Service offshoring and export experience

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Abstract

Service inputs are a key component of the costs of exporting and contribute to explain the process of internationalization of firms. A new dataset on the participation of French firms in global value chains reveals that firms with longer export experience to a market are more likely to source service inputs from there. We rationalize this fact in a model where firms are initially uncertain but learn their export profitabilities as they export. Because offshoring requires larger sunk costs than domestic sourcing, some firms decide to offshore only when they become sufficiently confident about their export success, i.e. they acquire export experience. The model implies that firms are also more likely to offshore when frictions in the provision of services between the domestic and the foreign market are greater. In turn, offshoring firms display less volatility in export volumes and a lower probability of exiting the foreign market. Exploiting our novel dataset, we provide empirical support for each of these predictions. We also show that more export experience in a foreign destination induces firms to offshore within the boundaries of the firm rather than at arm's length.

Keywords: Export Dynamics, Export Experience, Firm Boundaries, Fixed Export Costs, Offshoring, Outsourcing.

JEL codes: F12, F14, F23, L22, L23, L84.

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1 Introduction

What is the role of service inputs in shaping firms' participation to global value chains? Despite accounting for more than four fifths of GDP in most advanced countries, services still account for only one fifth of cross-border trade (WTO, 2019). However, services enter into global value chains in other, more complex ways. Since they are often upstream inputs to manufacturing goods, their share increases when computed in terms of value added rather than gross trade flows (Johnson and Noguera, 2017; Miroudot and Cadestin, 2017). In many ways, that still falls short of accounting for their real contribution, since services can be often provided in the specific destination market with modes of supply more related to a commercial presence or the movement of people, rather than a cross-border flow (Andrenelli et al., 2018).

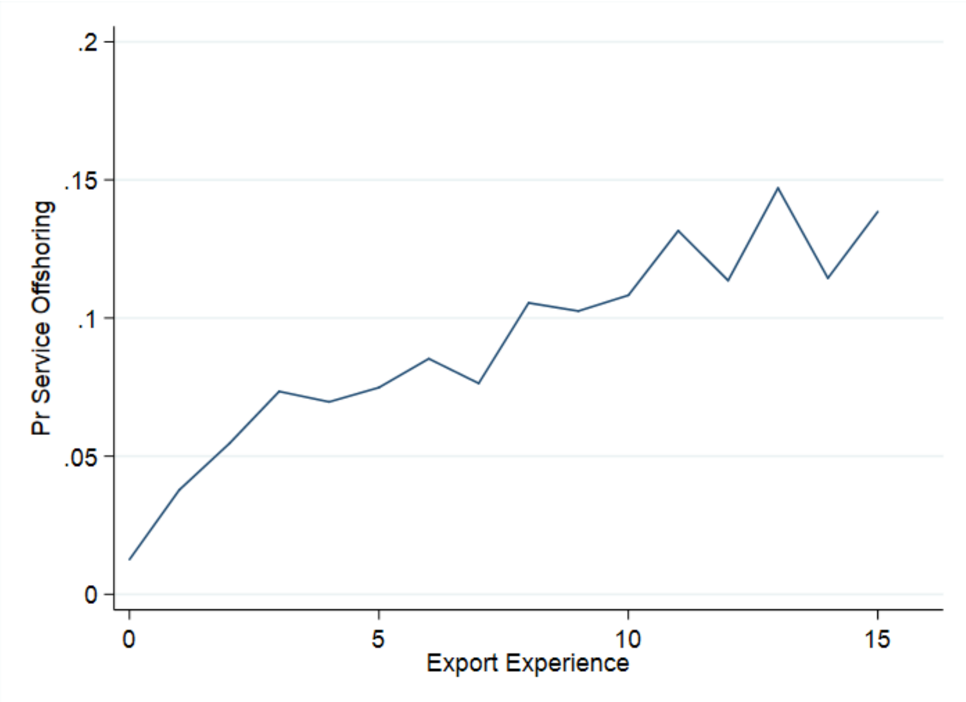
Our paper contributes to the understanding of this phenomenon by investigating how firms decide to source service inputs, and how the sourcing of service inputs affects the evolution of firms' exporting strategies. We do so by exploiting a unique firm-level data from France, which include a new survey of firms' participation in global value chain activities (CAM) that allows us to unveil the different modes of service sourcing, including the sourcing through the commercial presence in the destination market both in-house and at arm's length.

Our analysis identifies one clear channel through which services enter the firm's decision to source service inputs abroad or domestically, i.e. the firm's experience on the export market. Entering a new export destination market can be difficult and costly. Firms face substantial uncertainty on their probability to succeed and survive in the export market, while having to incur large costs to set up distribution channels, learn the institutional and regulatory environment, translate their products' labels in the foreign language, and advertise their products and monitor regulatory standards – all services activities (Das et al., 2007). In this paper, we argue that firms with longer export tenure have better knowledge of their profitability in the foreign market, and for that reason are more likely to offshore parts of production to that country, in particular the service inputs that are complementary to the exporting activity. Service offshoring helps them to avoid adjustment frictions related to the use of domestically provided services abroad.

Figure 1 displays the average probability with which a French firm sources service inputs from a foreign market, given the number of years of export experience in that destination. The probability of offshoring is clearly increasing in the firm's experience in exporting to the foreign destination. The unconditional probability that a firm offshores its inputs to a destination market in the first year of exporting to that market is as low as 1 percent, but it increases sharply to 7 percent in the following two years of exporting to the same destination. It keeps growing for longer export experience, but at a lower pace, exceeding 10 percent by the eighth year of export experience.

To investigate the relationship between export experience and offshoring, we develop a theoretical framework where firms tentatively enter new markets and commit greater resources only once uncertainty about the destination market profitability is resolved, in the spirit of Albornoz et al. (2012) and of Conconi et al. (2016). The idea is that, when entering a foreign market, a firm has an expectation about its profit as an exporter to that market. Over time, as the firm accumulates experience in that market, it eventually learns its actual profitability there. Once that happens, the firm may alter its sourcing mode of

Figure 1: Average probability of offshoring inputs to a given destination, by export experience - 2011



Note: Average probability of offshoring inputs to a destination market, by years of experience of exporting to any country within that destination market. Offshoring displays value 1 if the firm offshores any service input from a given destination. Experience equals one if the firm exports to at least one of the countries in the destination group. Firms re-entering an export destination after a period of absence are attributed the same experience as they had upon exit, augmented by one. In the meanwhile, they keep the same export experience. Plotted values are averages across all destinations and firms in the sample. The sample includes all exporting and non-exporting French firms surveyed in the Enquête sur les Chaînes d'Activité Mondiales (CAM).

export-related services. If the market proves to be highly profitable, a firm that initially sourced services domestically (which requires adjustment costs to be used and adapted to the foreign destination) will switch to offshoring directly in the destination country (which requires a higher sunk cost but do not entail adjustment frictions, and therefore imply a lower marginal cost). Otherwise, the firm keeps sourcing services domestically or, if the market proves to be unprofitable, it exits. A key implication of the model is that the longer a firm's experience selling is a foreign market (and therefore the more likely it is that it has found out a high profitability selling there), the more likely it is that the firm will source export-related services directly there.

Our empirical analysis exploits firm-destination-specific information both on the trading side and the sourcing side, constructed by matching trade and accounting data with the information contained in the CAM survey. We find empirical support for all the predictions of the model. Measuring export experience in several different ways, we confirm that it increases the probability of sourcing service inputs from abroad, even controlling for a large set of other determinants of offshoring and fixed effects. Specifically, one standard deviation increase in a firm's export experience leads to an increase of 0.7 percentage point in the probability of offshoring services to the same destination market. This corresponds to a roughly 40 percent increase in the average probability of offshoring. This indicates that learning one's ability to serve the market profitably, impacts the firm's choice between offshoring and domestic production. We also provide evidence that a firm's propensity to offshore service inputs to a foreign destination is higher if the destination market is larger and more capital intensive, has better enforcement of the rule of law, and shares a common currency and free trade agreement with France.

Furthermore, the model implies that offshoring firms sell larger volumes to the same destination market. They are also less likely to exit from the export market and experience less volatility in the exported volumes over time. Finally, we also show that greater export experience increases the probability that firms source service inputs from abroad through affiliates or other firms of their business group, rather than at arm's length. We find empirical support for each of those predictions.

Our work contributes to the existing literature studying the connections between services and goods in international trade. While industry-level analyses stress the importance of services in global value chains across countries (Timmer et al., 2014; Miroudot and Cadestin, 2017; Heuser and Mattoo, 2017; Liu et al., 2020), they cannot pinpoint whether this happens through an expansion of the output product range of manufacturing companies or through a change in the nature of inputs to production. A series of firm-level studies estimate instead the impact of service input liberalization on domestic performance in downstream manufacturing sectors (Bourlès et al., 2013; Arnold et al., 2011, 2016). Other contributions focus on firm-level exporting of services, and find a number of similarities with exports of goods (e.g. Breinlich and Criscuolo, 2011), but also a certain degree of complementarity between the two. Exporting both services and goods rather than goods only increases the quantity and price of the exported goods (Ariu et al., 2020), while importing both increases the firm's productivity, but subjects both flows to changes in barriers to importing goods (Ariu et al., 2019). In our firm-level analysis we expand on these studies by highlighting the importance of export experience in the decision to offshore service inputs. While we do not observe cross-border trade in services in our data, the CAM survey allows us to identify firms that require service inputs in production, and whether these are sourced from the export destination market. We can therefore precisely investigate the determinants of service sourcing through commercial presence (mode 3 of GATS), which account for more than 50% of total trade in services (WTO, 2019), as well as transactions that take place at arm's length and that remain undetected in trade statistics.[1]

While exporting to other markets can help the firm discover its own ability to export, each destination country imposes different challenges. This justifies differences in entry and exit behavior of exporters across countries (e.g. Eaton et al., 2011), a fact that has prompted a large literature on the dynamics of firms' exporting strategies. Our study is related to this line of research, which analyzes the role of past exporting experience for the entry decision and survival in export markets (Albornoz et al., 2012; Nguyen, 2012; Alvarez et al., 2013; Cadot et al., 2013; Fernandes and Tang, 2014, 2015; Timoshenko, 2015b; Araujo et al., 2016; Fernandes et al., 2016; Ruhl and Willis, 2017).[2] However, while many of these studies assume or explain the nature of export costs in light of service-intensive tasks (e.g. Arkolakis, 2010), none of them tests the role of experience in shaping the firm's sourcing strategy of service inputs. We are the first to show that learning through exporting affects the firm decision to source (service) inputs domestically or from abroad.

We also contribute to that literature by studying whether export experience in a given destination is related to the firm's choice on its international boundaries in that country. A few recent papers expand the choice set of firms to include FDI and its dynamics. They highlight how experienced, fast-growing exporters and exporters to low-volatility destinations start serving the market through foreign affiliates rather than exports only (Ramondo et al., 2013; Garetto et al., 2019; Gumpert et al., 2020). In this sense, our paper is most closely related to Conconi et al. (2016), who consider both the export and FDI activity of a firm in the destination market. In their study, a firm switches from exporting to horizontal FDI after a period of experimentation, in which uncertainty about the firm's success on the foreign market is resolved through exporting. We complement their results by showing how experience affects the sourcing of service inputs. Moreover, we also show that export experience increases the probability of offshoring service inputs through a foreign affiliated rather than an unaffiliated party. In this sense, our work relates to the research on the firm-to-firm network structure of domestic and global production (Bernard and Moxnes, 2018). In Bernard et al. (2019), improvements in the accessibility or direct knowledge of the (distant) market for suppliers raise the quality of the suppliers the manufacturer engages with, and the manufacturer's productivity. A reduction in the communication costs increases the fragmentation of production in Fort (2017), too, but capital-skill complementarity at the industry level guides the choice in domestic vs foreign outsourcing. Lastly, Bernard et al. (2020) uses a similar survey of value chain operations to ours to show that Danish firms often produce the same goods both domestically and abroad, albeit in varieties of different quality.

The remainder of the paper is organized as follows. Section 2 develops the theoretical

[1]Using data from the WTO Tismos database and restricting to French export of business services, Mode 3 accounts for 57% of total trade in services.

[2]Most of these studies propose a model of learning that influences the pattern of entry and exit into the export market. Timoshenko (2015a) distinguishes between sunk costs and learning effects in determining export persistence, and finds that it is mostly driven by learning rather than sunk costs.

model and draws testable empirical predictions from it. Section 3 describes the datasets of French companies we use to carry out the empirical analysis. Section 4 presents the results from estimating the baseline predictions, where we distinguish between domestic outsourcing and offshoring of services. There we exploit detailed information at the destination level to investigate whether offshoring to a given country is affected by the firm's trading activity in the same country, and by features of the destination market. Section 5 presents the results of testing other predictions, and in particular whether the relative propensity to offshore service inputs to a destination market affects the firm's exported volume and its volatility, and the firm's probability to stop exporting to the market altogether. Finally, Section 6 provides evidence that export experience to a destination market affects the firm's propensity of offshoring through vertical integration rather than arm's length in the same market. Section 7 concludes.

2 A simple model of self-discovery

We develop a simple model motivated by the empirical regularity highlighted in Figure 1. The model rationalizes the relationship between the provision of services offshored and export experience. In addition, the model generates further testable predictions, which we assess in the next section.

A key assumption of the model is that some services are essential for exporting. We can think of foreign distribution, marketing, but also of many other activities, as discussed in the introduction. Firms may acquire those services domestically or in the destination where they export to. We consider that sourcing service inputs domestically increases the cost of serving a foreign market, relative to a situation where the services are sourced directly in the destination country. The reason is that local providers have a lower (quality-adjusted) cost due to their knowledge and expertise of their own local markets. Put differently, we consider that obtaining service inputs domestically creates costly frictions, relative to obtaining them in the destination market.[3]

Specifically, we let the marginal cost of firm i selling to market j depend on where it obtains the services related to exporting:

$$\begin{cases} c_i > 0 & \text{if offshoring,} \\ c_i + \tau_j > c_i & \text{if sourcing domestically.} \end{cases}$$

We can split c_i in two components: $c_i = c_i^p + c_i^s$, where c_i^p represents the marginal cost of production and c_i^s denotes the marginal costs associated with the provision of export-related services in the destination the firm is exporting to. If the firm obtains those services domestically, it incurs an additional cost, τ_j, which we call the "adjustment friction." It reflects all the extra costs related to sourcing export-related service inputs domestically, rather than directly in the destination country.

On the other hand, there is a sunk cost to start offshoring services in j for any firm exporting to j, $F_j^o > 0$. It represents the cost of finding a service provider and establishing a trustworthy relationship in the foreign destination, among other potential costs.[4] Hence,

[3] Given the nature of the service inputs considered, we assume that the knowledge required in their production is mostly destination- rather than firm-specific.

[4] More precisely, F_j^o should be interpreted as the *additional* sunk cost to sourcing export-related inputs abroad, relative to doing so domestically.

when deciding its sourcing mode, a firm effectively chooses whether to incur F_j^o to save τ_j on each unit sold. Naturally, the choice will depend on the level of its "engagement" in the foreign market. The key is that one mode is cheaper in the absence of previous "investment," but more costly otherwise. Typically, if the firm expects large, long-term exports to market j, it will decide to 'invest' F_j^o to save τ_j per unit sold today and in the future; otherwise, it does not invest. Regardless of the service sourcing mode, there is a sunk, destination-specific, cost to start exporting to destination j for any firm, $F_j^e > 0$.

We consider that markets are segmented. Hence, the mechanics in each market is the same but independent across markets. For that reason, henceforth we drop destination subscripts in the description of the model, but it should be understood that we are describing the activities of a firm toward a specific foreign market, and that the same analysis should be extended to each market where the firm exports to. For simplicity, we assume that residual demand takes a simple linear form in each market the firm serves:

$$q_i(p_i) = d_i - p_i,$$

where q_i denotes the quantity sold by firm i, p_i is its price, and d_i is an idiosyncratic demand parameter.

