***	0.086***	0.086***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
HQ Share (Rev)	-0.052						
	(0.037)						
HQ Share (Empl)		-0.005					
		(0.049)					
PBS Share (Rev)			-0.047				
			(0.369)				
PBS Share (Empl)				-0.210			
				(0.420)			
HQ Est. (Salaries)					0.053		
					(0.071)		
HQ Est. (Empl)						0.007	
						(0.075)	
Professionals Share (CS3)							0.043
							(0.084)
Observations	174,682	161,755	174,682	161,755	174,745	174,812	174,892
Number of firms	30,159	29,464	30,159	29,464	30,126	30,161	30,172
R-sq W	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fixed effects	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr

Note: The dependent variable is the share of purchased services over total costs. All columns also include the following regressors: exports, capital and skill intensities. Year 2007 dropped in columns 2 and 4. See also notes in Table 4.

data. This issue is probably not too worrisome in the present context since I mainly focus on exporters. In fact it is well known that exporters are larger, and large firms tend to have establishments dedicated to services, as reported by Young and Triplett (1996). In any case, I propose another measure of internal production that is not subject to this problem since it comes from occupation data. I use the share of workers classified as managers and professional occupations in total employment (column 7). The measure comes from the DADS dataset and it is a relatively good proxy for internal production of PBS services since these activities are mainly performed by professionals.[47]

Another possibility is that manufacturing firms are not becoming more service oriented but they "consume" relatively more services in order to export. This is of course at the heart of the mechanism under study. Firms need more services inputs to export to more destination countries and the overall increase in the need of services might exceed their expansion in terms of total revenues or total costs, hence the share of services would mechanically increase. Firms might decide to source them both from inside and outside the firm, and if the shift takes place at the exact the same pace, the boundary of the firm might not be an issue after all. At first sight, it looks like the overall need of services has in fact increased. Columns (1)-(4) of Table 17 show the sum of both purchased services and internal production of services, measured as the share of professionals in total employment. It is indeed strongly related to the number of destination countries. This fact implies that the impact of globalization on structural transformation might

[47]This is category 3 (CS3) in the DADS data: "cadres et professions intellectuelles supérieures". Ideally I would control for their share in the total employment bill but I do not have wages disaggregated at that level of detail.

Table 17: Total Service Production and Outsourcing versus Internal Production

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Var.	Tot Serv	Tot Serv	Tot Serv	Tot Serv	OUT/IN	OUT/IN	OUT/IN	OUT/IN
NC	0.105***	0.107***	0.111***	0.124***	0.084***	0.079***	0.064***	0.067***
	(0.012)	(0.013)	(0.013)	(0.015)	(0.012)	(0.013)	(0.013)	(0.015)
Exports		-0.001	-0.000	0.001		0.004	-0.003	-0.001
		(0.005)	(0.005)	(0.006)		(0.005)	(0.005)	(0.006)
Capital Intensity			0.028**	0.010			0.036***	0.030*
			(0.014)	(0.015)			(0.014)	(0.016)
Scale			-0.039	-0.063**			0.213***	0.194***
			(0.025)	(0.027)			(0.023)	(0.025)
Num imp. products				0.030***				0.012
				(0.010)				(0.010)
Contract Intensity				0.021***				0.012*
				(0.007)				(0.007)
Observations	159,698	159,698	159,078	134,888	159,698	159,698	159,078	134,888
Number of firms	28,178	28,178	28,086	23,976	28,178	28,178	28,086	23,976
R-sq W	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02
Fixed effects	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr

Note: The dependent variable in columns 1-4 is the share of purchased services in total costs plus the share of professionals in total employment, while in columns 5-8 is ratio of the two shares. All variables are in logs. Data are for period 1996-2007. Firm-clustered standard errors in parentheses; (*, **. ***) indicate 10, 5, and 1 percent significance levels.

be even stronger than what the data shows. Many of these professionals are not employed in service establishments, hence they will be accounted within manufacturing when in fact they are producing services. The larger magnitude of the coefficient of interest with respect to the case of outsourcing only (Table 4) seems to point in that direction.

However the boundaries of the firms do matter. First of all, the magnitude for the overall production of services is larger than in the case of outsourcing only, but marginally. Thus internal production contributes much less then outsourcing, and exporting to more countries increases the outsourced share of services dis-proportionally more than internal production. This fact can be shown in two ways. First, in columns 5-8 of Table 17 I run a set or regressions where the dependent variable is the ratio of outsourcing over internal production (hence the log difference between the outsourcing share and the professionals share). The coefficients are positive and strongly significant, so an increase in the number of destination countries leads firms to increase outsourcing over internal production.

Second, it is evident from Table 18 that the magnitude of the effect for internal production alone (share of professionals, column 2) is significantly smaller than the one for outsourcing. The table also shows how other categories of occupations are related to the main variable of interest, these categories correspond to the hierarchical layers described by Caliendo et al. (2012). As expected the share of professionals (CS3, or Layer 2 in Caliendo et al. 2012) expands the most compared to all other internal layers, confirming that this is the occupational category most likely producing the specific services associated with exporting. Since the share of professionals is the one increasing the most with the number of destination countries, the exercise in columns (5)-(8) of Table 17 was the most demanding setting in which to test the ratio of the two. Table 18 also shows the ratio of outsourcing over internal production for all layers (columns 6-10,

column 7 coincides with column 7 of Table 17). Outsourcing increases with the number of export destination countries disproportionally more than any measure of internal production. All in all, the results appear to be very robust to internal production of services. This evidence shows not only that business services are a fixed export cost component but also that firms tend to acquire these key inputs by outsourcing them to external providers, rather then producing them in-house.

