Vertical integration and exporting*

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June 2018

Preliminary and incomplete
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Abstract

This work investigates the relationship between export intensity and the vertical structure of firms in terms of domestic and foreign outsourcing, both from a theoretical and empirical perspective. In line with Head and Spencer (2017), we consider a Cournot oligopoly model with two countries and heterogeneous firms that differ in their productivity, and more precisely, in the marginal cost of producing the essential input in-house. We develop a two-stage game where firms first choose their degree of vertical integration, intended as the share of essential input to produce in-house, and then they compete in the quantities. As for the empirical analysis, we employ the EFIGE dataset that enables us to resort to measure of export intensity and vertical integration at the firm level for a sample of European countries.

JEL codes: F14, F15, F60, L13

Keywords: vertical integration, exporting,trade, oligopoly

*We acknowledge the financial support by the University of Bologna under the 2017 RFO scheme and Fondazione Cassa dei Risparmi di Forlì.

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1 Introduction

Literature shows that exporting firms are more productive (Melitz and Redding, 2014) and larger than their non-exporting competitors. While we have evidence and theory on the productivity and size of exporting firms we have neither good evidence nor suitable theoretical analysis of the vertical organization, even though there is some consensus on the effect of openness on vertical settings. The seminal contribution of McLaren (2000) examined the hold up constraint that arises in vertical arms' length relationships whenever inputs have some degree of specificity. International trade openness seems to decrease this kind of captive limitation both for upstream (U) input producers and for downstream (D) input utilizers. Openness somehow thickens the market for an input and any D firm has more choice. However, the hold up constraint is not only the result of a tiny market but, mostly, of the degree of specificity of the input, that is not strictly related to openness. When input specificity is not that great a large global market for inputs is expected to lead firms to reduce the extent of the vertical chain they keep under direct control in house. Antras and Helpman (2004) show that open trade, decreasing transport and communication costs induce firms to adopt more outsourcing of inputs, i.e. less vertical integration. Grossman and Helpman (2004), Antras and Helpman (2006) add contractual issues and, surprisingly, specificities which add to trade openness as determinants of decreased vertical integration. On the other hand, Ornelas and Turner (2008) argue that trade liberalization increases the incentives of foreign suppliers to undertake cost-reducing investments and, it may prompt vertical multinational integration. The empirical evidence is not conclusive either. Chongvilaivan and Hur (2012) use data for the US manufacturing sectors at a six-digit NAICS disaggregation from 2002 to 2006 and find a negative link between vertical integration and openness, stronger in more concentrated industries and negative as the extent of market uncertainty goes up. However, Hyun and Hur (2014) analyse Korean firm-level data for 2 years, 2001 and 2006, and find evidence that upon trade liberalization, firms restructure their organization by downsizing their domestic production processes (i.e., domestic vertical disintegration) and relocating their input production plants to other countries (i.e. cross-border vertical integration).

While most contributions examine the role of trade openness at country-level on firms vertical organization, to the best of our knowledge, there is no contribution focusing on the role of export intensity at firm-level. The relevance of investigating the effect of export intensity is twofold. First, this can be a more accurate measure of market thickness for heterogeneous firms rather than trade openness. Secondly, many important economic areas are already characterized by free trade. Still, there is evidence of heterogeneity in the vertical structure of firms across countries as well as across sectors. This is plain, for instance, from the dataset EFIGE that we use for our empirical analysis. This is a firm level dataset provided by EU-EFIGE / Bruegel-UniCredit whose description is detailed in Section 3. In particular, Table 2 shows how firms' vertical structure differ across countries and sectors.

Our aim is to investigate the relationship between firms' vertical organization and export activity from both a theoretical and an empirical viewpoint. In line with Head and Spencer (2017), underlying the widespread presence of oligopolies in everyday life, we develop a Cournot oligopoly model of international trade. More precisely, we consider two countries with a number of heterogeneous oligopolistic firms playing the following two-stage game: first, they choose their degree of vertical integration, intended as the share of essential input to produce in-house, and then they compete in the quantities. Firms differ in their marginal cost of producing the essential input in-house; also, we assume that the price of outsourcing is affected by the firm's export intensity. In particular, it is decreasing with the export intensity. The underlying assumption is that the export activity implies an increase in the number of agents with which the firm can interact (market thickness increases) and this reduces the hold-up motive to vertically integrate. Suggestive evidence of this comes from Table 4, where we can see that, on average, non-exporters exhibit a higher degree of vertical integration than exporting firms.

The rest of the paper is organized as follows. In Section 2, we develop the theoretical model. In Section 3, we describe the dataset, some preliminary evidence and our empirical strategy. We relegate in Appendix the more technical details of the model.