Now, a key assumption is that, at entry, the 'long-run export profitability' of firm i is unknown, where export profitability is defined as $\mu_i \equiv d_i - c_i^s$ and distributed according to $G(\mu)$ in the interval $(\underline{\mu}, \bar{\mu})$, where $\underline{\mu} \leq 0 < \bar{\mu}$. The rationale is that, before exporting, a firm does not know its own residual demand in the foreign market and/or the level of the export-specific costs it will have to incur, both of which are encapsulated in μ_i. As a result, before the firm learns its own parameter μ_i, it chooses quantities and mode of servicing its exports based on its expectation. We assume that $E\mu$ is common across firms, so ex ante firms differ only in terms of observed productivity in production (i.e., heterogeneity in c_i^p). Thus, if the firm chooses to offshore, its expected period variable profit is $E\pi_i^o = E\left[q_i(d_i - c_i) - q_i^2\right] = q_i\left(E\mu - c_i^p - q_i\right)$, where superscript o denotes offshoring. Analogously, if the firm decides to source domestically, its expected period variable profit is $E\pi_i^d = E\left[q_i(d_i - c_i) - q_i^2 - \tau q_i\right] = q_i\left(E\mu - c_i^p - \tau - q_i\right)$, where superscript d denotes domestic sourcing.

We consider an infinite-horizon problem, where firms discount future profits at a factor $\delta < 1$. Firm i learns its own μ_i only if it exports $q_i > 0$. However, this happens probabilistically. Specifically, if in period t the firm has not learned μ_i yet and exports $q_i > 0$, at the end of that period it learns μ_i with probability $p \in [0, 1]$;[5] if $q_i = 0$, it does not learn μ_i. Conversely, if in period t the firm has already learned μ_i, then it will know it in every future period $t' \geq t$.

This simple framework captures the idea that firms need to experiment in foreign markets in order to learn how profitable they are as exporters, in line with the literature discussed in the introduction. Unlike some of those papers (e.g., Albornoz et al., 2012; Conconi et al., 2016), we do not impose that learning happens right after the firm starts to export. Instead, we allow for the more empirically plausible process where learning can happen either earlier or later in the firm's export tenure. This allows us to have a continuous definition for firms' "export experience," rather than a binary one. On the

[5]We can interpret the event of "not learning μ_i after an export experience" as a situation where the firm observes a profit realization that is too noisy to be informative about its true, long-run export profitability.

other hand (and as in Albornoz et al., 2012, and Conconi et al., 2016), we keep the learning process simple and link it solely to the duration of the experience firms have in foreign markets, rather than to the intensity of the firm's foreign presence (i.e., the level of q_i), although one could extend the model to allow for both components to play a role.

In this setup, if a firm has exported $q_i > 0$ for T periods, the probability that it has learned μ_i by then, p_T^μ, is

$$p_T^\mu = 1 - (1-p)^T . \tag{1}$$

Clearly, the greater the firm's export experience (as indicated by T), the more likely it is that it has uncovered its fundamental export profitability. Moreover, if the firm experiment enough, it knows that it will eventually learn its μ_i; that is, $\lim_{T\to\infty} p_T^\mu = 1$.

The first period in which the firm exports (t_1) is unique, both because it has to decide whether to pay the sunk cost to export, F^e, and because it is the only period in which we know for sure that the firm has not yet learned its μ_i. Now, if in the beginning of period $t' > t_1$ firm i has not yet learned μ_i, in that period it solves a problem identical to the one it had solved in all previous periods $t = \{t_2, ..., t'-1\}$, where t_2 is the second period in which it exported. Conversely, if in the beginning of period t'' firm i has learned μ_i for more than one period, then in that period it solves a problem identical to the one it will solve in all future periods $t > t''$.[6] Now, let $\hat{t}$ denote the first period after which firm i has learned its μ_i. Then, in period $\hat{t}$ it faces a distinct problem, where it may reassess its export service provision mode in light of the new information.

We start the analysis backwards, first looking at a period after $\hat{t}$, when the choices of the firm remain unchanged. We then look at the earlier periods until back to t_1, when the firm decides whether to enter and, if so, how. For notational ease, henceforth we drop firm subscripts. When needed, we use subscripts to identify the period of analysis.

2.1 Period $t > \hat{t}$

At period $\hat{t}$, the firm will have just learned its μ_i. Based on that, it will decide between exit, export while sourcing services domestically, and export while offshoring services. If it were not offshoring before, that option will also require spending F^o. Now, if the firm reaches $t > \hat{t}$, it is because it has decided to keep exporting. Moreover, if it has chosen to offshore, it has already paid F^o. Since no additional information is obtained after $\hat{t}$, the firm's problem becomes very simple, of just choosing quantities to maximize variable profits in each period. That, of course, depends on the firm's sourcing mode, as decided at $\hat{t}$.

Firm sourced domestically at $\hat{t}$ If the firm sourced export services domestically at $\hat{t}$, in each future period it chooses q to maximize the period variable profit under domestic

[6]This statement implicitly assumes that the firm can re-start exporting and/or offshoring after exiting, or equivalently, that the sunk costs F^e and F^o do not "depreciate" if the firm exits. Whether realistic or not, this implicit assumption is immaterial for our theoretical analysis, because in the absence of other shocks, if the firm chooses to exit, it will never desire to re-start exporting. In the empirical part, we operationalise this assumption by not depreciating export experience when a firm exits (and possibly re-enters) a certain destination. But we also show that the relationship between export experience and offshoring is robust to multiple definitions of experience, including when experience depreciates linearly in the number of years the firm does not export to the destination.

sourcing:

$$Max_q q\left(\mu - c^p - \tau - q\right) \Rightarrow q^d = \frac{\mu - c^p - \tau}{2}. \tag{2}$$

Clearly, if the firm chose to source domestically at $\hat{t}$, it is because it found out that $\mu > \tau$. By choosing q^d, it obtains a period profit of $\pi^d = \frac{(\mu - c^p - \tau)^2}{4}$. Afterwards, since it will face an identical problem in every period, it earns exactly the same profit in every future period.

Firm offshored at $\hat{t}$ If the firm offshored export services at $\hat{t}$, in each future period it chooses q to maximize the period variable profit under offshoring:

$$Max_q q\left(\mu - c^p - q\right) \Rightarrow q^o = \frac{\mu - c^p}{2}, \tag{3}$$

Clearly, if the firm chose to offshore at $\hat{t}$, it is because it found out that $\mu > 0$. By choosing q^d, it obtains a period profit of $\pi^o = \frac{(\mu - c^p)^2}{4}$. Afterwards, since it will face an identical problem in every period, it earns exactly the same profit in every future period.

2.2 Period $\hat{t}$

We now move to the problem of the firm at $\hat{t}$, right after it learns its μ. The firm's choices at that period depend on its export mode at $\hat{t} - 1$. We consider each case in turn.

Firm sourced domestically at $\hat{t} - 1$ Consider first a firm that sourced export services domestically at $\hat{t} - 1$. Clearly, this must have been its sourcing mode at every period since t_2, since at $\hat{t} - 1$ the firm faces the same problem it did at every period between t_2 and $\hat{t} - 1$.

Now, at $t = \hat{t}$, the problem is different, because the firm has just learned μ. Period-$\hat{t}$ profit depends on the sourcing mode, as follows:

- If the firm exits, it earns $\pi^{d\varnothing} = 0$ in that period, where the first superscript indicates the sourcing mode at $\hat{t} - 1$ and the second superscript the sourcing mode at $\hat{t}$, with $\varnothing$ denoting exit.

- If the firms keeps sourcing domestically, it chooses q to maximize the period variable profit under domestic sourcing: $q^d = \frac{\mu - c^p - \tau}{2}$ if $\mu > c^p + \tau$. In that case, the firm obtains a profit of $\pi^{dd} = \frac{(\mu - c^p - \tau)^2}{4}$ at $\hat{t}$. If $\mu \leq c^p + \tau$, $q^d = 0$, which is equivalent to exit, which yields $\pi^{d\varnothing} = 0$.

- If the firms switches to offshoring, it chooses q to maximize the period variable profit under offshoring: $q^o = \frac{\mu - c^p}{2}$ if $\mu > c^p$. In that case, the firm obtains a variable profit of $\frac{(\mu - c^p)^2}{4}$ at $\hat{t}$, which corresponds to a total period profit of $\pi^{do} = \frac{(\mu - c^p)^2}{4} - F^o$. If $\mu \leq c^p$, $q^o = 0$, which is equivalent to exit, which yields $\pi^{d\varnothing} = 0$.

Now, before considering the conditions under which each sourcing strategy is best, we need to impose restrictions on the relative sizes of $\{F^o, \tau\}$ so that there are circumstances when offshoring is the optimal sourcing mode and there are circumstances when domestic sourcing is the optimal sourcing mode. First, notice that π^{do} increases in μ at a higher rate than π^{dd} does. Thus, if d can ever be chosen over o, it must yield a higher present value profit ($PV\Pi$) at the lowest μ under which d is viable, which is when $\mu > c^p + \tau$ but arbitrarily close to $c^p + \tau$. In that case, $\lim_{\mu \to (c^p+\tau)^+} PV\Pi^d = 0$, whereas $\lim_{\mu \to (c^p+\tau)^+} PV\Pi^o = \frac{\tau^2}{4(1-\delta)} - F^o$. Thus, we require that

$A1 : F^o > \frac{\tau^2}{4(1-\delta)}$.

This ensures that there are circumstances when domestic sourcing is the optimal sourcing mode at $\hat{t}$. Similarly, if o can ever be chosen over d, it must yield a higher present value profit at the highest possible μ. In that case, $PV\Pi^d = \frac{(\bar{\mu}-c^p-\tau)^2}{4(1-\delta)}$ and $PV\Pi^o = \frac{(\bar{\mu}-c^p)^2}{4(1-\delta)} - F^o$. Thus, we require that

$A2 : F^o < \frac{\tau([2(\bar{\mu}-c^p)-\tau]}{4(1-\delta)}$.

This ensures that there are circumstances when offshoring is the optimal sourcing mode at $\hat{t}$.

We can now study when the firm will want to switch to offshoring in period $\hat{t}$. It will do so if

$$-F^o + \sum_{j=0}^{\infty} \delta^j \pi_{\hat{t}}^{do} > \sum_{j=0}^{\infty} \delta^j \pi_{\hat{t}}^{dd},$$

or equivalently, if

$$\frac{(\mu - c^p)^2}{4} - \frac{(\mu - c^p - \tau)^2}{4} > (1-\delta)F^o$$
$$\Leftrightarrow \mu > c^p + \frac{\tau^2 + 4(1-\delta)F^o}{2\tau}.$$

Hence, a firm will switch to offshoring in period $\hat{t}$ if $\mu > \tilde{\mu}$, where $\tilde{\mu}$ is defined as

$$\tilde{\mu} \equiv c^p + \frac{\tau}{2} + \frac{2(1-\delta)F^o}{\tau}\ . \tag{4}$$

Notice that the cutoff $\tilde{\mu}$ is firm-specific, as it depends on its (inverse) productivity, c^p. In particular, $\tilde{\mu}$ is increasing in c^p, because less productive firms gain less from a switch to offshoring than more productive firms do.

Using $A1$, we have that $\tilde{\mu} > c^p + \tau$. Furthermore, $\tilde{\mu}$ is decreasing in τ:

$$\frac{d\tilde{\mu}}{d\tau} = \frac{1}{2} - \frac{2\,(1-\delta)\,F^o}{\tau^2} < 0$$
$$\Leftrightarrow \tau^2 < 4\,(1-\delta)\,F^o,$$

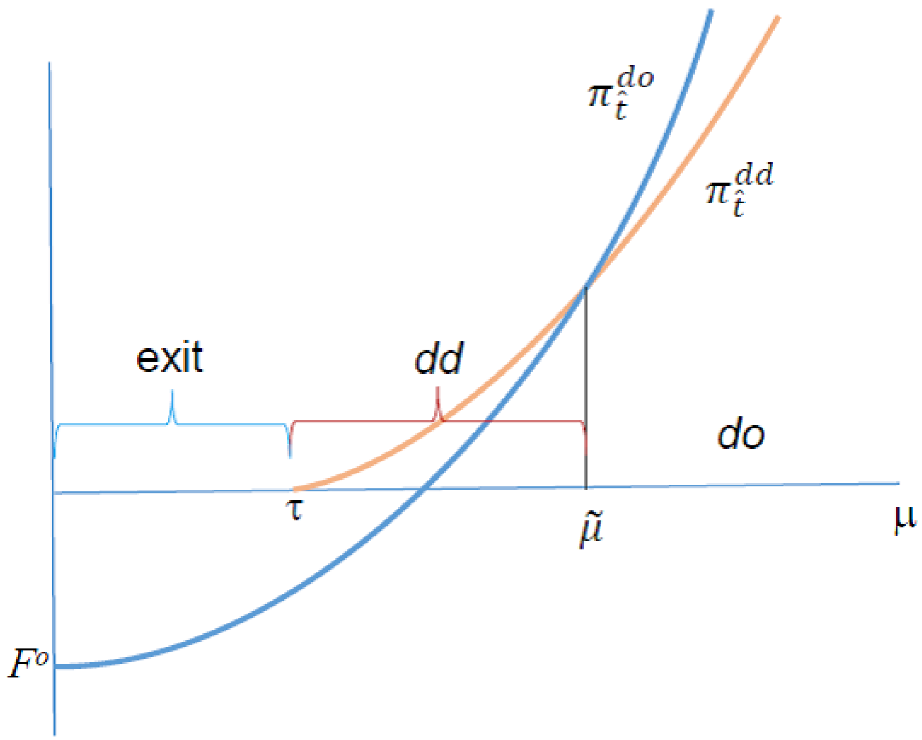
which is true under $A1$. Thus, a higher adjustment friction τ lowers the threshold of μ above which the firm switches from domestic sourcing to offshoring. Naturally, an increase in F^o has the opposite effect on $\tilde{\mu}$, raising the threshold under which the switch happens. In turn, if $\mu < c^p + \tau$, domestic sourcing is no longer viable, and the firm chooses to exit.

Hence, at $\hat{t}$ the firm chooses its sourcing mode according to the following rule:

$$\begin{cases} \text{if } \mu \leq c^p + \tau\text{:} & \text{exit} \\ \text{if } \mu \in (c^p + \tau, \tilde{\mu})\text{:} & \text{keep domestic sourcing} \\ \text{if } \mu \geq \tilde{\mu}\text{:} & \text{switch to offshoring} \end{cases} \tag{5}$$

That is, the firm chooses to engage in long-term commitment (and invest F^o accordingly) if it finds out that its μ is sufficiently high. If, instead, it finds out that its μ is too low, it gives up exporting. For intermediate cases, it keeps exporting while sourcing services domestically. Figure 2 illustrates the points above, indicating how a firm that starts exporting under domestic sourcing adjusts its exporting-sourcing strategy depending on the realization of μ.[7]

Figure 2: Offshoring and exit thresholds at $t = \hat{t}$ when firm enters with domestic sourcing



Firm offshored at $\hat{t}-1$ At $t = \hat{t}$, the firm has learned μ and has already paid F^o. Period-$\hat{t}$ profit depends on whether it keeps exporting. If the firms exits, it earns $\pi^{o\varnothing} = 0$ at $\hat{t}$. If instead it keeps offshoring, it chooses $q^o = \frac{\mu - c^p}{2}$, earning a period profit of $\pi^{oo} = \frac{(\mu - c^p)^2}{4}$. As we have seen, this is also the profit the firm would earn in every future period under offshoring. Thus, it keeps exporting under offshoring if $\mu > c^p$; otherwise, it exits.

Observe that the firm will never switch from offshoring to domestic sourcing, because $\pi^{od} < \pi^{oo}$ for any μ, since F^o has already been incurred and $\tau > 0$. Hence, if a firm was offshoring before uncertainty was revealed, it either exits (if $\mu \leq c^p$) or keeps exporting under offshoring (if $\mu > c^p$).

[7]The curves have those relative shapes because $\frac{\partial \pi_{\hat{t}}^{do}}{\partial \mu} = \frac{\mu - c^p}{2} > \frac{\mu - c^p - \tau}{2} = \frac{\partial \pi_{\hat{t}}^{dd}}{\partial \mu}$ and $\frac{\partial^2 \pi_{\hat{t}}^{do}}{\partial \mu^2} = \frac{\partial^2 \pi_{\hat{t}}^{dd}}{\partial \mu^2} = \frac{1}{2}$.

2.3 Period $t \in \left(t_2, \hat{t}-1\right)$[8]

After the firm has entered the foreign market, but before it learns its export profitability, it faces an identical problem in every period. It is the same problem it faced at entry, except that the sunk cost F^e has already been paid. The quantities are therefore identical to those at t_1. Accordingly, we now turn to the entry period.

2.4 Period $t = t_1$

We consider the total payoff of a firm entering with each sourcing mode. We then compare them to determine when it will choose each sourcing strategy.