Table 18: Internal Hierarchies and Outsourcing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Var.	CS2	CS3	CS4	CS5	CS6	OUT/CS2	OUT/CS3	OUT/CS4	OUT/CS5	OUT/CS6
NC	-0.015***	0.026***	0.023***	0.020***	-0.015***	0.078***	0.064***	0.062***	0.068***	0.097***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.015)	(0.013)	(0.012)	(0.012)	(0.012)
Exports	-0.010***	0.001	0.000	-0.003*	0.002**	0.019***	-0.003	-0.002	0.003	-0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Capital Intensity	-0.022***	-0.003	-0.003	0.001	0.019***	0.061***	0.036***	0.037***	0.033**	0.013
	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.016)	(0.014)	(0.012)	(0.014)	(0.014)
Scale	-0.695***	-0.134***	-0.089***	-0.098***	0.093***	0.756***	0.213***	0.153***	0.158***	-0.027
	(0.014)	(0.009)	(0.008)	(0.010)	(0.008)	(0.033)	(0.023)	(0.022)	(0.024)	(0.024)
Observations	104,420	171,963	186,270	178,793	188,624	96,898	159,078	171,851	165,286	173,584
Number of firms	22,640	29,141	30,899	30,256	31,318	21,722	28,086	29,719	29,126	30,098
R-sq W	0.18	0.13	0.04	0.09	0.05	0.04	0.02	0.01	0.02	0.01
Fixed effects	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr

Note: The dependent variable is the share of different occupational categories in total employment (column 1-5) and the ratio of the share of purchased services in total costs over the share of the categories in total employment (column 6-10). All variables are in logs. See notes in Table 4.

An interesting point to note is that one of the empirical results that do not match with the theory in Caliendo et al. (2012) is related to the proportional expansion of higher layers with respect to lower layers. For firms that start exporting, the theory would predict that higher layers should expand more than lower layers, but the authors do not seem to find evidence for this theoretical prediction in the data. An explanation for this apparent puzzle is that the theory developed by Garicano (2000) and Caliendo and Rossi-Hansberg (2012) does not explicitly draw the boundary of the firm. So there is nothing that imposes that problem solvers, who have the knowledge to solve exceptional problems, should be employed directly by the firm.[48] My results strongly suggest that the expansion of higher layers come from across the boundary of the firm: firms outsource these high skill and infrequent services to external specialists. This strategy also allows firms to be more flexible, in fact they do not need to pay the fixed cost correspondent to the wage of the problem solver, but they can access his knowledge only when needed. In the Caliendo and Rossi-Hansberg's (2012) framework this could be seen a way to smooth the transition between different number of layers.

8 Conclusions

By advancing the complexity of coordination, intrinsic to the managerial activity, as one of the main determinants of integration costs, this paper offers a better understanding of how the boundary of the firm are determined in presence of multiple inputs for which asset ownership is

[48] In fact Garicano and Rossi-Hansberg (2012), using a very similar setting, talk more generally about "referral markets".

not very important, like many services. I have looked at one possible driver of coordination complexity: the internationalization decision of the firm. Exporting to more destination countries implies that more inputs are needed, and the higher number of inputs increases coordination costs making market transactions more appealing. I find new systematic evidence about domestic service outsourcing: an increase in the number of export destination countries has a strong positive effect on the share of purchased business services in total costs. This result establishes a new causal effect of globalization on structural transformation, which is quantitatively very significant. In fact the IV estimates, based on plausibly exogenous demand shifts, show that the average increase in the number of destination countries explains more than two-thirds of the increase in domestic service outsourcing observed in the sample.

Finally the paper makes a significant step forward in understanding the nature of export costs. Firms need to access a variety of specialized services to be able to export; often they do not have the capabilities to produce these inputs in-house so they have to rely on external suppliers. And the effect is stronger, the higher the number of markets that need to be reached. A flourishing and productive business services industry is therefore a key ingredient for a country export success, and its competitiveness on the world markets.

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Appendix

A Extensions to the Model

A.1 Adapting to the Average Action

This appendix solves a more general case, where the firm coordination costs are computed with respect to the average action taken by the firm for the inputs internally produced. To show the full set of implications, I start from the problem in a discrete setting and then see what happens when I move to the continuous case. The problem of the manager, once the input conditions have been realized, becomes:

$$\min_{\{a^v(i)\}} Nf + \sum_{i\in T}(a^v(i)-\theta(i))^2 + \delta E\left[\sum_{i\in T}(a^v(i)-\bar{a})^2 + \sum_{j\notin T}(a^o(j)-\bar{a})^2\right] \tag{A.1}$$

where $\bar{a} = \frac{1}{N}\sum_0^N a(i)$, and T is the set of inputs produced in-house. Solving for the optimal internal action is much more tedious and requires inverting a t-by-t matrix, but it can be shown that:

$$a^{v*}(i)(\{\theta(i)\},\{\hat{\theta}(i)\},\{\hat{\theta}(j)\}) = \hat{a}^v + \frac{1}{1+\delta}(\theta(i)-\hat{\theta}(i)) + \frac{\delta}{1+\delta}\frac{1}{N+\delta(N-t)}\sum_{i\in T}(\theta(i)-\hat{\theta}(i)) \tag{A.2}$$

where $\hat{a}^v = \frac{1}{1+\delta}\hat{\theta}(i) + \frac{\delta}{1+\delta}\frac{1}{N+\delta(N-t)}\sum_{i\in T}\hat{\theta}(i) + \delta\frac{1}{N+\delta(N-t)}\sum_{j\notin T}\hat{\theta}(j)$. Hence the actions are fully interdependent: the optimal action for input i depends on all the average actions, plus the realizations of all the internal input conditions. The realization of the local input condition i still gets a higher weight compared to all others input conditions, but in order to internalize all externalities the manager moves away from that particular input condition to get closer to all other inputs. The optimal action is therefore a weighted average of all input conditions.

It is then possible to show that the expected costs become:

$$E[F] = Nf + \left[\frac{\delta}{1+\delta}\frac{N+\delta(N-t)-1}{N+\delta(N-t)}t + \delta\frac{N-1}{N}(N-t)\right]\sigma^2 + \\ + \frac{\delta}{1+\delta}\sum_{i\in T}(\hat{\theta}(i)-\tilde{\hat{\theta}})^2 + \delta\sum_{j\notin T}(\hat{\theta}(j)-\tilde{\hat{\theta}})^2 + M(t,N,K) \tag{A.3}$$

where $\tilde{\hat{\theta}}$ is a weighted average of the means of the input conditions and is defined as follows: $\tilde{\hat{\theta}} = \frac{1}{N+\delta(N-t)}\sum_{i\in T}\hat{\theta}(i) + \frac{1+\delta}{N+\delta(N-t)}\sum_{j\notin T}\hat{\theta}(j)$. Further assuming that all input conditions have the same mean, the expression becomes:

$$E[F] = Nf + \left[\frac{\delta}{1+\delta}\frac{N+\delta(N-t)-1}{N+\delta(N-t)}t + \delta\frac{N-1}{N}(N-t)\right]\sigma^2 + M(t,N,K) \tag{A.4}$$

This expression generalizes the expected costs of the baseline model. It is clear that the returns of integration are not constant anymore but depend on both t and N. It is possible to show

that t and N are complementary but become substitutes if t is large. This implies that the advantage of in-sourcing diminishes when N grows large. The reason is that when the number of inputs is very large the manager cannot really achieve much by coordinating all the inputs in-house because the dispersion is too high.

Interestingly, when the model is written in the continuous case, the expected costs take the same form as in the baseline model:

$$E[F] = Nf + \left[\frac{\delta}{1+\delta}t + \delta(N-t)\right](\sigma^2 + r^2) + M(t, N, K) \tag{A.5}$$

It is possible to formally show this result by re-solving the entire problem in continuum, or, more simply, by extending equation (A.4) in the limit. It is clear that the terms containing discrete elements tend to 1 (e.g. $(N-1)/N$). The intuition is that when the number of inputs grows very large, it is essentially not possible to internalize all the small externalities on the mean action, or more precisely, they do not matter in expectation. Mathematically all the interactions become quantities of a lower order when N grows large. Since the expected costs are the same, all the results in the main body of the paper apply.

A.2 Enforceable Contracts

This appendix investigates what happens when contracts are enforceable by an external court. The reason why the firm decides to outsource is precisely not to pay the monitoring costs. Assuming that there exists an external court that can do that for free implies assuming the problem the away, and hence this setting is not fully in-line with the rest of the paper. Still, it is reassuring that all the main effects of interest are also present in this setting, and this extension offers interesting and intuitive results on the effect of institutional quality.

If an external court can fully enforce the contract (at no cost), the firm can specify a full contract with price and action even in the case of outsourcing. The problem is that the firm is not investing in the technology to communicate with the external supplier, so the manager will only know the expected value and not the actual realization for the input conditions that are outsourced. The manager will then solve the following problem:

$$\min_{\{a^v(i)\},\{a^o(j)\}} Nf + \int_0^t (a^v(i) - \theta(i))^2 di + \delta \int_0^t (a^v(i) - \hat{\theta}^c)^2 di + E\left[\int_t^N (a^o(j) - \theta(j))^2 dj + \delta \int_t^N (a^o(j) - \hat{\theta}^c)^2 dj\right] \tag{A.6}$$

The optimal internal action does not change and it is easy to show that the optimal action for the generic outsourced input j is:

$$E[a^{o*}(j)(\theta(j), \hat{\theta}^c)] = \hat{a(j)}^{o*}(\hat{\theta}(j), \hat{\theta}^c) = \frac{1}{1+\delta}\hat{\theta}(j) + \frac{\delta}{1+\delta}\hat{\theta}^c \tag{A.7}$$

At time zero, the manager will then sign a contract with the external supplier that specifies the tuple $\{P(j), \hat{a(j)}^{o*}\}$, where $P(j) = f + (\hat{a}(j)^{o*} - \theta(j))^2$. The payment is again a fixed price but the court will check that the external supplier will not deviate ex-post and will enforce the

action $a\hat{(j)}^{o*}$. What the firm is achieving is what Dessein and Santos (2006) define ex-ante and rigid coordination. In fact the manager does not give any flexibility to the external supplier but asks him to implement a specific action that is at least good on average, and hence can save part of the coordination costs ex-post.

It is easy to show that the total expected costs will be lower and equal to:

$$E[F]^{enf} = Nf + \left[\frac{\delta}{1+\delta}t + \delta(N-t)\right]\sigma^2 + N\frac{\delta}{1+\delta}r^2 + M(t,N,K) \tag{A.8}$$

This is intuitive since the firm can achieve some degree of coordination despite avoiding the monitoring costs thanks to contract enforceability by court. Moreover the optimal share of inputs internally produced becomes:

$$\frac{t^{*enf}}{N} = \sqrt{\frac{K\sigma^2}{(1+\delta)N}} \tag{A.9}$$

This share is lower than the optimal share of the baseline case as long as $\delta > \delta^* = \sigma/\sqrt{\sigma + r}$. Hence, if adaptation is important enough, the share of outsourced inputs will be higher. This implies that firms in countries with better contracting institutions will be in general better off and will outsource a higher share of their inputs.

A.3 A General Condition on the Communication/Monitoring Cost Function

Another interesting extension of the paper is to study the general set of communication and monitoring cost functions that are consistent with the empirical results. The optimal number of inputs produced in-house is pinned down by:

$$\frac{\delta^2}{1+\delta}(\sigma^2 + r^2) - M_t(t,N,K) = 0 \tag{A.10}$$

where $M_t(t,N,K)$ is the marginal communication cost with respect to an increase in the number of inputs internally produced. The main finding in the empirical results corresponds to the following condition:

$$\frac{\partial t^*(N)/N}{\partial N} < 0 \Longleftrightarrow \varepsilon_{t^*,N} < 1 \tag{A.11}$$

where $\varepsilon_{t^*,N}$ is the elasticity of t^* with respect to N. The problem is separable and the previous condition boils down to a constraint on form of the monitoring function:

$$\varepsilon_{t^*,N} < 1 \Longleftrightarrow -\frac{\varepsilon_{M_t,N}}{\varepsilon_{M_t,t}} < 1 \tag{A.12}$$

where $\varepsilon_{M_t,N}$ and $\varepsilon_{M_t,t}$ are the elasticities of the marginal communication cost with respect to the number of countries and the number of inputs internally produced, respectively.[49]

It is interesting to note that the result is certainly more general than the setting of the

[49] The problem is not separable and this condition does not hold only in the discrete version of the extension presented in Appendix A.1.

baseline model, which gives a simple expression for the effect of interest but is based on the specific case of an uniform distribution for the overall events that the manager faces. Drawing on the intuition provided by Crémer et al. (2007), we know that an uniform distribution of events is actually the worst case, with the highest level of communication costs. The reason is that all events are equally likely and the manager cannot design a code targeted to a certain set of more frequent events. In a more general setting, the optimal code features words of different breadths: in order to save on the diagnosis costs, very precise words are used to refer to very frequent events, while very broad and costly words are used for rare events. Still, if fixed export costs are country specific, adding another country implies adding different events or events that were before very unlikely. Hence the overall distribution will tend to get closer to a uniform distribution when the firm will start exporting to more and more countries.