Firm enters with domestic sourcing at $t = t_1$ The firm chooses q_1 based on its expected profitability:

$$\begin{aligned} Max_q E\pi_1^d \quad &\Rightarrow \quad E\mu - c^p - \tau - 2q_1 = 0 \\ &\Leftrightarrow \quad q_1^d = \frac{E\mu - c^p - \tau}{2}. \end{aligned} \tag{6}$$

Naturally, this presumes that $E\mu > c^p + \tau$. In that case, the expected variable export profit at t_1 when sourcing domestically is:

$$\begin{aligned} E\pi^d &= q_1^d(E\mu - c^p - \tau - q_1^d) = \frac{E\mu - c^p - \tau}{2}\left(E\mu - c^p - \tau - \frac{E\mu - c^p - \tau}{2}\right) \\ &= \left(\frac{E\mu - c^p - \tau}{2}\right)^2. \end{aligned}$$

If instead $E\mu \leq c^p + \tau$, then any strictly positive quantity yields negative expected profits at $t = 1$. However, a small quantity $\epsilon \to 0$ makes that loss arbitrarily small in absolute value, while also uncovering the firm's export profitability with probability p.

To compute the present value profit from starting to export with domestic sourcing of services (Ψ^d), we first need to define its ex-ante expected profit at $\hat{t}$ under that sourcing mode, right after uncertainty is revealed, as well as subsequently. From decision rule (5), we know that, at $\hat{t}$, the firm's period profit will be π^{dd} if it keeps sourcing domestically, π^{do} if it switches to offshoring, and zero if it exits. Hence, when the firm starts exporting while sourcing services domestically, its expected profit at $\hat{t}$ is

$$\begin{aligned} \tilde{\pi}_{\hat{t}}^d &= \int_{\tau+c^p}^{\tilde{\mu}} \frac{(\mu - c^p - \tau)^2}{4} dG(\mu) + \int_{\tilde{\mu}}^{\bar{\mu}} \left[\frac{(\mu - c^p)^2}{4} - F^o\right] dG(\mu) \\ &= \int_{\tau+c^p}^{\tilde{\mu}} \frac{(\mu - c^p - \tau)^2}{4} dG(\mu) + \int_{\tilde{\mu}}^{\bar{\mu}} \frac{(\mu - c^p)^2}{4} dG(\mu) - F^o\left[1 - G(\tilde{\mu})\right]. \end{aligned} \tag{7}$$

Subsequently, at any $t > \hat{t}$, the firm's period profit will be π^d if it had chosen to keep sourcing domestically, π^o it it had chosen to switch to offshoring, and zero if it had chosen

[8] If uncertainty is revealed right after $t_1, \hat{t} = t_2$ and there is not any period between t_2 and $\hat{t} - 1$.

to exit. Hence, when the firm starts exporting while sourcing services domestically, its expected profit at $t > \hat{t}$ is

$$\tilde{\pi}^d_{>\hat{t}} = \int_{\tau+c^p}^{\tilde{\mu}} \frac{(\mu - c^p - \tau)^2}{4} dG(\mu) + \int_{\tilde{\mu}}^{\bar{\mu}} \frac{(\mu - c^p)^2}{4} dG(\mu). \tag{8}$$

Now notice that, at t_2, with probability p uncertainty will have been already revealed, in which case the firm's expected profit in that period is $\tilde{\pi}^d_{\hat{t}}$ and thereafter it is $\tilde{\pi}^d_{>\hat{t}}$. In contrast, with probability $1 - p$, at t_2 the firm faces exactly the same problem it faced at t_1, in which case its period profit is $E\pi^d$.

Hence, when entering with domestic sourcing, the firm's present value payoff is:

$$\begin{aligned}
\Psi^d &= E\pi^d \left[1 + (1-p)\delta + (1-p)^2\delta^2 + ...\right] + \left[p\left(\delta\tilde{\pi}^d_{\hat{t}} + \delta^2\tilde{\pi}^d_{>\hat{t}} + \delta^3\tilde{\pi}^d_{>\hat{t}} + ...\right)\right. \\
&\quad \left. +p(1-p)\left(\delta^2\tilde{\pi}^d_{\hat{t}} + \delta^3\tilde{\pi}^d_{>\hat{t}} + \delta^4\tilde{\pi}^d_{>\hat{t}} + ...\right) + p(1-p)^2\left(\delta^3\tilde{\pi}^d_{\hat{t}} + \delta^4\tilde{\pi}^d_{>\hat{t}} + \delta^5\tilde{\pi}^d_{>\hat{t}} + ...\right) + ...\right] \\
&= \frac{E\pi^d}{1-\delta(1-p)} + \tilde{\pi}^d_{\hat{t}}\left[p\delta + p(1-p)\delta^2 + p(1-p)^2\delta^3 + ...\right] + \tilde{\pi}^d_{>\hat{t}}\sum_{j=0}^{\infty}\delta^j\left[p\delta^2 + p(1-p)\delta^3 + p(1-p)\right. \\
&= \frac{E\pi^d}{1-\delta(1-p)} + p\delta\tilde{\pi}^d_{\hat{t}}\sum_{j=0}^{\infty}\delta^j(1-p)^j + \frac{p\delta^2\tilde{\pi}^d_{>\hat{t}}}{1-\delta}\sum_{j=0}^{\infty}\delta^j(1-p)^j \\
&= \frac{E\pi^d}{1-\delta(1-p)} + \frac{\delta p\tilde{\pi}^d_{\hat{t}}}{1-\delta(1-p)} + \frac{\delta^2 p\tilde{\pi}^d_{>\hat{t}}}{(1-\delta)\left[1-\delta(1-p)\right]} \\
&= \frac{1}{1-\delta(1-p)}\left[E\pi^d + \delta p\left(\tilde{\pi}^d_{\hat{t}} + \frac{\delta}{1-\delta}\tilde{\pi}^d_{>\hat{t}}\right)\right].
\end{aligned}$$

From (7) and (8), observe also the relationship between $\tilde{\pi}^d_{\hat{t}}$ and $\tilde{\pi}^d_{>\hat{t}}$:

$$\tilde{\pi}^d_{\hat{t}} = \tilde{\pi}^d_{>\hat{t}} - F^o\left[1 - G(\tilde{\mu})\right].$$

Hence,

$$\Psi^d = \frac{1}{1-\delta(1-p)}\left[E\pi^d + \delta p\left(\frac{\pi^d_{>\hat{t}}}{1-\delta} - \left[1 - G(\tilde{\mu})\right]F^o\right)\right].$$

Firm enters with offshoring at $t = t_1$ Again, the firm chooses q_1 based on its expected profitability:

$$\begin{aligned}
Max_q E\pi^o_1 &\Rightarrow E\mu - c^p - 2q_1 = 0 \\
&\Leftrightarrow q^o_1 = \frac{E\mu - c^p}{2}.
\end{aligned} \tag{9}$$

Naturally, this presumes $E\mu > c^p$. In that case, expected variable export profit at t_1 when offshoring is:

$$\begin{aligned}
E\pi^o &= q^o_1(E\mu - c^p - q^o_1) = \frac{E\mu - c^p}{2}\left(E\mu - c^p - \frac{E\mu - c^p}{2}\right) \\
&= \left(\frac{E\mu - c^p}{2}\right)^2.
\end{aligned}$$

If instead $E\mu \leq c^p$, then any strictly positive quantity yields negative expected profits at $t = 1$. However, a small quantity $\epsilon \to 0$ makes that loss arbitrarily small in absolute value, while also uncovering the firm's export profitability with probability p.

To compute the present value profit from starting to export with offshoring (Ψ^o), we first need to define its ex-ante expected profit at $\hat{t}$ under that sourcing mode, right after uncertainty is revealed, as well as subsequently. We know that, at $\hat{t}$, the firm's period profit will be π^{oo} if it keeps offshoring and zero if it exits.[9] Hence, when the firm starts exporting while offshoring services, its expected profit at $\hat{t}$ is simply

$$\tilde{\pi}^o_{\hat{t}} = \int_{c^p}^{\bar{\mu}} \frac{(\mu - c^p)^2}{4} dG(\mu). \tag{10}$$

Subsequently, at any $t > \hat{t}$, the firm's period profit will be π^o, which is identical to π^{oo}, if it had chosen to keep exporting, and zero if it had chosen to exit. Hence, when the firm starts exporting while offshoring services, its expected profit at $t > \hat{t}$ is

$$\tilde{\pi}^o_{>\hat{t}} = \int_{c^p}^{\bar{\mu}} \frac{(\mu - c^p)^2}{4} dG(\mu) = \tilde{\pi}^o_{\hat{t}}.$$

At t_2, with probability p uncertainty will have been already revealed, in which case the firm's expected profit in that period is $\tilde{\pi}^o_{\hat{t}}$ and thereafter it is $\tilde{\pi}^o_{>\hat{t}}$. With probability $1-p$, at t_2 the firm faces exactly the same problem it faced in t_1, in which case its period profit is $E\pi^o$.

Proceeding analogously to the analysis with domestic sourcing, we have that, when entering with offshoring, the firm's present value payoff is:

$$\Psi^o = \frac{1}{1-\delta(1-p)} \left[E\pi^o + \delta p \left(\tilde{\pi}^o_{\hat{t}} + \frac{\delta}{1-\delta} \tilde{\pi}^o_{>\hat{t}} \right) \right].$$

Since $\tilde{\pi}^o_{\hat{t}} = \tilde{\pi}^o_{>\hat{t}}$, the expression becomes

$$\Psi^o = \frac{1}{1-\delta(1-p)} \left[E\pi^o + \delta p \frac{\tilde{\pi}^o_{>\hat{t}}}{1-\delta} \right].$$

Firm does not enter in $t = t_1$ In this case, the firm makes no profit:

$$\Psi^{\varnothing} = 0.$$

2.5 When is domestic sourcing better than offshoring at entry?

At entry, a firm compares the present value payoff under the two sourcing strategies (and from not entering) to decide its sourcing mode (if it decides to export). It will prefer to

[9] Recall that the firm will never want to switch from offshoring to domestic sourcing.

start with domestic sourcing over offshoring when $\Psi^d > \Psi^o$. That happens when

$$\frac{1}{1-\delta(1-p)}\left[E\pi^d + \delta p\left(\frac{\tilde{\pi}^d_{>\hat{t}}}{1-\delta} - [1-G(\tilde{\mu})]\,F^o\right)\right] \geq \frac{1}{1-\delta(1-p)}\left[E\pi^o + \delta p \frac{\tilde{\pi}^o_{>\hat{t}}}{1-\delta}\right]$$

$$\Leftrightarrow -\delta p\,[1-G(\tilde{\mu})]\,F^o \geq \left[E\pi^o - E\pi^d\right] + \frac{\delta p}{1-\delta}\left(\tilde{\pi}^o_{>\hat{t}} - \tilde{\pi}^d_{>\hat{t}}\right)$$

$$\Leftrightarrow \{1-\delta p\,[1-G(\tilde{\mu})]\}\,F^o \geq \left[I_{\{E\mu>c^p\}}\frac{(E\mu-c^p)^2}{4} - I_{\{E\mu>c^p+\tau\}}\frac{(E\mu-c^p-\tau)^2}{4}\right] + \frac{\delta p}{1-\delta}\left(\tilde{\pi}^o_{>\hat{t}} - \tilde{\pi}^d_{>\hat{t}}\right). \tag{11}$$

Each of the three elements in the inequality are positive. The left-hand side represents the expected savings of the sunk cost of offshoring that entering with domestic sourcing entails. Naturally, it increases in the size of the sunk cost, F^o. Conversely, it decreases in p and δ, because higher p and δ imply, respectively, that the resolution of uncertainty will be quicker (and the firm may choose to incur F^o sooner) and that the future is more valuable (so saving F^o early on is relatively less important).

On the right-hand side, the term in square brackets represents the additional period-t_1 variable profit under offshoring, relative to domestic sourcing.[10] In turn, the term $\left(\tilde{\pi}^o_{>\hat{t}} - \tilde{\pi}^d_{>\hat{t}}\right)$ reflects the additional variable profit under offshoring, relative to domestic sourcing, after uncertainty has been revealed. It is greater when the firm enters with o than with d because it saves τ whenever $\mu \in (c^p, \tilde{\mu})$. More precisely:

$$\begin{aligned}\tilde{\pi}^o_{>\hat{t}} - \tilde{\pi}^d_{>\hat{t}} &= \int_{c^p}^{\bar{\mu}} \frac{(\mu-c^p)^2}{4} dG(\mu) - \left[\int_{c^p+\tau}^{\tilde{\mu}} \frac{(\mu-c^p-\tau)^2}{4} dG(\mu) + \int_{\tilde{\mu}}^{\bar{\mu}} \frac{(\mu-c^p)^2}{4} dG(\mu)\right] \\ &= \int_{c^p}^{c^p+\tau} \frac{(\mu-c^p)^2}{4} dG(\mu) + \tau \int_{c^p+\tau}^{\tilde{\mu}} \frac{2(\mu-c^p)-\tau}{4} dG(\mu) > 0. \end{aligned} \tag{12}$$

Since this expression is multiplied by $\frac{\delta p}{1-\delta}$ in inequality (11), the whole term is increasing in p (because uncertainty is expected to be resolved sooner) and δ (because the future is more valuable).

Hence, as each of $\{p, \delta\}$ increases, the left-hand side of criterion (11) falls while its right-hand side rises, and offshoring becomes more attractive as an entry strategy. Conversely, as F^o increases, the left-hand side of criterion (11) rises while its right-hand side remains unchanged, so a higher F^o makes entering with d more desirable as an export entry strategy in foreign markets.

While intuitive, it is not immediate from inequality (11) that a larger adjustment friction makes offshoring more appealing at entry. The following lemma confirms that intuition.

Lemma 1 *As the adjustment friction τ rises, inequality (11) is satisfied under a smaller set of parameters, and in that sense offshoring becomes more appealing at entry.*

Proof of Lemma 1. See Appendix B. ■

[10]Note that it is always positive, since $I_{\{E\mu>c^p+\tau\}} = 1 \Rightarrow I_{\{E\mu>c^p\}} = 1$, and in that case the first term is greater than the second. Moreover, $I_{\{E\mu>c^p\}} = 1$ in some circumstances when $I_{\{E\mu>c^p+\tau\}} = 0$, and in that case the first term is strictly positive.

2.6 Measure of firms in each sourcing mode

Ex ante, firms are different only because of their heterogeneity in productivity (i.e., in their production cost, c_i^p). Let c_i^p be distributed according to $H(c^p)$, where $H(.)$ is the distribution function of the firms that choose to enter. We want to define a cutoff that determines how firms that are sufficiently productive behave, relative to less productive ones. To do so, we first need to show that the criterion for entering with domestic sourcing, inequality (11), varies monotonically with c^p.

Lemma 2 *If inequality (11) is satisfied when $c^p = c_1^p$, then it is also satisfied when $c^p = c_2^p$, for any $c_2^p > c_1^p$.*

Proof of Lemma 2. See Appendix B. ■

Let us then define $\widetilde{c^p}$ as the value of c^p that solves equation (11) with equality. From the proof of Lemma 2, we know that value is unique. It follows that, among the firms that enter, all firms with $c^p < \widetilde{c^p}$ will enter with offshoring, whereas those with $c^p \geq \widetilde{c^p}$ will enter with domestic sourcing. Hence, the measure of firms entering with o is $H(\widetilde{c^p})$; the remainder enter with d. In turn, the measure of firms that switch to o when uncertainty is revealed is given by

$$\int_{\tilde{\mu}}^{\bar{\mu}} \left[1 - H(\widetilde{c^p})\right] dG(\mu) = \left[1 - H(\widetilde{c^p})\right] \left[1 - G(\tilde{\mu})\right].$$

2.7 Testable predictions

Having established the basic workings of the model, we now proceed to identify testable predictions from it. In doing so, we take into account the data available for estimation and some key stylized facts from the data.

As we have seen, if a firm starts exporting under offshoring, it will never switch to domestic sourcing. Now, among the firms that enter with domestic sourcing, some will switch to offshoring once they uncover their long-run export profitability. The probability that uncertainty is resolved, in turn, increases with export tenure. This follows directly from equation (1), which implies that the greater the firm's export experience (T), the more likely it is that it will have uncovered its fundamental export profitability by then. It follows that, as T rises, the probability that a firm will export under offshoring increases. This gives our first, and central, prediction:

Prediction 1 *All else equal, firms with more export experience in a foreign destination are more likely to serve it through offshoring.*

Proof of Prediction 1. See Appendix B. ■

Our model is silent about whether this happens at the firm level (in line with the results of Albornoz et al., 2012, and Morales et al., 2019) or at the firm-destination level (in the spirit of most other analyses of firm export dynamics). It is plausible that part of the knowledge a firm obtains comes from its experience as an exporter in general, whereas another part is specific to experience selling in specific destinations, for instance local institutions or the network of suppliers and distributors. Accordingly, in our baseline empirical specification we test Prediction 1 considering exporting and sourcing at the firm-destination level only. However, we also estimate specifications that allow the overall firm-level exporting activities to affect sourcing decisions.