B Data

B.1 Data Description

The industry level data come from the EU KLEMS database, while input-output data come from the OECD STAN database. Professional and Business Services include (Nace Rev 1 industry in parenthesis):

- Renting of machinery and equipment (71);
- Computer and related activities (72);
- Research and development (73);
- Other business activities (74), which include: legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; architectural, engineering and other technical activities; advertising; labor recruitment and provision of personnel; investigation and security activities; industrial cleaning; miscellaneous business activities n.e.c.

The French micro-data come from the following four main data sources:

1. The Enquête annuelle d'Entreprise (EAE) that collects balance sheet data on all French firms with more than 20 employees and a sample of smaller firms;
2. The Déclaration annuelle de données sociales (DADS) that collects employment data on all firms with paid employees; the data used are aggregated at the establishment level;
3. Transaction level import-export data come from the French Customs. These data have been used among others by Eaton et al. (2004);
4. Finally the service outsourcing data contained in the EAE are integrated with the Enquête Recours aux Services par l'Industrie (ERSI), a survey of firms with more than 20 employees and the census of firms with more than 250 employees that collects detailed information about service outsourcing policies for the year 2005. The total response rate of the survey is 85% and is well-balanced across industries and firm sizes.

Data for the gravity variables are provided by Mayer and Zignago (2011).

B.2 Variable Definitions

B.2.1 The Enquête annuelle d'Entreprise and DADS

Exporter: the variable takes the value of 1 if the firm reports positive exports in the Custom data, 0 otherwise (including the firms that do not appear in the Custom data).

Capital Intensity (K/L): ratio of the total capital stock to total employment, where the capital stock is measured as the total of tangible capital assets at end of year (I150) and total employment is the total number of full time equivalent employees (E101).

Headquarters intensity: ratio of workers employed in branches that produce services (Nace codes from 50 to 93) to total employment. It is a measure of internal production of services.

Contract intensity: the variable is constructed using the information about firms' imports. The firm-level contract intensity is therefore a weighted average of the contract intensity of all firm imports, where the measure of contract intensity is taken from Rauch (1999), and the weights are the shares of each product in the total firm imports. An imported good is considered as contract intense if it is neither sold on an organized exchange nor reference priced, I use the Rauch's (1999) 'Liberal' classification as in Nunn (2007) and Corcos et al. (2013).

PBS Outsourcing Share: in the baseline case it is defined as the sum of purchases of studies (D321), purchases of IT services (D329), and advertising (D360) over either Total Costs or Turnover (R310).

Professionals Share: it is the share of workers classified as managers and professional occupations (cadres et professions intellectuelles supérieures) in total employment. It comes from DADS and it is another proxy for internal production of PBS services, given that they are mainly produced by professionals.

Scale: total number of full time equivalent employees (yearly average, E101).

Skill Intensity (S/L): ratio of skilled workers to unskilled workers (from DADS). The number of skilled workers is the sum over all establishments of non-secondary jobs at the end of the year for the following categories: chief executives (chefs d'entreprises salariés), managers and professional occupations (cadres et professions intellectuelles supérieures), intermediate professions and technicians (professions intermédiaires). Unskilled workers include the following categories: sales and administrative occupations (employés), qualified and unqualified operators and laborers (ouvriers). All of the previous categories include ordinary employment only and exclude for instance interns and apprentices.

Value Added over Sales (VA/Sales): ratio of value added to turnover (R310). Value added is defined as turnover minus purchases of goods (R210) and purchases of raw materials (R212). In the baseline definition I do not use other purchases and charges (R214), and other charges (R222) because they also include some labor costs. The former contains charges for external personnel (D350), while the latter board of directors' fees.

TFP: It is computed using the revised Levinsohn and Petrin's (2003) methodology proposed by Wooldridge (2009). The coefficient of a Cobb-Douglas value-added production function are estimated at the 3 digit NACE industry level using intermediate inputs (R210 and R212) as the proxy for the productivity shock. Real value added is obtained by double-deflation using

deflators for output, intermediates, and capital from the OECD STAN database. TFP at the firm level is then calculated as a residual between the actual and predicted value added using the estimated coefficient.

Total costs: it is used to calculate the outsourcing shares. It is the sum of purchases of goods (R210), purchases of raw materials (R212), other purchases and charges (R214), total labor costs (R216), social contributions (R217), and other charges (R222).

B.2.2 ERSI

The ERSI survey contains information about 34 types of services; in particular for each service type it provides a binary variable equal to one if the service is outsourced by the firm. Hence the OUT_{is} variable corresponds to the B* variables contained in the survey. I use the revised version of the variables, adjusted to remove internal inconsistencies. The service types are:

1. ICT Services
   - 1.1: IT consulting
   - 1.2: Software and IT third party maintenance
   - 1.3: Data processing and IT management
   - 1.4: Telecommunications
2. R&D and Professional Services
   - 2.1: Research and development
   - 2.2: Architecture, engineering and technical studies
3. Transportation Services and Logistics
   - 3.1: Railways, air, water and land transport
   - 3.2: Handling and warehousing
   - 3.3: Packaging
   - 3.4: Courier and post
   - 3.5: Chartering and international transport
4. Administrative Services
   - 4.1: Secretariat, translation and interpreting
   - 4.2: Vocational training
   - 4.3: Business and management consultancy
   - 4.4: Legal services
   - 4.5: Accounting, book-keeping and auditing
   - 4.6: Labour recruitment and provision of permanent personnel
   - 4.7: Temporary work
   - 4.8: Securities broking and fund management
   - 4.9: Insurance and other financial services
   - 4.10: Leasing
   - 4.11: Invoicing/billing and debt recovery
5. Commercial Services
   - 5.1: Advertising, marketing and communication
   - 5.2: After-sales services

6. Maintenance and General Services
   - 6.1: Car, equipment and machinery maintenance
   - 6.2: Buildings maintenance
   - 6.3: Cleaning
   - 6.4: Investigation and security activities
   - 6.5: Sewage and sanitation
   - 6.6: Refuse collection, treatment and recycling
   - 6.7: Real estate
   - 6.8: Renting of machinery, car and transport equipment
7. Personnel Services
   - 7.1: Restaurants, canteens and catering
   - 7.2: Day care, nurseries and personal services

B.2.3 Robustness Checks

Scale_2: sum of non-secondary jobs at the end of the year over all establishments from DADS (EFF_3112_ET).

K/L_2: capital intensity where capital is measured as before but total employment is taken from DADS (EFF_3112_ET).

Out_2: compared to the baseline case it adds non-capital expenditures on software purchases (D511). It is again computed as a share of either Total Costs or Turnover (R310).

Out_3: compared to Out_2 it adds capital expenditures on software purchases (I461) and investment in R&D (I122). It is again computed as a share of either Total Costs or Turnover (R310). The investment in R&D corresponds to expenses of the firm due to the acquisition, the creation, the provision, or the transfer of R&D in the current year. It is not possible to rule out the possibility that some of these expenses are actually incurred within the firm, hence this is probably the least reliable measure of outsourcing.

Out_1b, Out_2b, Out_3b: compared to their respective cases they include outsourcing of non-core activities (D323) instead of purchases of studies (D321). Outsourcing of non-core activities corresponds to item 611 of the French national accounting code (Plan Comptable Général - PCG), which is defined as the outsourcing of tasks not specifically related to the core business of the firm and not already counted in item 604 of the PCG (D321).

S/L_2: skill intensity calculated as the ratio of skilled workers to total workers.

VA_2: value added defined as the sum of turnover (R310) and other goods sold (R315) minus purchases of goods (R210), purchases of raw materials (R212), and other purchases and charges (R214). Note that other purchases and charges contain the cost of external personnel (payments to employment agencies).

B.3 Data Cleaning

All variables from EAE before 2001 and salary from DADS before 2000 are transformed into euro. Unfortunately there are no missing values in the database and all variables are zeros even when they are clearly missing. So I set the relevant variables to missing in the following cases:

- If all balance sheet variables are zeros (E* R* D* I* S*);
- If all income statement variables are zeros (R1* R2* R3* R40* D* S001);
- If all cost variables are zeros (R2*);
- If all employment variables are zeros (E* S003 D350 D351 D352 - after having performed the adjustments described below);
- If employment is zero (E101) but total labor costs are positive (R216);
- If all intangible investment variables are zeros;
- If capital stock is zero (I150);
- If purchases of studies (D321) and purchases of materials (D322) are zeros but the variable containing their sum (D314) is positive;
- If all outsourcing and external charges are zeros (D3* D5*);

The following adjustments are also performed: *Capital* (I150): whenever possible, I obtain the end of the year capital stock from the stock at the beginning of the year by adding acquisition and revaluations and subtracting decumulation and disposals.

Exporter and other trade variables: I set them to missing (from zero) if a firm is reporting positive exports in EAE but exports are missing in the Custom data. This is mainly true for small exporters within the EU, who are not required to fill Customs data if the total value of annual exports is below 100k€[50]. At the same time there are also some cases of large exporters, this could be due for instance to confidential trade.

Other purchases and charges (R214): whenever it is zero or too small I take the sum of its components, which, according to the French accounting rules (Plan Comptable Général), are: outsourcing of non-core activities (D323), payments for leasing (D330), salaries to external employees (D350), advertising (D360).

Employment (E101): employment is measured as the total number of full time equivalent employees (annual average). Whenever possible, I replace the zeros with the sum of the annual average employment over all branches (S003), or with employment at the end of the year (E200), or with with the sum of the annual average employment over all establishments (V001), or, finally, with the sum of non-secondary jobs at the end of the year over all establishments from DADS (EFF_3112_ET). I use employment at the end of the year from DADS instead of the annual average employment (EFF_MOY_ET) because the latter is not available before 2002; non-secondary jobs (postes non annexes) exclude secondary jobs that last or are paid too little (see INSEE, 2013). When I use EFF_3112_ET as a robustness for capital intensity, I replace the missing and zeros with E101 to keep the same sample size.

Headquarters intensity: when calculated in terms of labor shares, it is set to missing in 2007 because very few firms report employment by branch in that year.

Outsourcing shares: firms are dropped whenever any of the outsourcing shares (in terms of turnover or total costs) exceed one.

Purchases of goods (R210), *Purchases of raw materials* (R212): they are set to missing if negative (only few cases in 1996).

[50]The reporting threshold is 100k€in the 2001-2005 period, 150k€in 2006 and 2007, and 38k€(250k Francs) before 2001

Purchases of Studies (D321): the sum of purchases of studies and purchases of materials (D322) is contained in the outsourcing of activities related to the core business (D314). I calculate the average share of purchases of studies in the total at the two digit Nace industry level. Whenever the total is positive but the components are missing, I impute their values by using the industry average shares. I cannot impute missing values for the food and beverage industry (Nace 15) because no firm is reporting the subcategories.

Value Added: I drop the observation if it is negative.

Total labor cost (R216): when I take total employment from DADS I also replace total labor cost with the sum of gross salaries over all establishments from DADS (S_BRUT). I do so only when Total costs are non-missing, otherwise total costs would be heavily underestimated (would contain labor cost only).

Total costs: instead of purchases of goods (R210), purchases of raw materials (R212), and other purchases and charges (R214), I use their reported sum (total purchases and external charges, R771) whenever it is bigger.

Turnover (R310): if it is zero, it is set equal to the sum of turnover over all branches (S001) when this is positive. I also use turnover from branches if reported exports are larger than turnover but smaller than turnover from branches (only two cases in 2005).

Finally I drop the observations in the following cases:

- Value added is negative;
- Turnover comes entirely from branches classified in services;
- Turnover is lower than total exports. More precisely I allow for a 10% reporting error, hence I drop the observation if total exports are 10% bigger than turnover.