The model also has predictions about the relative incidence of offshoring depending on the characteristics of the destination. Intuitively, because the cost of offshoring has a sunk nature, firms are more likely to offshore when they expect larger variable profits. The same is true if the adjustment friction is higher, because offshoring helps to save on them. Moreover, if the mass of firms around the cutoff $\widetilde{c^p}$ is small, those effects increase with export experience. Intuitively, this happens because when τ (or $E\mu$) is higher, the cutoff $\tilde{\mu}$ to switch to offshoring is lower, so export experience makes it especially likely that firms will switch to offshoring.

Prediction 2 *If the expected profitability of a market ($E\mu$) is higher and/or the adjustment friction (τ) is larger, firms are more likely to offshore. Moreover, the effects of $E\mu$ and τ on the probability of offshoring increase with export experience if the mass of firms around the cutoff $\widetilde{c^p}$ is sufficiently small.*

Proof of Prediction 2. See Appendix B. ■

We test this prediction by using alternative measures for the expected profitability of the market and for the adjustment friction. For the former, the natural proxy is the real GDP of the destination market, which tends to be associated with demand size and firm profit. For the latter, several proxies are plausible. Essentially, any destination characteristic that makes it easier for a domestic firm to conduct business there could be associated with a lower relative cost of foreign sourcing (i.e., a higher τ), and therefore a greater benefit from offshoring. Several "gravity-like" variables fit that description: a common currency (which makes foreign transactions free of exchange rate risk and other currency transaction costs); a regional trade agreement (which often lowers the regulatory costs of contracting services in that destination); a common legal system (which tends to facilitate the resolution of disputes in the foreign destination); a stronger rule of law (which lowers the regulatory costs of contracting services in the destination country); and higher human capital stock (which tends to increase the quality of services offshored). In contrast, greater distance from the *Home* country should have the opposite effect. The impact of sharing a common language is less clear-cut, however. On the one hand, a common language makes it easier to contract services in the foreign destination. On the other hand, it also makes domestic services for exports more valuable abroad (e.g., marketing services can be 'transported' from the *Home* country to the destination country with little friction if the population in the two countries speak the same language).

As Prediction 2 indicates, the model implies that those effects are magnified by export experience. The reason is that a higher adjustment cost τ lowers the cutoff firms follow to decide whether to switch to offshoring. This requires, however, that an increase in τ does not affect too much the mass of firms that choose domestic sourcing at entry. This seems to be the case in our setting, where very few firms offshore at entry, as already hinted by Figure 1. Moreover, in typical distributions of firm productivity, which are highly skewed, the mass of firms at the very top of the distribution tends to be indeed very low.

The model also associates the sourcing mode of a firm with its trade volume. Before the resolution of uncertainty, quantities are higher if the firm offshores than if it sources domestically, as equations (6) and (9) show. This effect is reinforced by selection at entry: only high-productivity firms, which export more for any sourcing mode, choose to offshore at entry. The same is true after uncertainty is resolved, as equations (2) and (3) indicate. The reason is simply that total marginal cost is lower under offshoring. Furthermore, there is selection also at $\hat{t}$: the firms that uncover a high enough μ are the ones that switch to offshoring. Since a higher μ is associated with higher volumes, the selection further reinforces the relationship.

Thus, we have that a firm's export volume to a destination is higher under o than under d because (i) the former entails lower marginal cost than the latter (an assumption of the model); because (ii) firms that choose o at entry have lower marginal cost than those that choose d (a result of the model); and because (iii) firms that switch from d to o after entry are those that find out to have higher export profitability. Hence:

Prediction 3 *All else equal, if a firm exports to a destination while offshoring services there, it will export more than it would if it sourced services domestically.*

To test this prediction empirically, we will use firm and destination fixed effects. That implies that we will effectively comparing the behavior of the same firm across markets when the firm's sourcing behavior varies across markets. Those fixed effects absorb changes in export volumes due to different marginal cost of production across firms and due to destination-specific differences. Furthermore, since our model is silent about which activities are key for that result, we test Prediction 3 in different ways, looking both at the effect of the number of activities offshored and at the effect of offshoring any activity.

Our model has clear results as well about firms' exit pattern from foreign destinations. Upon entry, exit happens only at $\hat{t}$. If a firm entered with domestic sourcing, it exits at $\hat{t}$ if it learns that $\mu \leq c^p + \tau$. If instead the firm entered with offshoring, it exits at $\hat{t}$ if it learns that $\mu \leq c^p$—an event that has a lower probability for a given firm.

As we have seen, the firms entering with offshoring have higher productivity (i.e., lower c^p) than those entering with domestic sourcing. That, in turn, reinforces the relationship between offshoring and lower exit rates, because the event $\mu \leq c_i^p$ is less likely than the event $\mu \leq c_j^p$ if $c_i^p \leq c_j^p$. Thus, the probability of exit for a firm that chooses o at entry is lower than the probability of exit for a firm that chooses d at entry: $G(c_i^p) < G(c_j^p) < G(c_j^p + \tau)$.

Now, it is important to point out that we have abstracted from other shocks that could lead firms to exit a foreign market. We did so because those shocks would not affect the main messages of the model. If we allowed for i.i.d. shocks that could hit firms of all types, firms would exit in periods other than $\hat{t}$ (and possibly re-enter later), but the result about how different sourcing modes relate to exit would either remain unchanged or be reinforced. To see that, notice that, if those shocks were simply "death shocks" (i.e., firms exit immediately after being hit), then it obviously makes no difference for the relative exit frequency of offshoring/domestic sourcing exporters. If the i.i.d. shocks were instead on μ—so that the firms only learn about its permanent component—then they would have a greater impact on exit rates for firms sourcing domestically, which operate under a tighter margin (they sell strictly positive quantities only if $\mu_i > c_i^p + \tau$), than on firms offshoring (which sell strictly positive quantities if $\mu_i > c_i^p$). Since strictly positive sales is what defines exit empirically, that type of shock reinforces our previous claim Thus, we have the following:

Prediction 4 *All else equal, exit rates are lower if the firm offshores.*

In our empirical analysis, we test the Prediction 4 in different ways, depending on how we define "exit" from a destination, and whether we define offshoring as the number of offshored activities or as a dummy for offshoring some activity. Also notice that, strictly within the model, the prediction is about the exit pattern of different firms, which select o or d at entry based on their productivities. However, with i.i.d. shocks on firm-destination export profitability μ_{id}, the prediction also applies to the behavior of a given firm across markets. This allows us to use firm fixed effects in our empirical specification.

Finally, the model also has implications about firms' trade flows volatility. As illustrated by Figure 1, in the data very few firms enter with o, implying that $\widetilde{c^p}$ is very low. Thus, if the firm uses o in period t, it is most likely because uncertainty has been resolved; in that case, there is no longer a reason for q_i to change in that market. If instead the firm uses d, it is either because the uncertainty has been resolved and μ is relatively low ($\mu < \widetilde{\mu}$), in which case there is no longer a reason for q_i to change in that market, or the uncertainty is still unresolved, in which case q_i may fall or rise in the future. Thus, there are more reasons for future changes in q_i under d than under o. Once again, adding i.i.d. socks to the analysis would not affect this result. Hence, we have that:

Prediction 5 *All else equal, there is more volatility in trade volumes for firms sourcing domestically than for firms offshoring.*

2.8 Extension: vertical integration abroad

It is plausible that vertical integration abroad (v) requires a higher fixed cost, $F^v > F^o$, but yields a lower marginal cost of production θc^p, $\theta < 0$, than offshoring at arm's length. In that case, a similar analysis can be carried out, with a third option that the firm chooses only if μ is observed to be sufficiently high. The same trade-offs that exist between o vs. d extend to, respectively, v vs. o. In particular, more export experience will increase the probability that a firm sources services in the destination market through vertical integration, relative to at arm's length.

3 Data

Most of the analysis relies on data from the Enquête sur les Chaînes d'Activité Mondiales (CAM), a survey on global value chains administered by INSEE in 2012, which asks firms about their outsourcing and offshoring decisions in the previous three years. The survey covers the population of firms with more than 250 employees and a sample of firms between 50 and 249 employees (with employment levels observed at the end of 2008), for a total of 6,024 firms, net of non-responses. Firms belong to the sections B to N of the NACE Rev.2 classification (i.e. mining, manufacturing, and all market services) except for financial and insurance services.

The survey is unique in that it identifies the outsourcing activity of the firm, differentiating activities between the core of the firm's production and six other non-core services activities, as well as between activities that were outsourced locally and to providers in a foreign country (offshoring). In Section 6, we also use the distinction between offshored activities that take place outside and within the boundaries of the business group (either a direct affiliate of the firm or another firm of the same group), which we identify henceforth as "Offshoring Out" and "Offshoring In," respectively.

To the best of our knowledge, only Bernard et al. (2020) have so far used a similar type of data, for Denmark, but to approach a different question. Furthermore, they focus on the core activities of manufacturing firms, while we use the full information set covering both manufacturing and non-manufacturing companies, and study the sourcing of the whole range of service inputs used by exporting firms.

The core activity is identified by the sector of the firm's operation (Manufacturing, Utilities, Construction, Trade, Other services, Other). Offshoring in non-core activities refers instead to the following six broad service categories: a) transport and logistics; b) marketing, commercial and after-sales services; c) ICT services; d) administrative and management services; e) Design, R&D, engineering and technical services; f) other support activities. For example, for a manufacturing firm, service activities cover both downstream (marketing, logistics) and upstream (R&D, ICT, management) phases of production. Several of these activities can be thought of as representing variable adjustment costs (e.g., after-sale services), while others represent fixed costs (e.g., R&D). The analysis focuses on these non-core service inputs.

Information on the destination of offshoring is reported at a geographical level sometimes referring to a country, sometimes to a group of countries: Africa, Brazil, China, EU15, the "new" 12 EU countries, Other European countries, India, Russia, USA and Canada, Other Latin American countries, Other Asia and Oceania. Information about the destination of offshoring for service inputs allows us to analyse firms' sourcing decision at the firm-activity-destination level, and to test whether destination-specific experience, together with other characteristics of the destination, affects the offshoring decision. The inclusion of destination fixed effects in the econometric specification ensures that differences in size and composition among destination markets do not affect the identification of the main relationship of interest.

While our main empirical specification exploits cross-sectional variation from the CAM, panel information is needed to compute the firm's exporting experience. For firms engaged in international trade, we use French Customs data on imports and exports by product and country of destination for the period 1996-2017. These data have been widely used, e.g. by Eaton et al. (2004).

Lastly, we source balance sheet data for firms in France from the Fichier Approché des Résultats d'Esane (FARE), which contains accounting information for the population of French firms.

3.1 Descriptive Statistics

In our sample, 37 percent of exporters offshore at least one service activity to at least one destination, but only 9 percent of non-exporters do so (Table 1).[11] Furthermore, exporters are almost six times more likely than non-exporters to offshore one such activity within the boundaries of the business group, and nearly four times more likely to do so outside

[11] For the purpose of this table, information on the mode of input sourcing is aggregated to the firm level from the original firm-activity-destination level: offshoring takes a value of one for a given firm if it sources any of the service categories from abroad.

of those boundaries. Differences between exporters and non-exporters are even starker for manufacturing firms, with the average exporter being 7 times more likely to offshore one service activity (44 percent) than the average non-exporter (Table A.1). Manufacturing firms represent 29 percent of the total number of firms in the sample, but 44 percent of exporters and 10 percent of non-exporters.

A natural measure of a firm's experience in an export market, which follows directly from the model, is the number of years it has been exporting to the given market since 1996, the first year of available French custom data at the firm level.[12] Now, the fact that the CAM survey only reports relatively aggregate destinations for offshoring commands a more flexible approach. Throughout the analysis, our main measure of exporting experience is the number of years in which the firm has been exporting to the destination, no matter the country (henceforth "export experience"). However, we evaluate the robustness of our results using several alternative definitions for export experience. In addition, when calculating the experience indicators, we assume, consistently with the theoretical model, that experience does not depreciate over time, even if the firm exits the export market. Nevertheless, we evaluate the sensitivity of the results to the possibility of depreciating experience, computed in different ways. As we will see, variations in the measurement of export experience makes little difference for the sign and magnitude of the main relationship of interest.

The resulting experience at the firm-destination level is averaged across destinations for the purposes of Table 1. The average firm thus serves a destination for 4.6 years, whereas the average exporter does so for 7.6 years. This number increases to 9.2 for exporters in the manufacturing sector (Table A.1). As experience never depreciates in the baseline definition, non-exporters that have exported in the past can have positive export experience, although this is small relative to current exporters.

On average, exporters in the sample sold 74 different products to 21 countries in 2011.[13] Again, those figures are higher if we consider only manufacturing firms.[14]

Table 2a reports the frequency of offshoring by exporting status, at the firm-activity-destination level, for service activities. This is the level at which the baseline empirical specification will be defined, as we are primarily interested in investigating the effects of destination-specific learning. Around 1.7 percent of the firm-activity-destination observations relate to offshoring to one or more destinations, a percentage that increases to 4.9 percent for exporting firms. Note that firms may simultaneously engage in offshoring and in other modes of production (in-house production, domestic outsourcing within or outside the boundaries of the business group) within the same activity, although it is also possible - since the service categories are relatively broad - that these firms are making

[12]This is a common approach, but not the only possible one. For example, Conconi et al. (2016) uses the number of markets served through export in a given region. In Araujo et al. (2016), experience in similar markets is also calculated as the number of markets sharing a given feature (language, border, GDP quartile etc.). Another example is Albornoz et al. (2012), who use dummies to identify markets which the firm has or has not already served through exports.

[13]Recall the distinction between "country" and "destination," which can denote a group of countries. Here the figure refers to actual countries, not destinations.

[14]Observe that service companies are on average more capital intensive than manufacturing companies, a fact driven by the presence of a few utility companies in the sample. Indeed the opposite is true when considering median rather than average values. For the same reason, while the average exporter is significantly larger and more capital intensive than the average non-exporter in the manufacturing sector, non-exporters are on average more capital intensive in the overall sample.

Table 1: Summary Statistics of by Trade Status - 2011

	All firms				Non-exporters				Exporters			
	mean	median	sd	count	mean	median	sd	count	mean	median	sd	count
Offshoring	0.24	0	0.43	6,428	0.092	0	0.29	2,881	0.37	0	0.48	3,547
Offshoring In	0.18	0	0.39	6,428	0.053	0	0.22	2,881	0.29	0	0.45	3,547
Offshoring Out	0.13	0	0.33	6,428	0.053	0	0.22	2,881	0.19	0	0.39	3,547
Num. offshored activities	0.6	0	1.32	6,428	0.19	0	0.72	2,881	0.93	0	1.57	3,547
Export experience (avg across destinations)	4.59	3	4.61	6,428	0.88	0	1.47	2,881	7.6	7.18	4.06	3,547
Total num. countries exported to	11.6	1	20.8	6,428	0	0	0	2,881	21	12	24.2	3,547
Total num. exported products	40.9	1	143.6	6,428	0	0	0	2,881	74.1	20	186.8	3,547
Total exports (volume)	29,580.2	7.5	270,254	6,428	0	0	0	2,881	53,606.3	2,820.6	362,062	3,547
Total num. imported products	61.8	7	154	6,428	8.69	0	45.6	2,881	104.9	50	192.7	3,547
Total imports (volume)	35,416.2	196.8	414,893	6,428	1,327.7	0	30,624	2,881	63,104	6,028.2	556,344	3,547
Employment	789.6	294	5,410.5	6,347	594.3	243	4,956.4	2,830	946.7	342	5,745.9	3,517
Capital/Labour Ratio	178.3	41.2	797.3	6,333	211	17.2	798.3	2,820	152	64.1	795.7	3,513

Note: *Offshoring In* stands for offshoring within the boundaries of the business group (i.e. offshoring to an affiliate). *Offshoring Out* stands for offshoring outside said boundaries, or at arm's length. *Export experience (avg across destinations)* is the firm's export experience in each destination, averaged over all destinations served by the firm. *Total num. countries exported to* and *Total num. exported products* aggregate over all countries served by the firm across all destinations. Total exports, imports and capital/labor (K/L) ratio are measured in thousands of €.

different choices for more detailed services, something that we cannot investigate with our data.

Table 2: Frequency of sourcing decision at the firm-service-destination level (2011)

(a) Offshoring by exporting status

	All firms	Exporters only
Offshoring: Yes	6,934	5,114
Offshoring: No	417,314	104,254

(b) Offshoring In vs Offshoring Out

	All firms		Exporters only	
	Offshoring Out: No	Offshoring Out: Yes	Offshoring Out: No	Offshoring Out: Yes
Offshoring In: No		1,604		1,058
Offshoring In: Yes	4,549	781	3,498	558

Note: *Offshoring In* stands for offshoring within the boundaries of the firm (i.e. offshoring to an affiliate). *Offshoring Out* stands for offshoring outside the boundaries of the firm, or at arm's length. Only offshoring of service activities are considered. Firms with mixed domestic and foreign sourcing strategies are included.

Table 2b displays the frequency with which offshoring firms choose to do so outside vs within the boundaries of the business group (from a direct affiliate or other firm of the group). Consistently with panel (a) and with the baseline regressions, frequencies are calculated at the firm-activity-destination level, but conditional on firms doing offshoring to at least one destination and for at least one activity. Firms are significantly more likely to offshore the provision of service inputs within the boundary of the group rather than outside it, with exporters doing either activity three times more frequently than the average firm. This outcome might be partially explained by the fact that we consider the boundary of the business group, while the literature often only considers the direct affiliates. Mixed strategies, when firms offshore both at arm's length and through an affiliate, are the least frequent choice, albeit slightly more so among exporters than in the full sample of offshoring companies.

4 Export Experience and the Propensity to Offshore

Prediction 1 of the theoretical model establishes a positive relationship between firms' export experience and their propensity to source service inputs from abroad (offshoring). In this section, we test Prediction 1 using the cross-section of firms from the CAM survey and the 1996-2011 customs data for the panel of French firms operating in sections NACE Rev.2 B to N (mining, manufacturing and market services except for finance and insurance).

In the first subsection we present the baseline results, which assess whether offshoring service inputs to a given destination is affected by the firm's trading activity *in the same destination*. If exporting provides information that can enhance a firm's wilingness to offshore, this information is naturally more relevant for the offshoring of inputs in the same destination, rather than different ones. Regressions at the firm-activity-destination level, i.e. the most granular level available in our data, allow us to control for the most detailed set of fixed effects.

In the second subsection, we test Prediction 1 again, but distinguishing between export experience gathered in the same market from which service inputs are sourced and other export markets. We show that the sign and strength of the empirical relationship between offshoring and export experience do not depend on how we aggregate the data, and in particular on discarding the destination dimension altogether.

Finally, in subsection 4.3, we test Prediction 2 of the model, on how characteristics of the destination market affect firms' decisions to offshore services there. Market characteristics affect those decisions directly but also indirectly, depending on the firm's export experience.

4.1 Offshoring by Destination

Prediction 1 indicates a positive relationship between a firm's experience in serving a destination through exports and its propensity to source inputs from that foreign market. The longer the experience in the export market, the more likely the firm is to discover its fundamental export profitability, and to offshore services rather than source them domestically if its profitability is sufficiently high. Intuitively, this should be especially true for outsourced service inputs that are at least partially destination-specific. In Arkolakis (2010), for instance, the fixed cost of exporting is associated to market-specific services such as advertising and distribution.

In this subsection we test whether firms behave differently in their propensity to offshore depending on their experience in the market where they are exporting. We test Prediction 1 on the CAM data exploiting the full extent of its variation (firm-activity-destination), i.e. the level at which the probability of offshoring is reported in the dataset:

$$OFF_{iad} = \alpha + \beta_1 Experience_{id} + \beta_2 D^x_{id} + \boldsymbol{X'_{id}}\boldsymbol{\vartheta} + \chi_a + \varphi_i + \gamma_d + \xi_{iad} \tag{13}$$

where OFF_{iad} is a dummy variable with value 1 if the firm is offshoring a given service activity a from destination d in 2011.[15]

Our main regressor is the firm's experience as an exporter in the market ($Experience_{id}$). It is defined as the number of years since the firm started exporting to any country belonging to a destination group ("export experience" in Table 1). We also add a dummy taking value 1 when the firm is exporting to a country in that destination and 0 otherwise (D^x_{id}), and a number of controls for the size of the firm's trading activity with the destination, as summarized by $\boldsymbol{X_{id}}$: the number of countries reached within the destination group, total export volume and the number of products exported by the firm, and the volume and number of products imported by it from the destination in 2011. All explanatory variables related to trade are constructed at the overall firm-destination level. The estimating sample is designed so that all firms-activity-destinations are defined, even if they

[15]Each activity a refers to one of the service categories contained in the CAM. A zero value therefore implies that the firm sources the input at home, from a different destination, or does not use the input at all. The next subsection, by factoring in experience in other destinations as well, excludes the possibility that our baseline results is driven by firms sourcing service inputs exclusively from abroad, which would be in contradiction to the setup of the theoretical model.

imply a zero value. As we control for firm, activity and destination fixed effects (φ_i, χ_a, γ_d), all firm-specific regressors that are not destination-specific are absorbed by the firm fixed effect.

The main coefficient of interest is β_1, which is expected to be positive: better knowledge of their own export profitability, which comes with a successful experience in the export destination, provides greater incentives for firms to switch away from domestic sourcing of service inputs in favor of foreign supply. The dummy for exporting into tests whether exporters to the specific destination source service inputs more or less intensively than non-exporters, and allows us to identify the effect of experience on offshoring conditional on the exporting status. The model is built on the idea that service inputs are needed for exporting. The sign of the export dummy is, therefore, predicted to be positive. That said, especially at entry, exporters may source inputs domestically if the expected profitability of the export market is low, or if the fixed cost of starting to offshore is too high. This would make them indistinguishable from non-exporters, thus potentially reducing the magnitude of the association between the exporter dummy and offshoring. The coefficient can be empirically estimated as a small number of firms offshore services even without engaging in any export activity (Table 1), and because our baseline measure of experience remains positive even if the firm stops exporting.

Measures of the intensive margin of exports (volume and number of products) are expected to correlate positively to offshoring, too: conditional on being an exporter into the destination, the higher the exported volume to a given destination, the more likely it is that the market is profitable and can sustain offshoring. Lastly, the propensity to offshore inputs from the destination market is also expected to increase with the number of countries (in the destination) that are served through exporting, each country representing an extra source of learning.

In Table 3 we present the results of estimating a linear specification of Equation 13, with clustered standard errors at the firm level. All explanatory variables except the exporter dummy are standardized; this simplifies the comparison of the magnitudes of the coefficients.

Our main prediction holds: an increase in one standard deviation of export experience towards a given destination increases the probability with which the firm sources service inputs from that destination by 0.6 to 0.8 percentage points, depending on the set of extra controls included (Columns I to IV). These figures should be compared to the average probability of offshoring to a given destination in the sample, as defined at the firm-activity-destination level, i.e. 1.6 percent.[16] A five-year increase in experience in a destination market (approximately one standard deviation of experience) thus raises the probability to offshore service inputs there by 35 to 46 percent of the average probability of offshoring, depending on the extra controls included.

Columns V to VIII report the same coefficients when the activity dimension is aggregated away. Coefficients increase in magnitude, as does the average probability of offshoring (5 percent): a 5-year increase in experience thus translates, for the most conservative specification, into a 33 percent rise in the average probability of offshoring, an

[16] The lower probability of offshoring relative to Table 1 is explained by the shape of the dataset for the regression analysis, which exploits firm-activity-destination variation and where the dataset has been rectangularized to account for all zeros. The probability perfectly corresponds to what is reported in Table 2.

increase of comparable magnitude to that expressed by Column IV.

The export dummy captures the average effect of exporting to a certain destination. It allows us to distinguish the increase in offshoring probability due to the entry into a certain destination market, from the increase due to the accumulation of experience over time.[17] It has the expected positive sign but it becomes insignificant once the number of export countries within the destination is included, which has a consistently positive effect on the probability of offshoring. For a larger number of export countries within the destination, enhancing the exporting activity through local inputs at destination is easier than adapting domestic inputs to all exported countries.[18]

Table 3: Offshoring by Destination

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Experience	0.008***	0.007***	0.007***	0.006***	0.023***	0.021***	0.020***	0.018***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Exporter dest.	0.003**	0.003	0.004**	0.003	0.012***	0.010**	0.012***	0.010**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)
Num. exp. countries		0.003***		0.003***		0.007***		0.008***
		(0.001)		(0.001)		(0.002)		(0.002)
Further controls:								
Exports	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Imports	No	No	Yes	Yes	No	No	Yes	Yes
Observations	424,248	424,248	424,248	424,248	70,708	70,708	70,708	70,708
R-squared	0.192	0.193	0.198	0.198	0.401	0.402	0.408	0.408
Num. Firms	6,428	6,428	6,428	6,428	6,428	6,428	6,428	6,428
Fixed Effects	Activity	Activity	Activity	Activity	-	-	-	-
	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	Destination	Destination	Destination	Destination	Destination	Destination	Destination	Destination

Note: *** p<0.01, ** p<0.05, * p<0.1. Cross-sectional data at the firm-activity-destination level (Columns I to IV) or firm-destination (Columns V to VIII), for 2011. *Activity* refers to the type of service which is offshored, and *Destination* includes one of 12 aggregates reported in the CAM survey. The dependent variable is a dummy with value 1 if the firm is only offshoring to a given destination group, 0 otherwise, in a given activity in 2011. All trade-related variables are defined at the firm-destination level (over all countries in the destination group), including *Experience*, which is defined as the number of years since the firms started exporting to any country belonging to a certain destination group. Further controls for *Exports* (resp. *Imports*) stand for the exported (resp. imported) volume and the number of exported (resp. imported) products. The results are obtained estimating a fixed effect linear model, with clustered errors at the firm level (in parentheses).

These results are robust with respect to the definition of export experience. The measure of experience used in these baseline specifications does not distinguish between experience gained by exporting consistently to one single country within the destination, or by exporting occasionally to multiple countries in the destination. In this sense, it equates experience to the time spent serving a destination market, and allows us to introduce a separate term for the number of countries in the destination served through export, which is identified separately. Furthermore, this definition of experience does not increase mechanically with the number of countries encompassed by the destination

[17]Recall that, in the theoretical model, only part of the uncertainty over profitability is resolved at entry in an export market, the remaining part being resolved with a certain probability over time. A robustness specification in Columns I and II of Table A.4 in the Appendix drops the exporter dummy. As expected, the coefficient of export experience on offshoring increases, as it now captures both effects. A second robustness specification in Columns III and IV excludes all non-exporters and coherently retrieves slightly lower coefficients.

[18]It is also possible that the number of export countries is at least partially capturing the firm's overall export experience: firms which have engaged in exports for long tend to know the ins and outs of exporting better than new exporters, including how to use local (foreign) inputs.

group. This is a desirable property when destination fixed effects are omitted (ref. Section 4.3), which absorb the impact of the destination group's size on offshoring. A different approach, however, can bring together both the geographical and time dimensions of export: after all, an exporter can be defined as experienced both because of the duration its activities in a market, and because of the complexity of serving multiple countries in the same destination market. "Cumulative export experience" therefore counts the number of years in which the firm has served a given country, then sums these over all countries in the destination.[19] Both definitions of experience measure the capacity of the firm to learn from the exporting activity, but "cumulative" experience captures possible knowledge spillovers from serving multiple nearby countries, while the baseline experience more clearly identifies learning from a given destination market.

A third definition of experience distinguishes again its time and geographical dimensions, and separately calculates the average number of years a firm has served a given export country within a destination group and the number of served countries in the destination. Lastly, a fourth indicator of experience introduces another dimension to evaluate experience, i.e. how much the firm exports in each year to a given country, a concept we introduced as "intensity" in the model's section. Smaller exported quantities can be used by the firm to experiment in the market, and can signal a higher degree of uncertainty on the market's export profitability. This measure sums over the total volume sold by the firm in the destination market in the previous years (and takes it in logarithm, to minimise the importance of outlier country-activity pairs in the destination). It has the advantage of avoiding giving equal weight to small and large countries within one destination.

All approaches are presented in Table A.2 in the Appendix. The results confirm the positive link between export experience and the probability of sourcing service inputs from the export destination, no matter the definition of experience. While coefficients differ in magnitude across specifications, standard deviations and average value change with each definition of experience, too. One extra standard deviation in experience increases the probability of offshoring consistently between 31 and 39 percent of the average offshoring probability in the sample.

A second type of robustness relates to the rate of depreciation of knowledge gained in the export market. In the baseline specification, *Experience* accumulates linearly over time and the knowledge gathered by the exporter does not depreciate after exiting the destination market. Therefore, a firm keeps the same export experience over time, even years after exiting the export market. If this implies that the firm stops offshoring there, that measure of *Experience* introduces a downward bias in the estimated relationship between offshoring and experience.[20] As our theoretical model does not speak about the mechanism of depreciation of experience, this is just one possible measurement approach.

In Table A.3 in the Appendix, we propose alternative approaches that assume that a firm forgets the lessons learnt in an export market, as more time passes from the moment in which it left exited that market. One approach posits that experience depreciates

[19] Consider two firms, both exporting to two different countries in the same destination, but one serving both countries for both years, the other serving only one country in each year. According to the baseline definition of experience, the two firms have the same export experience (two years), while under the cumulative definition the first firm has double the experience (4 years) of the second firm.

[20] It is of course possible that the firm stops serving the market through exports, and starts doing so by establishing a production unit in the destination market, as in Conconi et al. (2016). In such a case, offshoring of service inputs is expected to persist, if not become more frequent.

linearly over time, i.e. one year is subtracted from experience for every year in which the firm is not exporting to a given export market (Columns III, IV). Another specification takes a mixed approach instead, where there is no depreciation of experience in any year of (even non-consecutive) exporting to a destination, but experience drops to zero in years in which the firm does not export to the destination. Under this particular approach, non-exporters always have zero experience. Results for the mixed approach to depreciation are reported in Columns V and VI of Table A.3. Once again, an immediate comparison across coefficients is not possible, since the standard deviation of export experience is different across specifications. However, we confirm that a 5-year increase in export experience increases the probability of offshoring by 36 percent (linear depreciation schedule) to 41 (mixed depreciation schedule) of the average offshoring probability in the sample. Differences are therefore tiny compared to the baseline effect reported in Columns I and II.

Finally, Table A.4 in the Appendix contains further robustness tests for the baseline specification. In Columns I and II, we drop the destination exporter dummy. Columns III and IV restrict the sample to firms that export to at least one destination in 2011. In Columns V and VI, we restrict the sample to manufacturing firms. We also change the econometric specification. In Columns VII and VIII, we estimate a linear model using the sampling weights provided in the CAM survey, whereas in Columns IX and X we use a non-linear specification (logit). The sign and significance of the coefficients on export experience are robust. Magnitudes, when directly comparable (columns I-IV), are also in the same order of magnitude as the baseline table.[21]

4.2 Experience in other markets

The previous section explored the link between exporting to a destination and sourcing inputs from the same market. For firms' learning, this seems the most natural approach. It also allows for a cleaner identification of the relationship of main interest. Nevertheless, our theoretical model is agnostic about the correspondence between export and offshoring market. While certain "lessons" are certainly market-specific, there are spillovers in experience from one market to the other, i.e., the firm can learn something about itself and its own profitability as exporter in market a from operations in market b, for a given activity or across activities.[22] Therefore, there could be both a firm and a firm-destination dimension to this process of self-discovery, with potential consequences for the firm's propensity to offshore. Exploring that possibility, in this subsection we test Prediction 1 by adding a component of export experience in markets different from the one where the firm is offshoring.

Table 4, Columns I to IV, presents the results from estimating Equation 13 with an additional term for the experience the firm has accumulated by exporting to third

[21]The magnitudes cannot be compared between linear and non-linear specifications, as the table reports coefficients for the logit specification, not the marginal effects. The two specifications also differ in the number of observations, due to the mechanics of the conditional logit estimation: whenever the firm has the same offshoring behavior across all destinations, the outcome is perfectly predicted and the firm gets automatically dropped from the sample. Further differences in the magnitude may be attributed to genuine differences in the way the linear vs non-linear model capture the underlying relationship of interest.

[22]In fact, this is the central message of Albornoz et al., 2012.

markets, i.e., any of the 11 destination markets other than d. A first measure simply averages the firm's experience across all destinations $k \neq d$; a second measure considers all destinations $k \neq d$ as if they were countries within one large worldwide destination market, and therefore assigns value one to each year in which a firm is exporting anywhere in the world which is not destination d.