C Extra Results

Table C.1: Outsourcing of Non-core Activities and Coordination Complexity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Exporter	0.090***								
	(0.017)								
NC		0.069***	0.084***	0.083***	0.080***	0.079***	0.079***	0.087***	0.090***
		(0.010)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.013)
Exports			-0.012***	-0.012**	-0.010**	-0.010**	-0.011**	-0.011**	-0.010*
			(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Capital Intensity				0.007	0.011	0.011	0.012	0.013	0.006
				(0.011)	(0.011)	(0.011)	(0.012)	(0.013)	(0.013)
Skill Intensity					0.042***	0.041***	0.042***	0.050***	0.052***
					(0.010)	(0.010)	(0.010)	(0.012)	(0.012)
HQ Intensity						0.081**	0.081**	0.085**	0.087**
						(0.036)	(0.036)	(0.037)	(0.038)
Scale							0.009	0.000	-0.003
							(0.022)	(0.024)	(0.025)
Num imp. products								0.005	0.010
								(0.008)	(0.009)
Contract Intensity									0.011*
									(0.006)
Observations	237,085	185,964	185,964	184,879	176,260	176,038	176,038	152,245	146,251
Number of firms	39,595	31,287	31,287	31,147	30,246	30,234	30,234	26,168	25,417
R-sq O	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fixed effects	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr

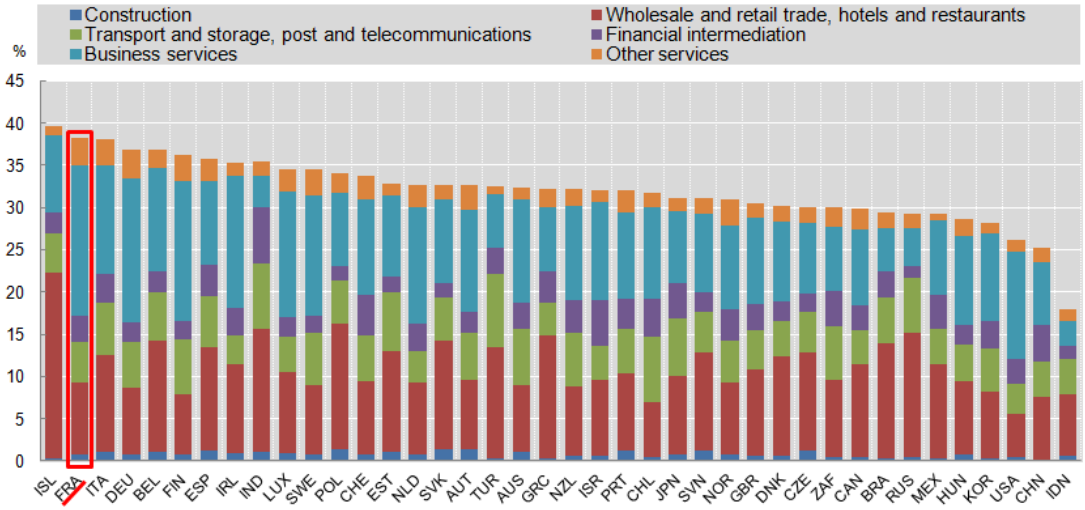
Note: The dependent variable is the share of outsourcing (*Out_1b*) over total costs. All variables are in logs apart from HQ Intensity. Data are for period 1996-2007. Firm-clustered standard errors in parentheses; (*, **. ***) indicate 10, 5, and 1 percent significance levels.

Table C.2: Service Outsourcing and Country Re-entry

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Exporter	0.042***	0.034***	0.034***	0.034***	0.033***	0.034***	0.034***	0.034***	0.039***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.010)
NC		0.156***	0.156***	0.155***	0.148***	0.148***	0.145***	0.139***	0.135***
		(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)
NC-Reentry		-0.007	-0.007	-0.007	-0.006	-0.006	-0.006	-0.006	-0.001
		(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
NC#NC-Reentry		-0.004**	-0.004**	-0.004**	-0.004**	-0.004**	-0.003**	-0.003**	-0.004**
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Exports			0.006	0.005	0.001	0.001	0.004	-0.000	0.003
			(0.011)	(0.011)	(0.012)	(0.012)	(0.015)	(0.014)	(0.014)
Capital Intensity				-0.000	-0.002	-0.002	-0.002	-0.002	-0.001
				(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Skill Intensity					0.001	0.001	0.001	0.001	0.002
					(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
HQ Intensity						-0.004	-0.004	-0.005	-0.003
						(0.005)	(0.005)	(0.005)	(0.005)
Scale							0.023	0.017	0.017
							(0.014)	(0.013)	(0.013)
Num imp. products								0.024**	0.029***
								(0.011)	(0.011)
Contract Intensity									0.003
									(0.008)
Observations	235,182	235,182	235,182	234,756	224,561	224,260	224,260	224,260	167,621
Number of firms	39,500	39,500	39,500	39,457	38,326	38,300	38,300	38,300	29,027
R-sq W	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fixed effects	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr	ind#yr

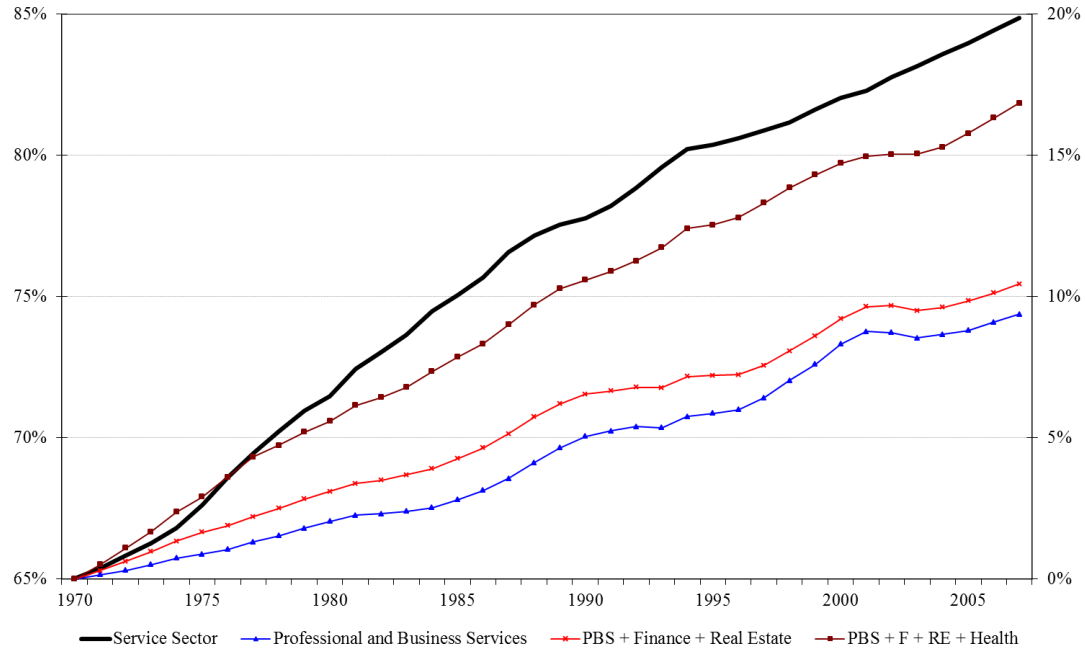
Note: The dependent variable is the share of outsourcing over total costs. All variables are in logs apart from HQ Intensity. Data are for period 1996-2007. Firm-clustered standard errors in parentheses; (*, **. ***) indicate 10, 5, and 1 percent significance levels.

Figure 3: Services content of manufactured exports by type of service, 2009



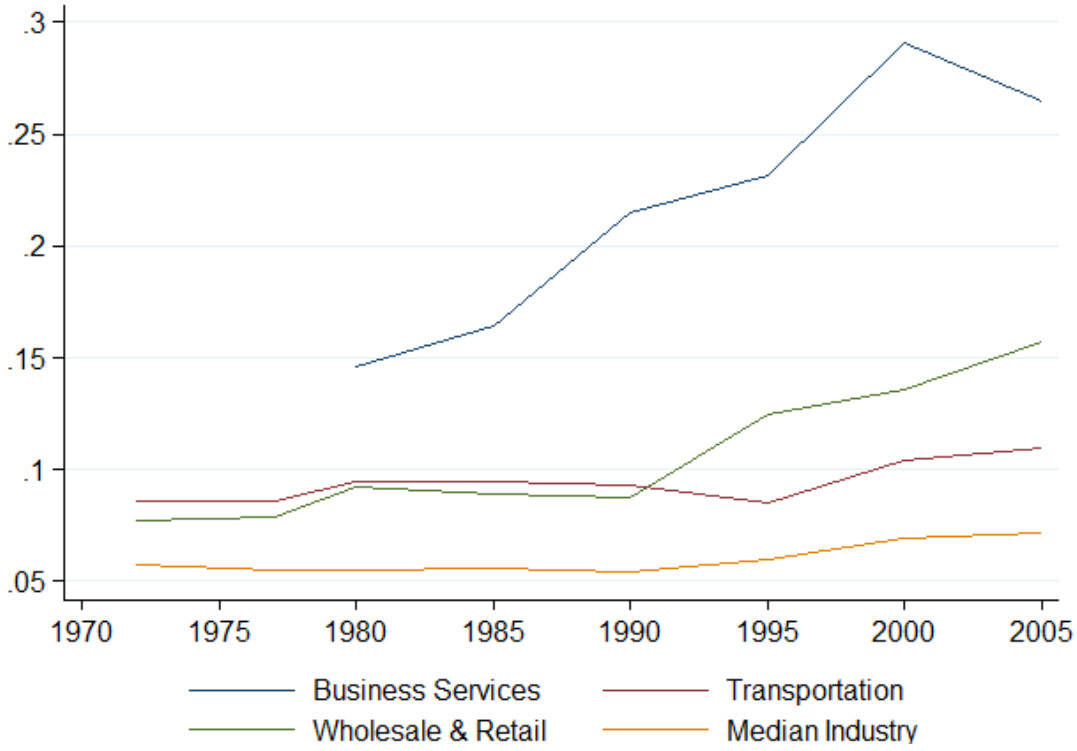
Source: OECD-WTO, Trade in Value-Added (TiVA) Database (OECD, 2013).
Note: The figure shows the services content of manufactured exports as percentage of total manufactured exports.

Figure 4: Service Sector Growth in France



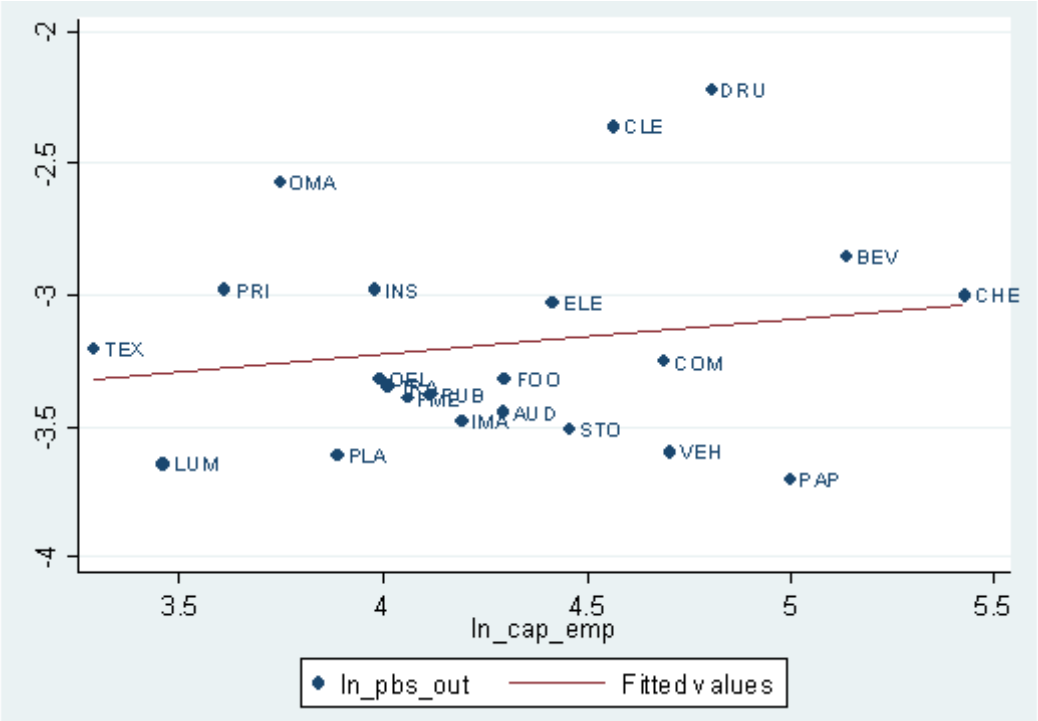
Source: EU KLEMS Dataset.
Note: The left-hand side axis displays the absolute share of the entire service sector (thick black line) in terms of total employment. The right-hand side axis applies to all series and displays the change in percentage points of total employment. The triangle marked line represents the percentage point change of Professional and Business Services (PBS); the cross marked line for the combined sector PBS, Finance and Real Estate; analogously the square marked line for the combined sector PBS, Finance, Real Estate and Health Care.