Table 4: Offshoring and Third-Market Experience

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)
	Firm-Activity-Destination				Firm-Activity		
Experience	0.009***	0.008***	0.009***	0.007***	0.046***	0.045***	0.045***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.006)	(0.006)	(0.006)
Experience 3rd market	0.007**	0.007**					
	(0.003)	(0.003)					
Experience 3rd market (overall)			0.010**	0.009**			
			(0.004)	(0.004)			
Exporter dest.	0.003**	0.003**	0.004**	0.004**	0.031***	0.027***	0.027***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.007)	(0.007)	(0.008)
Further controls:							
Exports	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Imports	No	Yes	No	Yes	No	Yes	Yes
Scale	No	No	No	No	No	No	Yes
Observations	424,248	424,248	424,248	424,248	38,088	38,088	37,998
R-squared	0.192	0.198	0.192	0.198	0.095	0.098	0.098
Num. firms	6,428	6,428	6,428	6,428	6,348	6,348	6,333
Fixed Effects	Activity	Activity	Activity	Activity	Activity	Activity	Activity
	Firm	Firm	Firm	Firm	Industry	Industry	Industry
	Destination	Destination	Destination	Destination	-	-	-

Note: *** p<0.01, ** p<0.05, * p<0.1. Cross-sectional data at the firm-activity level, for 2011, where *Activity* refers to the type of service which is offshored, and *Destination* includes one of 12 aggregates reported in the CAM survey. In Columns I to IV, the sample is the same as in Table 3 and is declined at the firm-activity-destination level, while in Columns V to VII the destination dimension is aggregated away. The dependent variable is a dummy with value 1 if the firm is offshoring service inputs and 0 otherwise, in a given activity in 2011 (and in a given destination, for Columns I to IV). *Experience* is defined as the number of years since the firms started exporting to any country belonging to a certain destination group (Columns I to IV), or as the average export experience in countries within one of the 12 destinations specified in the CAM survey, then averaged across all the destinations served by the firm (Columns V to VII). *Experience 3rd market* takes an average of the baseline experience gained in each of the 11 destination markets different from d. *Experience 3rd market (overall)* gives value equal to one for any year of export to a given destination different from d, then sums those over the years and destinations. *Exporter* is a dummy with value 1 when the firm is exporting in 2011 in a given destination. Further controls for *Exports* (resp. *Imports*) stand for the exported (resp. imported) volume and the number of exported (resp. imported) products. *Scale* (Column VII) stands for the firm's number of employees and its capital intensity, measured as the ratio of assets to the number of employees. Fixed effect linear model regressions with clustered standard errors at the firm level (in parentheses).

The results show that the additional controls for third-market experience hardly affects the coefficient on the destination-specific *Experience*, relative to Table 3. Moreover, longer experience in third markets is also positively associated with the probability of offshoring to d and by a similar magnitude (albeit estimated with slightly lower precision). Taken together, these results suggest that firms do indeed leverage knowledge acquired in previous markets to explore the firm's potential profitability in the marginal export market, and to decide how to structure operations across the domestic and new foreign market.

A different way to simultaneously capture the effects of destination-specific and overall export experience is to aggregate the destination dimension in the data, and test Prediction 1 for all firm-activity pairs. In other words, we can estimate:

$$OFF_{ia} = \alpha + \beta_1 Experience_i + \beta_2 D_i^x + \boldsymbol{X_i'}\boldsymbol{\vartheta} + \chi_a + \lambda_j + \xi_{ia}, \qquad (14)$$

where, for each service activity a of firm i, OFF_{ia} is a dummy variable with value 1 if the firm is offshoring the activity to any destination. $\boldsymbol{X_i'}$ includes the usual export and import controls as well as the firm's total number of employees and capital intensity.[23] Activity and industry fixed effects ($\chi_a; \lambda_j$) capture possible specificities of industry or activity that correlate with the relative probability of offshoring.

The results are reported in Columns V to VII of Table 4. The effect of experience on offshoring is positive and well identified but, once again, magnitudes cannot be immediately compared to those of Table 3, as the distribution of the offshoring probability is different in the firm-activity sample. A five-year longer export experience increases the probability of offshoring by 49 percent of its average in the sample.

Overall, the results discussed in this and the previous subsections provide strong empirical validation for Prediction 1. Regardless of how it is measured, of how its depreciation is computed, of whether or not it is also accumulated in third markets, and of the set of controls included, export experience is a key determinant of the propensity of firms to offshore services in their export destinations.

4.3 Offshoring by Destination: Market Characteristics

The baseline specification in Equation 13 captures how export experience across the different destination markets affects the firm's offshoring behavior. Our model, however, predicts a role in this relationship for specific features of the export market, in particular $E\mu$ (the expected profitabiity of the market) and τ (the adjustment friction). According to Prediction 2, the probability that a firm offshores is increasing in both: more profitable markets help sustain the fixed cost of offshoring, while large adjustment frictions provide a disincentive for firms to do domestic sourcing relative to offshoring. In our context, measures of economic proximity and similarity between France and the offshoring country increase the relative profitability of offshoring because it facilitates doing business with foreign suppliers relative to domestic ones. Similarly, markets where expected profits are higher also tend to induce offshoring of services.

We therefore test the validity of Prediction 2 as:

$$OFF_{iad} = \alpha + \beta_1 Experience_{id} + \beta_2 D^x_{id} + \beta_3 \mu_d + \beta_4 \tau_d + \boldsymbol{X'_{id}} \boldsymbol{\vartheta} + \chi_a + \varphi_i + \xi_{iad}. \quad (15)$$

The difference between this specification relative to Equation 13 is thatbut the destination fixed effect γ_d is omitted, so that we can estimate the impact of expected market profitability ($E\mu_d$) and the adjustment friction (τ_d) on the probability of sourcing service inputs from the destination market. We approximate the profitability of the destination market by its real GDP.

Choosing a measure for τ_d is less straightforward: τ_d stands for any factor that eases doing business with foreign suppliers relative to domestic ones, and therefore reduces the firm's relative cost to source inputs from abroad rather than domestically. We therefore need measures of (dis)similarity between origin and export country that affect the firm's

[23]Firms engaging in offshoring are on average bigger and more capital-intensive (Tomiura, 2009). Berthou and Vicard (2015) explore the relative importance of size and experience in shaping firms' export dynamics. They find that large firms are less likely to display high volatility in export markets both in products and destinations, and that experience is inversely related to net export growth, conditional on survival.

ability to effectively source service inputs and its cost. Several gravity-like variables (Head and Mayer, 2014) are *a priori* good candidates: being part of the same regional trade agreement (RTA) or sharing the same currency or legal system are likely to increase τ, i.e. to reduce the relative marginal cost of sourcing inputs from abroad.[24] Strong rule of law provisions and enforcement, as measured by the World Bank Governance Indicators database (ref. Kaufmann et al., 2010), should also reduce the marginal cost of offshoring services by creating a more business-friendly institutional environment in the destination. Lastly, both the quality of services tends to be higher and transaction costs (be them communication costs or costs associated to failures in production) tend to be lower when the workforce at destination is more skilled, which we approximate with the human capital level at destination (Human Capital Index, from the Penn World Tables v9). We have the opposite expectation for the physical distance between France and the foreign market: if the distance between the two countries increases, offshoring of service inputs becomes less convenient.

The results of estimating Equation 15 are reported in Table 5. The first column only controls for our measure for $E\mu$, while all other columns simultaneously estimate an effect for $E\mu$ and for τ. First, we confirm that longer export experience increases the probability of offshoring to the same destination, in a comparable magnitude to what reported in Table 3 (0.6 to 1 percent, depending on the specification), especially if we consider that destination fixed effects are omitted here.

As predicted by the model, larger economies command a higher probability of offshoring there. Moreover, the probability of offshoring in a destination increases with the strength of the rule of law there, and with the existence of a common currency, of a free trade agreement, and of a common legal system between that market and France. In contrast, since countries that are further away from France are likely to be less profitable to offshore in, the effect of distance on the probability of offshoring decreases in the distance to France. The effect of sharing the same language is more subtle. While it should make offshoring easier, it also increases the effectiveness of locally sourced services in the destination. The estimate indicates that the net effect of sharing the same language on the propensity to offshore service inputs to a destination is relatively small but negative.

The estimates have the same signs when the proxies for $E\mu$ and τ are interacted with our measure of experience (see Table A.5 in the Appendix): the effect of the size of the destination market and of the adjustment friction on the firm's probability to offshore there is stronger, the longer the firm's experience in exporting there, and hence its knowledge of the destination market. This further validates the claim of Prediction 2: higher profitability or domestic adjustment costs reduce the cost threshold beyond which the firm switches to offshoring, thus also lowering the export experience required to firms before offshoring.

[24] These variables have already been used to estimate the importance of a country's institutions for international trade after controlling for factor endowments (for a review, see Nunn and Trefler, 2014). Araujo et al. (2016), in particular, highlight that low experience and low quality institutions in the export market aggravate the fixed cost of exporting, but can also influence export volumes and export dynamics after entry.

Table 5: Offshoring and Destination Characteristics

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Experience	0.010***	0.010***	0.006***	0.010***	0.006***	0.006***	0.008***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Exporter dest.	0.004***	0.004***	0.003*	0.004***	0.003**	0.003*	0.004**	0.004***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Real GDP	0.003***	0.003***	0.006***	0.003***	0.001***	0.006***	0.001***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Common language		-0.011***						
		(0.001)						
RTA			0.026***					
			(0.001)					
Common Legal System				0.004***				
				(0.001)				
Common Currency					0.054***			
					(0.003)			
Distance						-0.010***		
						(0.000)		
Rule of Law							0.008***	
							(0.000)	
Human capital								0.004***
								(0.000)
Further controls:								
Exports	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Imports	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	424,248	424,248	424,248	424,248	424,248	424,248	424,248	424,248
R-squared	0.189	0.189	0.194	0.189	0.196	0.194	0.192	0.190
Num. firms	6,428	6,428	6,428	6,428	6,428	6,428	6,428	6,428
Fixed Effects	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity
	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm

Note: *** p<0.01, ** p<0.05, * p<0.1. Cross-sectional data at the firm-activity-destination level, for 2011, where *Activity* refers to the type of service which is offshored, and *Destination* includes one of 12 aggregates reported in the CAM survey. The dependent variable is a dummy with value 1 if the firm is offshoring to a given destination group, and 0 otherwise, in a given activity in 2011. All trade-related variables are defined at the firm-destination level (over all countries in the destination group), including *Experience*, which is defined as the number of years since the firms started exporting to any country belonging to a certain destination group. *Distance* measures the distance between France and the country of export destination. *Common Language*, *Common Legal System*, *Common Currency*, and *RTA* are dummy variables with value 1 if France and one of the countries in the offshoring destination group share, respectively, a common official language, common legal origin, currency and a free trade agreement. *Rule of Law* is the average index of the effectiveness of the rule of law in the destination countries, as measured by the World Bank Governance Indicators database. *Real GDP* measures the cumulative USD value of the underlying indicator over the countries in the destination group, taken in logarithm. *Human Capital* is the Human Capital Index from the Penn World Tables (v9), averaged across countries in the destination. All specifications include the following controls: export and import volume, and number of exported and imported products. The results are obtained estimating a fixed effect linear model, with clustered errors at the firm level (in parentheses).

5 Trade Consequences of Offshoring

5.1 Offshoring and Trade Volumes

Our model also predicts that offshoring firms export greater volumes (Prediction 3). As discussed in the model section, this is the result of both model assumptions (the lower marginal cost of offshoring relative to domestic sourcing) and model results (the selection of firms to offshore both at entry and when they discover their export profitability). We test this prediction by estimating the following specification:

$$ExpVolume_{id} = \alpha + \rho OFF_{id} + \boldsymbol{Z'_{id}\vartheta} + \varphi_i + \gamma_d + \xi_{id}, \tag{16}$$

where $ExpVolume$ is the (log of the) volume exported towards a destination, OFF is a measure of the firm's offshoring activities of service inputs in the destination, φ_i captures firm fixed effects, and γ_d captures destination-specific effects. Prediction 3 indicates that ρ should be positive. Note that there is no $Experience$ term in Equation 16, since the link between destination-specific offshoring and exporting holds true independently of the length of the exporting spell. The relationship is estimated on the sub-sample of exporters.

Firm and destination fixed effects imply that we are comparing the behavior of the same firm across destinations, while also controlling for destination characteristics. If a firm chose o in destination A but d in destination B, it is because it found out that its export profitability is greater in A than in B. Accordingly, it should sell more in A than in B.

Table 6 reports the outcomes of estimating Equation 16 using data for 2011 with a linear regression and firm fixed effects. All regressors are aggregated at the firm-destination level. A first measure of offshoring acquires value 1 if the firm offshores at least one service activity to the destination in 2011, and 0 otherwise (Columns I to III). As predicted by the model, firms offshoring to a destination export greater volumes of goods there. According to the most demanding specification (Column III), volumes exported are approximately 107 percent higher for firms that offshore at least one service activity to the same destinations than for firms that do not, everything else held constant.[25]

An alternative measure of offshoring is the number of activities that are offshored by the firm to the destination (Columns IV to VI). The results indicate that one additional standard deviation of offshored service activity increases the exported volume by 24 percent. Evaluated at the mean, adding one offshored service activities leads to an extra 2.3 million Euros in exports, approximately.

Hence, controlling for destination characteristics, a given firm sells more in the markets where it offshores services (or offshores more services). This supports the basic assumption and the basic mechanism of the model.

5.2 Offshoring and Exit

Prediction 4 states that, everything else equal, exit rates from export markets should be lower for firms that offshore services there, relative to those that do not. This happens

[25] Exp(0.728)-1 = 1.07.

Table 6: Offshoring and Trade Volumes

	(I)	(II)	(III)	(IV)	(V)	(VI)
Offshoring	0.791***	0.724***	0.728***			
	(0.068)	(0.067)	(0.068)			
Num. Offsh. Activities				0.246***	0.215***	0.218***
				(0.025)	(0.025)	(0.026)
Further controls:						
Exports	No	Yes	Yes	No	Yes	Yes
Imports	No	No	Yes	No	No	Yes
Observations	17,534	17,534	17,534	17,534	17,534	17,534
R-squared	0.626	0.643	0.643	0.622	0.639	0.640
Num. firms	2,853	2,853	2,853	2,853	2,853	2,853
Fixed Effects	Firm	Firm	Firm	Firm	Firm	Firm
	Destination	Destination	Destination	Destination	Destination	Destination

Note: *** p<0.01, ** p<0.05, * p<0.1. Cross-sectional data at the firm-destination level for 2011, where *Destination* includes one of 12 aggregates reported in the CAM survey. The dependent variable is the log of the total exported volumes towards all countries included in the offshoring destination group and is not defined for non-exporting firms. $Offshoring$ is a dummy with value 1 if the firm offshores at least one service activity to that destination in 2011, and 0 otherwise. *Num. Offshored Activities* is the number of service activities that are offshored by the firm to that destination. Further controls for $Exports$ (resp. $Imports$) stand for the number of exported (resp. imported) products and for the volume of imported goods. The results are obtained estimating a fixed-effect linear model, with clustered errors at the firm level (in parentheses).

because through offshoring firms avoid the adjustment frictions from domestically provided services and because better firms select themselves into offshoring at entry. For both reasons, firms offshoring are more likely to keep serving the market upon finding out their export profitability there. Allowing for i.i.d. shocks on firm profitability in a market makes the prediction also apply to a given firm selling in different markets. That is, in destinations where the firm decided to offshore, its propensity to exit is lower than in destinations where the firm chose to not offshore services.

We test this prediction by estimating Equation 17:

$$Exit_{id} = \alpha + \eta OFF_{id} + \boldsymbol{Z'_{id}\vartheta} + \varphi_i + \gamma_d + \xi_{id}, \tag{17}$$

where OFF is, as before, a measure of the firm's offshoring activities in a given destination, φ_i and γ_d capture, respectively, firm and destination fixed effects. $Exit$ is a measure of the propensity of the firm to stop serving the destination market through exports. The model predicts that η is negative: exporting firms that also offshore services to that destination should exhibit lower probability of exit from the export market.

The results from estimating Equation 17 are reported in Table 7. We propose two measures of exit from the export market: one identifies firms that export to a destination in 2011, but stop exporting there at least once in the period 2012-2017 (Columns I to IV); the other measures the number of times between 2012-2017 in which the firm stops serving the destination market (all the countries in the destination group) after serving it in the previous year, divided by six (Columns V to VIII).

The estimates support our hypothesis: firms that are both exporting to and offshoring in a destination stop exporting to that market less frequently than firms that do not offshore in that destination. In particular, starting to source at least one service input from one of the countries of a destination decreases the probability of quitting that export market at least once between 2012 and 2017 by 4.6 percentage points. For comparison, the average probability of exit is 33 percent. The same switch in offshoring status decreases the period in which the firm does not export to the destination by 0.026 units, or about two months. In a similar way, offshoring one extra service activity to a country in the destination market decreases the probability of exit by 1.2 percentage points.

Table 7: Offshoring and Exit from Export

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
	Outcome: At least one Exit				Outcome: Length of Non-Export			
Offshoring	-0.046***	-0.046***			-0.026***	-0.026***		
	(0.010)	(0.010)			(0.006)	(0.006)		
Num. Offsh. Activities			-0.012***	-0.012***			-0.005**	-0.006**
			(0.004)	(0.004)			(0.002)	(0.002)
Further controls:								
Exports	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Imports	No	Yes	No	Yes	No	Yes	No	Yes
Observations	17,534	17,534	17,534	17,534	17,534	17,534	17,534	17,534
R-squared	0.516	0.516	0.515	0.515	0.545	0.545	0.545	0.545
Num. firms	2,853	2,853	2,853	2,853	2,853	2,853	2,853	2,853
Fixed Effects	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	Destination	Destination	Destination	Destination	Destination	Destination	Destination	Destination

Note: *** p<0.01, ** p<0.05, * p<0.1. Cross-sectional data at the firm-destination level for 2011, where *Destination* includes one of 12 aggregates reported in the CAM survey and only exporters are considered. The dependent variable is a dummy with value 1 if the firm stops exporting to one of the countries in the destination group at least once from 2012 to 2017 (Columns I to IV), or the number of years between 2012 and 2017 in which the firm does not export to any country in the destination group, divided by six (Columns V to VIII). $Offshoring$ is a dummy with value 1 if the firm offshores at least one activity to that destination in 2011, and 0 otherwise. $Num.\ Offsh.\ Activities$ is the number of offshored activities in the destination in 2011, and ranges from zero (no offshoring for the firm) to 6. Further controls for *Exports* (resp. *Imports*) stand for the exported (resp. imported) volume and the number of exported (resp. imported) products. The results are obtained estimating a fixed effect linear model, with clustered errors at the firm level (in parentheses).

In a similar vein, Prediction 5 states that an offshoring firm is more likely to keep exported volumes stable than a firm choosing to outsource inputs domestically. That is also true for a given firm choosing different sourcing modes in different markets. In other words, Prediction 5 stipulates that offshoring inputs to a destination should decrease the volatility of the firm's export volume to that destination. The reason is that firms offshoring in a market are more likely to have already found out their export profitability in that market.

We test that prediction by estimating the following equation:

$$ExportVolatility_{id} = \alpha + \kappa OFF_{id} + \boldsymbol{Z'_{id}\vartheta} + \varphi_i + \gamma_d + \xi_{id}, \tag{18}$$

where $ExportVolatility$ is a measure of the volatility of the firm's exports towards a given destination. The model predicts κ is negative: offshoring firms should exhibit lower volatility in exports relative to exporting firms that source domestically.

Table 8 reports the results from estimating Equation 18. The specifications in Columns I to IV measure the volatility of exports as the logarithm of the coefficient of variation in the volumes exported to all countries in a given destination group between 2011 and 2017, while Columns V to VIII measure it as the number of years in which the firm has stopped serving the destination market between 2012-2017.[26] The results from both

[26]Some firms export in 2011, then exit until the end of the sample. The coefficient of variation in export volume is not defined for those firms, and they do not contribute to estimating the results of Columns I-IV. This explains why the reported number of observations is slightly lower there than in Columns V-VIII.

specifications confirm that firms offshore service inputs to the destination where they also export with lower volatility. Sourcing at least one service input from the destination market decreases the volatility of export volumes by 12 percent (Column II), or 20 percent of the average volatility across exporters in the sample. Furthermore, one extra offshored activity decreases the volatility of export volumes by, approximately, 3 percent.

Table 8: Offshoring and Export Volatility

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
	Outcome: Log CV of Export Volume				Outcome: Number of Exits			
Offshoring	-0.115***	-0.117***			-0.068***	-0.069***		
	(0.020)	(0.020)			(0.014)	(0.015)		
Num. Offsh. Activities			-0.028***	-0.030***			-0.016***	-0.016***
			(0.008)	(0.008)			(0.005)	(0.005)
Further controls:								
Exports	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Imports	No	Yes	No	Yes	No	Yes	No	Yes
Observations	16,762	16,762	16,762	16,762	17,534	17,534	17,534	17,534
R-squared	0.589	0.589	0.588	0.589	0.446	0.446	0.445	0.445
Num. firms	2,720	2,720	2,720	2,720	2,853	2,853	2,853	2,853
Fixed Effects	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	Destination	Destination	Destination	Destination	Destination	Destination	Destination	Destination

Note: *** p<0.01, ** p<0.05, * p<0.1. Cross-sectional data at the firm-destination level for 2011, where *Destination* includes one of 12 aggregates reported in the CAM survey and only exporters are considered. The dependent variable is the logarithm of the coefficient of variation in the volumes exported to all countries in a given destination group between 2011 and 2017 (Columns I to IV), or the number of times between 2012-2017 in which the firm has stopped serving the destination market (all the countries in the destination group) after having served it the previous year (Columns V to VIII). $Offshoring$ is a dummy with value 1 if the firm offshores at least one activity to that destination in 2011, and 0 otherwise. Further controls for *Exports* (resp. *Imports*) stand for the exported (resp. imported) volume and the number of exported (resp. imported) products. The results are obtained estimating a fixed effect linear model, with clustered errors at the firm level (in parentheses).

6 Offshoring In vs Offshoring Out

In this section, we move beyond the relationship between export experience and the choice of sourcing at home versus abroad. A firm developing a global sourcing strategy decides on where to source different parts of its production, as well as the degree of control over these activities. Here we test the choice between vertical integration and arm's length subcontracting of service inputs.

According to our theoretical model, an offshoring firm may choose to source inputs from an affiliated company if it discovers the destination market to be especially profitable, and prefers arm's length offshoring otherwise.

This approach is consistent with the literature that has explored the link between the firm's choice for its international boundaries and the degree of relationship specificity of investment by final good producers and their suppliers, or the ability to specify these investments in enforceable contracts (Antràs, 2003; Antràs and Helpman, 2004, 2008; Ornelas and Turner, 2012). Although we do not test any of the theoretical predictions therein, we assume a ranking of fixed costs for different forms of firm internationalization, where cross-country vertical integration has higher fixed cost than arm's length offshoring. Conditional on doing offshoring of service activities, an exporting firm reaching a new market may therefore first resort to outsourcing; in a second moment, when it has gathered sufficient knowledge of the destination market, the firm may move to vertical integration.

As a consequence, we expect export experience to increase the relative probability of vertical integration relative to arm's length contracting.

In Tables 9 and A.6, we investigate the role of export experience in determining the probability of offshoring in-house rather than arm's length, estimating both a linear and a non-linear specification. For each activity and destination, the outcome variable has value 1 if the firm is vertically integrating with the supplier of services abroad, 0 if it is sourcing them at arm's length. Export experience is defined as before, i.e., as the number of years since the firm started exporting to any country belonging to a certain destination group defined in the CAM survey. All other trade variables are defined as the sum of flows over all countries within a broader destination group.

Table 9: Offshoring: Vertical Integration vs Arm's Length

	(I)	(II)	(III)	(IV)	(V)	(VI)
Experience	0.038***	0.037**	0.040***	0.034**	0.036**	0.036**
	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)
Exporter dest.	-0.008	-0.009	-0.009	-0.014	-0.015	-0.014
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Num. exp. countries			-0.008			-0.005
			(0.007)			(0.009)
Further controls:						
Exports	Yes	Yes	Yes	Yes	Yes	Yes
Imports	No	Yes	No	Yes	No	Yes
Observations	6,499	6,499	6,499	6,499	6,499	6,499
R-squared	0.683	0.684	0.684	0.687	0.687	0.687
Num. Firms	1,129	1,129	1,129	1,129	1,129	1,129
Fixed Effects	Activity	Activity	Activity	Activity	Activity	Activity
	Firm	Firm	Firm	Firm	Firm	Firm
	-	-	-	Destination	Destination	Destination

Note: *** p<0.01, ** p<0.05, * p<0.1. Cross sectional data at the firm-activity-destination level, for 2011, where *Activity* refers to the type of service which is offshored, and *Destination* includes one of 12 aggregates reported in the CAM survey. The dependent variable is a dummy with value 1 if the firm is only offshoring to a given destination group, 0 otherwise, in a given activity in 2011. All trade-related variables are defined at the firm-destination level (over all countries in the destination group), including *Experience*, which is defined as the number of years since the firms started exporting to any country belonging to a certain destination group. Columns IV to VI also control for destination-specific fixed effects. The results are obtained estimating a fixed effect linear model, with clustered errors at the firm level (in parentheses).

The results in Columns I to III of Table 9 show that greater export experience increases the relative probability of vertical integration to produce services.[27] Columns IV to VI further control for destination fixed effects and identify coefficients through within-firm variation across activities and destinations. In these demanding specifications, too, the correlation of experience with "offshoring-in" remains positive and statistically significant, and of similar magnitude: one extra standard deviation in export experience to a destination increases the probability of offshoring within the boundaries of the group

[27] As we exploit here within-firm, between-destination variation (at least in Columns I to III of Table 9), our results cannot be explained by firm-specific changes in productivity (important in Antràs and Helpman, 2004), unless the firm displays different productivity across destinations, which we cannot observe.

by 3.4 to 4 percentage points. In Table A.6 in the Appndix, we re-estimate the same relationship with a non-linear specification and obtain compatible results.

7 Conclusions

An extensive literature has recently investigated exporter dynamics across countries using firm- and transaction-level data. Firms undergo important changes in order to export, even more so if across multiple destinations, with high entry and exit rates, and large differences in survival, exported volumes and growth across firms. These differences among firms have been partially explained by the existence of fixed costs incurred when starting to export or entering export markets, themselves linked to the availability of export-related services, such as advertising or establishing a network of distributors in the foreign country, and the firm's knowledge about its own profitability in the export market. However, no attempt has yet been made to analyse the effect of export dynamics on the firms' service sourcing behavior. In this paper, we document several facts concerning the behavior of firms when it comes to the sourcing of services and relate them to the the companies' export dynamics. As starting to export is a costly and infrequent activity, firms entering a new market may want to outsource export-related service activities to other firms. Whether that is done towards domestic or foreign supplies depends on the expectation about the firm's profitability in the export market.

We develop a theoretical model linking a firm's propensity to offshore service inputs and its experience in the export market, through which the firm better understands its position in the market. The empirical analysis documents several facts on the relationship between export experience and the pattern of input sourcing by exploiting balance sheet and trade information for French firms, and a new survey of firms' participation in global value chain activities (CAM). It is plausible that, when outsourced service inputs are functional to the export process to a specific destination, firms may choose to source (service) inputs from the destination market rather than from domestic suppliers, as these inputs may better fit the necessities and constraints of that market. We confirm empirically that that greater export experience increases the intensity and likelihood of offshoring, other determinants of offshoring held constant. These results are robust to the use of firm-destination-specific information both on the trading side and the sourcing side.

Furthermore, we confirm the model's predictions that an offshoring firm exports more and more continuously to the same destination market to which it offshores, and is less likely to stop exporting there. We also provide evidence that greater export experience increases the probability of vertical integration across borders relative to arm's length offshoring, when it comes to production of service inputs. This reinforces the general idea developed in the paper that firms are more likely to incur the fixed costs related to a long-run commitment to an export market after a sufficiently long (and successful) experience selling in that market.

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Appendix

A Extra Results

Table A.1: Sample composition by trade status, manufacturing only - 2011

	Non-exporters				Exporters			
	mean	median	sd	count	mean	median	sd	count
Offshoring	0.065	0	0.25	278	0.44	0	0.5	1,578
Offshoring In	0.014	0	0.12	278	0.36	0	0.48	1,578
Offshoring Out	0.054	0	0.23	278	0.22	0	0.41	1,578
Num. offshored activities	0.13	0	0.65	278	1.18	0	1.74	1,578
Export experience (avg across destinations)	1.29	1	1.78	278	9.17	9.33	4.06	1,578
Total num. countries exported to	0	0	0	278	29.2	21	26.5	1,578
Total num. exported products	0	0	0	278	76.2	33	149.9	1,578
Total exports (volume)	0	0	0	278	84,355.2	14,379	373,493.3	1,578
Total num. imported products	7.12	0	17.9	278	102.3	66.5	134.5	1,578
Total imports (volume)	1,342.9	0	6,930.4	278	78,176.6	10,796.5	709,396.1	1,578
Employment	341.5	226	592.7	278	675.4	318.5	2,370.1	1,578
Capital/Labour Ratio	165.3	29.1	657	276	169.5	93.2	455.5	1,575

Table A.2: Offshoring by Destination - Different Definitions of Experience

	(I)	(II)	(III)	(IV)	(V)	(VI)
Experience (cumulative)	0.005***	0.005***				
	(0.001)	(0.001)				
Experience (avg across countries)			0.013***	0.011***		
			(0.001)	(0.001)		
Num. exp. countries			0.002***	0.002***		
			(0.001)	(0.001)		
Log Experience (volume)					0.015***	0.014***
					(0.001)	(0.001)
Exporter dest.	0.011***	0.010***	-0.000	-0.000	-0.003*	-0.003
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Further controls:						
Exports	Yes	Yes	Yes	Yes	Yes	Yes
Imports	No	Yes	No	Yes	No	Yes
Observations	424,248	424,248	424,248	424,248	169,368	169,368
R-squared	0.192	0.198	0.194	0.199	0.224	0.227
Num. firms	6,428	6,428	6,428	6,428	4,700	4,700
Fixed Effects	Activity	Activity	Activity	Activity	Activity	Activity
	Firm	Firm	Firm	Firm	Firm	Firm
	Destination	Destination	Destination	Destination	Destination	Destination

Note: *** p<0.01, ** p<0.05, * p<0.1. Cross sectional data at the firm-activity-destination level for 2011. *Activity* refers to the type of service which is offshored, and *Destination* includes one of 12 aggregates reported in the CAM survey. The dependent variable is a dummy with value 1 if the firm is only offshoring to a given destination group, 0 otherwise, in a given activity in 2011. All trade-related variables are defined at the firm-destination level (over all countries in the destination group). *Experience* (*cumulative*) is the number of years since the firms started exporting to a given country, summed over all countries served in the same destination group; *Experience* (*avg across countries*) takes the same number of years of export in the country, but averages across all countries in the destination group; *Log Experience* (*volume*) sums the volume of goods exported in all countries within the destination group in the year. *Num. exp. countries* reports the number of countries with positive exporting experience within the destination group. Further controls for *Exports* (resp. *Imports*) stand for the exported (resp. imported) volume and the number of exported (resp. imported) products. The results are obtained estimating a fixed effect linear model, with clustered errors at the firm level (in parentheses).

Table A.3: Offshoring by Destination - Different Depreciation Methods

	(I)	(II)	(III)	(IV)	(V)	(VI)
Experience (no depreciation)	0.007***	0.006***				
	(0.001)	(0.001)				
Experience (depreciation)			0.007***	0.006***		
			(0.001)	(0.001)		
Experience (mixed depreciation)					0.009***	0.007***
					(0.001)	(0.001)
Exporter dest.	0.003	0.003	0.002	0.002	-0.003	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Num. exp. countries	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Further controls:						
Exports	Yes	Yes	Yes	Yes	Yes	Yes
Imports	No	Yes	No	Yes	No	Yes
Observations	424,248	424,248	424,248	424,248	424,248	424,248
R-squared	0.193	0.198	0.193	0.198	0.193	0.198
Num. firms	6,428	6,428	6,428	6,428	6,428	6,428
Fixed Effects	Activity	Activity	Activity	Activity	Activity	Activity
	Firm	Firm	Firm	Firm	Firm	Firm
	Destination	Destination	Destination	Destination	Destination	Destination

Note: *** p<0.01, ** p<0.05, * p<0.1. Cross sectional data at the firm-activity-destination level, for 2011, where *Activity* refers to the type of service which is offshored, and *Destination* includes one of 12 aggregates reported in the CAM survey. The dependent variable is a dummy with value 1 if the firm is only offshoring to a given destination group, 0 otherwise, in a given activity in 2011. All trade-related variables are defined at the firm-destination level (over all countries in the destination group), including *Experience*, which is defined as the number of years since the firms started exporting to any country belonging to a certain destination group, as in Table 3. Columns I and II report the baseline coefficients as in Table 3 and assume no depreciation of experience over time. Columns III and IV assume a linear depreciation of experience. Columns V and VI assume complete depreciation of experience when firms are not exporting, and no depreciation in the years when the firm exports. Further controls for *Exports* (resp. *Imports*) stand for the exported (resp. imported) volume and the number of exported (resp. imported) products. The results are obtained estimating a fixed effect linear model, with clustered errors at the firm level (in parentheses).