Figure 5: The Influence of PBS on the French Economy



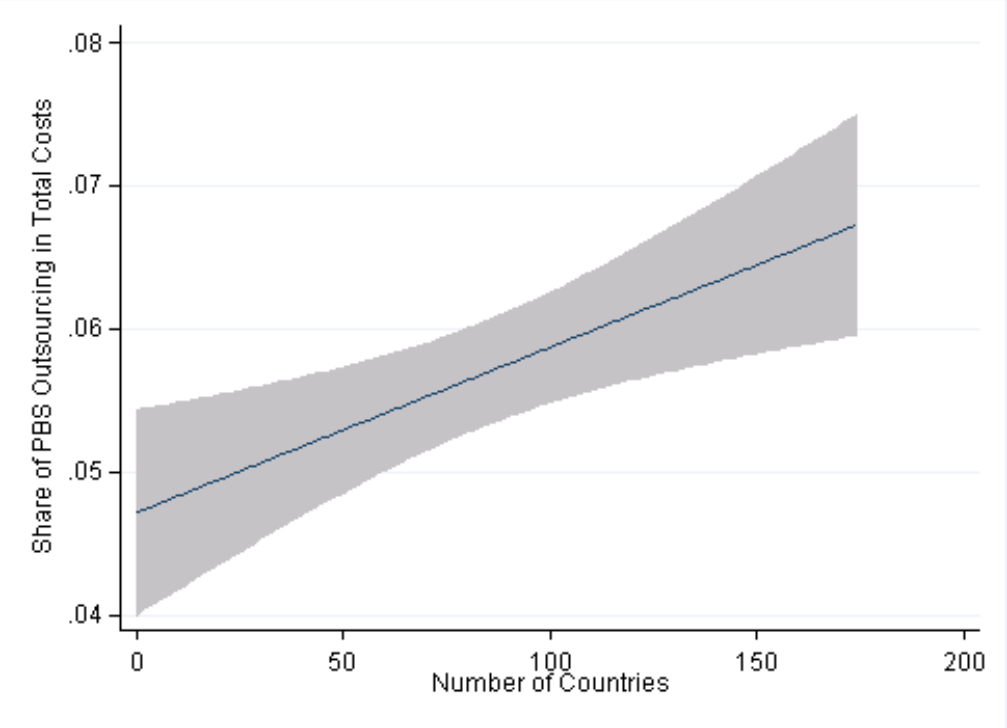
Source: EU KLEMS Dataset.

Figure 6: Share of Service Outsourcing and Relative Factor Intensities



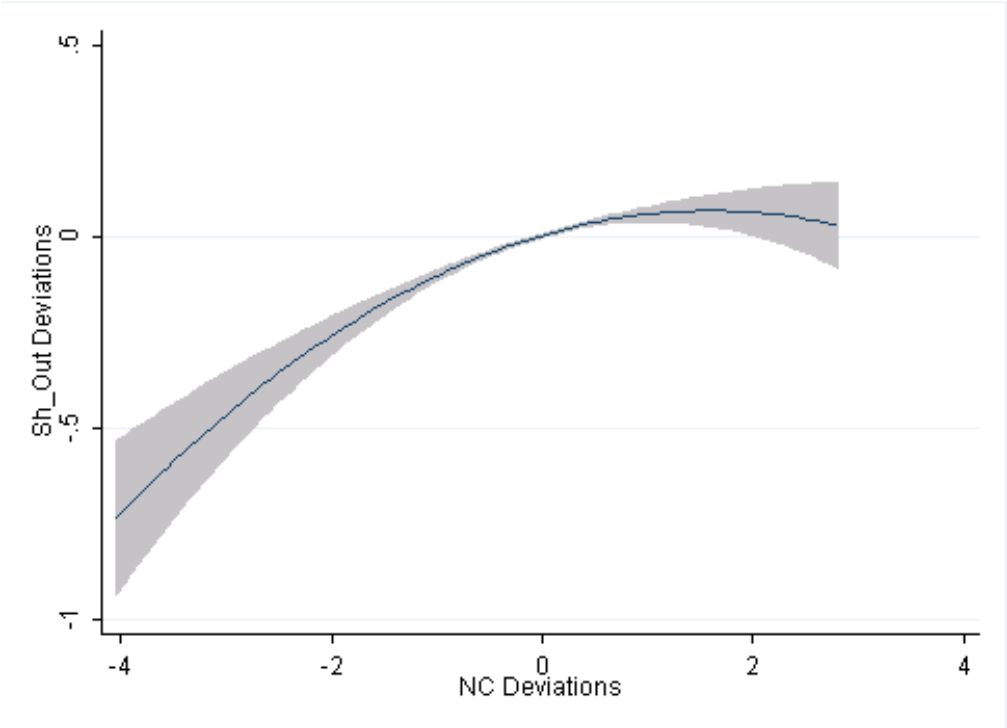
Source: BEA Bechmark Industry Accounts, NBER-CES Manufacturing Industry Database.
Note: All data are for 1992. The set of industries is defined as in Antràs (2003) apart from "other chemical products" that is combined with "Industrial chemicals and synthetics"; concordance tables are available on request.

Figure 7: Share of Service Outsourcing over Number of Destination Countries



Source: The Enquête annuelle d'Entreprise (EAE) and French Customs data, 1997-2007.

Figure 8: Share of Service Outsourcing over Number of Destination Countries



Source: The Enquête annuelle d'Entreprise (EAE) and French Customs data, 1997-2007.
Note: The fitted relationship corresponds to the best fitting quadratic functional form. The shaded area indicates 95% confidence intervals. The y-axis and the x-axis depict the residuals of two regressions of the log share of outsourcing or the log of the number of countries on firm and year-by-industry fixed effects. A very similar picture is obtained when also all other controls are added to the regressions.