Table A.4: Offshoring by Destination - Robustness on the Specifications

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	(X)
	No Exporter Dummy		Exporter Firms Only		Manuf. Only		All firms - WLS		All firms - Logit	
Experience	0.008***	0.007***	0.005***	0.005***	0.004***	0.004***	0.006***	0.005***	0.881***	0.851***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.037)	(0.038)
Exporter					0.005**	0.005**	0.006*	0.004	0.483***	0.470***
					(0.002)	(0.002)	(0.003)	(0.003)	(0.059)	(0.060)
Num. exp. countries		0.003***		0.003***		0.001		0.005***		0.075***
		(0.001)		(0.001)		(0.002)		(0.001)		(0.015)
Further controls:										
Exports	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Imports	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	424,248	424,248	234,102	234,102	122,496	122,496	424,248	424,248	103,158	103,158
R-squared	0.198	0.198	0.208	0.209	0.232	0.232	0.165	0.165	-	-
Fixed Effects	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Activity
	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	Destination	Destination	Destination	Destination	Destination	Destination	Destination	Destination	-	-

Note:*** p<0.01, ** p<0.05, * p<0.1. Cross sectional data at the firm-activity-destination level, for 2011, where *Activity* refers to the type of service which is offshored, and *Destination* includes one of 12 aggregates reported in the CAM survey. The dependent variable is a dummy with value 1 if the firm is only offshoring to a given destination group, 0 otherwise, in a given activity in 2011. All trade-related variables are defined at the firm-destination level (over all countries in the destination group), including *Experience*, which is defined as the number of years since the firms started exporting to any country belonging to a certain destination group, as in Table 3. Further controls for *Exports* (resp. *Imports*) stand for the exported (resp. imported) volume and the number of exported (resp. imported) products. Columns I and II report the outcome of estimating the specification on the sample of manufacturing-only firms; Columns III and IV of doing so in a fixed effect linear model but exploiting the sampling weights available in the CAM survey; Columns V and VI of estimating a logit specification. Marginal effects reported instead of coefficients for the logit specification. The results are obtained estimating a fixed effect linear model with clustered errors at the firm level for Columns I to IV, and robust standard errors for Columns V and VI. Number of observations vary between the logit and OLS specification due to treatment of singleton observations: whenever the firm has the same offshoring behavior across all destinations, the outcome is perfectly predicted and the firm gets automatically dropped from the sample.

Table A.5: Offshoring by Destination and Destination Characteristics - Robustness

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)
Experience	0.006***	0.001	0.005***	0.002***	0.001	0.003***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Exporter	0.004**	0.006***	0.004**	0.006***	0.006***	0.005***	0.005***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Experience x Real GDP	0.004***	0.006***	0.004***	0.002***	0.006***	0.002***	0.003***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Experience x Common Language	-0.001***						
	(0.000)						
Experience x RTA		0.007***					
		(0.001)					
Experience x Common Legal System			0.000				
			(0.000)				
Experience x Common Currency				0.006***			
				(0.001)			
Experience x Distance					-0.007***		
					(0.001)		
Experience x Rule of Law						0.006***	
						(0.001)	
Experience x Human capital							0.004***
							(0.000)
Further controls:							
Exports	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Imports	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	424,248	424,248	424,248	424,248	424,248	424,248	424,248
R-squared	0.199	0.201	0.198	0.201	0.201	0.201	0.199
Num. firms	6,428	6,428	6,428	6,428	6,428	6,428	6,428
Fixed Effects	Activity	Activity	Activity	Activity	Activity	Activity	Activity
	Firm	Firm	Firm	Firm	Firm	Firm	Firm
	Destination	Destination	Destination	Destination	Destination	Destination	Destination

Note: *** p<0.01, ** p<0.05, * p<0.1. Cross-sectional data at the firm-activity-destination level, for 2011, where *Activity* refers to the type of service which is offshored, and *Destination* includes one of 12 aggregates reported in the CAM survey. The dependent variable is a dummy with value 1 if the firm is only offshoring to a given destination group, 0 otherwise, in a given activity in 2011. All trade-related variables are defined at the firm-destination level (over all countries in the destination group), including *Experience*, which is defined as the number of years since the firms started exporting to any country belonging to a certain destination group. *Distance* measures the distance between France and the country of export destination. *Common Language*, *Common Legal System*, *Common Currency*, and *RTA* are dummy variables with value 1 if France and one of the countries in the offshoring destination group share, respectively, a common official language, common legal origin, currency and a free trade agreement. *Rule of Law* is the average index of the effectiveness of the rule of law in the destination countries, as measured by the World Bank Governance Indicators database. *Real GDP* measures the cumulative USD value of the underlying indicator over the countries in the destination group, taken in logarithm. All specifications include the following controls: export and import volume, and number of exported and imported products. The results are obtained estimating a fixed effect linear model, with clustered errors at the firm level (in parentheses).

Table A.6: Offshoring: Vertical Integration vs Arm's Length - Robustness

	(I)	(II)	(III)	(IV)
Experience	0.493***	0.494***	0.535***	0.530***
	(0.146)	(0.146)	(0.148)	(0.148)
Exporter	-0.105	-0.100	-0.091	-0.087
	(0.265)	(0.264)	(0.265)	(0.265)
Num. exp. countries			-0.119	-0.104
			-0.073	(0.074)
Further controls:				
Exports	Yes	Yes	Yes	Yes
Imports	No	Yes	No	Yes
Observations	2,178	2,178	2,178	2,178
Num. Firms	289	289	289	289
Fixed Effects	Activity	Activity	Activity	Activity
	Firm	Firm	Firm	Firm

Note: *** p<0.01, ** p<0.05, * p<0.1. Cross sectional data at the firm-activity-destination level, for 2011, where *Activity* refers to the type of service which is offshored, and *Destination* includes one of 12 aggregates reported in the CAM survey. The dependent variable is a dummy with value 1 if the firm is only offshoring to a given destination group, 0 otherwise, in a given activity in 2011. All trade-related variables are defined at the firm-destination level (over all countries in the destination group), including *Experience*, which is defined as the number of years since the firms started exporting to any country belonging to a certain destination group. Further controls for *Exports* (resp. *Imports*) stand for the exported (resp. imported) volume and the number of exported (resp. imported) products. The results are obtained estimating a non-linear specification of the empirical model (conditional maximum likelihood specification for the logistic function). Errors are "robust", as specified in the body of the text. The table reports coefficients, as opposed to marginal effects.

B Proofs

Proof of Lemma 1. First, we use equation (12) to calculate

$$\begin{aligned}\frac{d\left(\tilde{\pi}^o_{>\hat{t}}-\tilde{\pi}^d_{>\hat{t}}\right)}{d\tau} &= \frac{\tau^2}{4}g(c^p+\tau)+\int_{c^p+\tau}^{\tilde{\mu}}\frac{2\left(\mu-c^p\right)-\tau}{2}dG(\mu)+\tau\frac{d\tilde{\mu}}{d\tau}\frac{2\left(\tilde{\mu}-c^p\right)-\tau}{4}g(\tilde{\mu})-\frac{\tau^2}{4}g(c^p+\tau)\\ &= \int_{c^p+\tau}^{\tilde{\mu}}\frac{2\left(\mu-c^p\right)-\tau}{2}dG(\mu)+\frac{d\tilde{\mu}}{d\tau}\frac{\left[2\left(\tilde{\mu}-c^p\right)-\tau\right]\tau}{4}g(\tilde{\mu}),\end{aligned}$$

where we use the Leibniz rule several times. This can be further simplified using the definition of $\tilde{\mu}$ from (4):

$$\frac{d\left(\tilde{\pi}^o_{>\hat{t}}-\tilde{\pi}^d_{>\hat{t}}\right)}{d\tau}=\int_{c^p+\tau}^{\tilde{\mu}}\frac{2\left(\mu-c^p\right)-\tau}{2}dG(\mu)+(1-\delta)F^og(\tilde{\mu})\frac{d\tilde{\mu}}{d\tau}. \tag{B.1}$$

Now rewrite criterion (11) as

$$CR\equiv\left\{\{1-\delta p\left[1-G(\tilde{\mu})\right]\}F^o-\frac{\delta p}{1-\delta}\left(\tilde{\pi}^o_{>\hat{t}}-\tilde{\pi}^d_{>\hat{t}}\right)\right\}-\left[I_{\{E\mu>c^p\}}\frac{\left(E\mu-c^p\right)^2}{4}-I_{\{E\mu>c^p+\tau\}}\frac{\left(E\mu-c^p-\tau\right)^2}{4}\right. \tag{B.2}$$

Using (B.1), the term in curly brackets of this inequality changes as follows with τ:

$$\begin{aligned}\frac{d\{.\}}{d\tau} &= \delta pF^og(\tilde{\mu})\frac{d\tilde{\mu}}{d\tau}-\frac{\delta p}{1-\delta}\left[\int_{c^p+\tau}^{\tilde{\mu}}\frac{2\left(\mu-c^p\right)-\tau}{4}dG(\mu)+(1-\delta)F^og(\tilde{\mu})\frac{d\tilde{\mu}}{d\tau}\right]\\ &= -\frac{\delta p}{1-\delta}\int_{c^p+\tau}^{\tilde{\mu}}\frac{2\left(\mu-c^p\right)-\tau}{4}dG(\mu)<0.\end{aligned}$$

In turn, it is straightforward to see that the term in square brackets of (B.2) increases with τ. Hence, as τ rises, inequality (11) is satisfied under a smaller set of parameters. ■

Proof of Lemma 2. To prove the lemma, it suffices to show that the left-hand side of (B.2) increases in c^p. First, we use equation (12) to calculate

$$\begin{aligned}\frac{d\left(\tilde{\pi}^o_{>\hat{t}}-\tilde{\pi}^d_{>\hat{t}}\right)}{dc^p} &= -\int_{c^p}^{c^p+\tau}\frac{\mu-c^p}{2}dG(\mu)+\frac{\tau^2}{4}g(c^p+\tau)\\ &\quad+\tau\left[-\int_{c^p+\tau}^{\tilde{\mu}}\frac{1}{2}dG(\mu)+\frac{d\tilde{\mu}}{dc^p}\frac{2\left(\tilde{\mu}-c^p\right)-\tau}{4}g(\tilde{\mu})-\frac{\tau}{4}g(c^p+\tau)\right]\\ &= -\int_{c^p}^{c^p+\tau}\frac{\mu-c^p}{2}dG(\mu)-\int_{c^p+\tau}^{\tilde{\mu}}\frac{\tau}{2}dG(\mu)+\frac{d\tilde{\mu}}{dc^p}\frac{\left[2\left(\tilde{\mu}-c^p\right)-\tau\right]\tau}{4}g(\tilde{\mu}),\end{aligned}$$

where we use the Leibniz rule several times. This can be further simplified using the definition of $\tilde{\mu}$ from (4) and noticing that $\frac{d\tilde{\mu}}{dc^p}=1$:

$$\frac{d\left(\tilde{\pi}^o_{>\hat{t}}-\tilde{\pi}^d_{>\hat{t}}\right)}{dc^p}=-\int_{c^p}^{c^p+\tau}\frac{\mu-c^p}{2}dG(\mu)-\int_{c^p+\tau}^{\tilde{\mu}}\frac{\tau}{2}dG(\mu)+(1-\delta)F^og(\tilde{\mu}). \tag{B.3}$$

Now, using (B.3), notice that the term in curly brackets of (B.2) increases with c^p:

$$\begin{aligned} \frac{d\{.\}}{dc^p} &= \delta p g\left(\tilde{\mu}\right) - \frac{\delta p}{1-\delta}\left[-\int_{c^p}^{c^p+\tau}\frac{\mu-c^p}{2}dG(\mu) - \int_{c^p+\tau}^{\tilde{\mu}}\frac{\tau}{2}dG(\mu) + (1-\delta)F^o g(\tilde{\mu})\right] \\ &= \frac{\delta p}{1-\delta}\left[\int_{c^p}^{c^p+\tau}\frac{\mu-c^p}{2}dG(\mu) + \int_{c^p+\tau}^{\tilde{\mu}}\frac{\tau}{2}dG(\mu)\right] > 0. \end{aligned}$$

Finally, observe that the term inside square brackets in (B.2) decreases with c^p:

$$\begin{aligned} \frac{d[.]}{dc^p} &= -I_{\{E\mu>c^p\}}\frac{E\mu-c^p}{2} + I_{\{E\mu>c^p+\tau\}}\frac{E\mu-c^p-\tau}{2} \\ &= -I_{\{c^p+\tau>E\mu>c^p\}}\frac{E\mu-c^p}{2} - I_{\{E\mu>c^p+\tau\}}\frac{\tau}{2} < 0. \end{aligned}$$

Hence, the left-hand side of (B.2) is increasing in c^p, completing the proof. ■

Proof of Prediction 1. The probability that a given firm offshores export-related services after exporting for T periods is

$$pr(o_T) = pr(o_1) + [1-pr(o_1)] \times pr\left(\text{switch to } o \text{ by } T\right),$$

where $pr(o_t)$ indicates the probability that the firm offshores in period t and $pr\left(\text{switch to } o \text{ by } T\right)$, which indicates the probability that a firm that entered with d will switch to o by period T, can be expressed as

$$pr\left(\text{switch to } o \text{ by } T\right) = p_\mu^T\left[1-G(\tilde{\mu})\right].$$

Therefore,

$$pr(o_T) = pr(o_1) + [1-pr(o_1)]\left[1-G(\tilde{\mu})\right]p_\mu^T. \tag{B.4}$$

Hence,

$$\frac{dpr(o_T)}{dT} = [1-pr(o_1)]\left[1-G(\tilde{\mu})\right]\frac{dp_\mu^T}{dT} = -\left[1-pr(o_1)\right]\left[1-G(\tilde{\mu})\right](1-p)^T\ln(1-p) > 0,$$

concluding the proof. ■

Proof of Prediction 2. From equation (B.4), we have that the probability that a firm offshores after exporting for T periods varies with the friction τ according to:

$$\begin{aligned} \frac{dpr(o_T)}{d\tau} &= \frac{dpr(o_1)}{d\tau} - \frac{dpr(o_1)}{d\tau}\left[1-G(\tilde{\mu})\right]p_\mu^T - \left[1-pr(o_1)\right]p_\mu^T g(\tilde{\mu})\frac{d\tilde{\mu}}{d\tau} \\ &= \frac{dpr(o_1)}{d\tau}\left\{1-\left[1-G(\tilde{\mu})\right]p_\mu^T\right\} - \left[1-pr(o_1)\right]p_\mu^T g(\tilde{\mu})\frac{d\tilde{\mu}}{d\tau}. \end{aligned}$$

The second term is negative because $\frac{d\tilde{\mu}}{d\tau} < 0$. Furthermore,

$$\frac{dpr(o_1)}{d\tau} = \frac{dH\left(\widetilde{c^p}\right)}{d\tau} = h\left(\widetilde{c^p}\right)\frac{d\widetilde{c^p}}{d\tau} = -h\left(\widetilde{c^p}\right)\frac{\partial CR/\partial\tau}{\partial CR/\partial c^p} > 0, \tag{B.5}$$

where CR is defined in (B.2) and the sign follows from Lemma 1 (which implies $\partial CR/\partial\tau <$ 0) and Lemma 2 (which implies $\partial CR/\partial c^p > 0$). Hence, $\frac{dpr(o_T)}{d\tau} < 0$ at any T.

Observe now that

$$\frac{d^2pr(o_T)}{d\tau dT} = -\frac{dpr(o_1)}{d\tau}\left[1 - G(\tilde{\mu})\right]\frac{dp_\mu^T}{dT} - \left[1 - pr(o_1)\right]g(\tilde{\mu})\frac{d\tilde{\mu}}{d\tau}\frac{dp_\mu^T}{dT}.$$

This expression has an ambiguous sign, because the first term is negative whereas the second is positive. However, we know from (B.5) that $\frac{dpr(o_1)}{d\tau}$ is proportional to the mass of firms around the cutoff to enter with offshoring, $h\left(\widetilde{c^p}\right)$. If that value is sufficiently small, the positive effect dominates. ■