2 The model: oligopoly

The framework we adopt is one of international oligopoly markets where firms sell on both the domestic and the external markets which are reachable only incurring a transport and communication cost (TC) which is strictly larger than the one incurred selling at home. The firms we consider are described in their vertical organization, i.e., of the inputs they buy from external providers either at home or abroad.

More precisely, we analyse firms belonging to the home country H and to the rest of the world W. In country H there are N_H firms labeled as $h = 1, 2, .., N_H$, in country W there are N_W firms labeled as $w = 1, 2, .., N_W$. The following analysis is sector-specific, and we confine to homogeneous goods. Notice, however, that transport costs introduce a kind of cross country implicit differentiation since the iceberg transport cost $t \in [0.1]$ makes the domestic and the foreign goods imperfect substitutes. Formally, the inverse demand for country H (W) in sector j is defined as (since each variable and parameter of the following model is sector-specific, we forego the sector specific index without loss of generality):

$$p^H = a^H - Q_H^H - tQ_W^H \quad (1)$$
$$p^W = a^W - Q_W^W - tQ_H^W \quad (2)$$

where Q_H^H (resp. Q_W^W) is the total domestic quantity of market H (resp. W), that is:

$$\begin{aligned} Q_H^H &= \sum_{h=1}^{N_H} q_h^H \quad (3) \\ &= Q_H^{H-h} + q_h^H \text{ with } Q_H^{H-h} = \sum_{j \neq h} q_j^H \end{aligned}$$

and Q_W^H (resp. Q_H^W) is the total imported quantity in market H (resp. W), that is

$$\begin{aligned} Q_W^H &= \sum_{w=1}^{N_W} q_w^H \quad (4) \\ &= Q_W^{H-w} + q_w^H \text{ (where } Q_W^{H-w} = \sum_{j \neq w} q_j^H) \end{aligned}$$

A corresponding demand function may be written for the rest of the world, or country W.

Given the market price, let q_h^H and q_h^W denote the quantities sold by firm h in market H and W, respectively; $\gamma_h \in [0, 1]$ denotes firm h's degree of vertical disintegration, defined as the share of (essential) inputs purchased from outside the firm. As it is customary we assume perfect vertical complementarity. whereby each unit of output requires one unit of input. The profit function of (domestic) firm h then writes as:

$$\begin{aligned} \pi_H &= p^H q_h^H + tp^W q_h^W - c_h (1 - \gamma_h) \left(q_h^H + q_h^W\right) \quad (5) \\ &\quad -\gamma_h \left(q_h^H + q_h^W\right) c_h \left(1 + \frac{q_h^H}{\left(q_h^H + q_h^W\right)}\right) - G\frac{(1-\gamma_h)^2}{2} - F - F_{ex} \end{aligned}$$

where:

- $\left(p^H q_h^H + tp^W q_h^W\right)$ represents the total revenue coming from home and the rest of the world;
- $c_h (1 - \gamma_h) \left(q_h^H + q_h^W\right)$ is the firm-specific cost of the share of inputs produced in house.
- $\gamma_h \left(q_h^H + q_h^W\right) c_h \left(1 + \frac{q_h^H}{(q_h^H + q_h^W)}\right)$ is the firm-specific cost of the share of input outsourced. Notice that the marginal cost the of internally produced (share of) input is lower than the marginal cost incurred by the firm when outsourcing ($c_h < c_h \left(1 + \frac{q_h^H}{(q_h^H + q_h^W)}\right)$). This is quite standard assuming that the input is transferred at marginal cost inside the firm, whereas when it is acquired outside on an imperfectly competitive market, the price may be higher than its marginal cost of production. We also explicitly assume that this price of outsourcing is affected by export intensity. In particular, it is decreasing with the export intensity. The underlying assumption is that the export activity implies an increase in the number of agents with which the firm can interact (market thickness increases) and this reduces the hold-up motive to vertically integrate.
- $G\frac{(1-\gamma_h)^2}{2}$ is the convex cost of internal production of the input which grows with the share of internally produced inputs (G is a technical parameter that describes the extent of the internal organization cost relevance) that could be assimilated to a vertical integration organization cost. In words, we assume that there are increasing coordination costs along the vertical chain of production whenever this chain is kept in house.

- F is the fixed cost of entry (to operate in the market) and F_{ex} is a further cost to start exporting (to operate in the foreign market).

The profit function can be re-written as:

$$\pi_h = \left(p^H - c_h - \gamma_h\right) q_h^H + \left(tp^W - c_h\right) q_h^W - G\frac{\left(1-\gamma_h\right)^2}{2} - F - F_{ex} \tag{6}$$

For the sake of simplicity, in the following analysis we set the two fixed costs (F and F_{ex}) to zero. The underlying assumption is that all firms (N_H and N_F) are active in the domestic as well as in the foreign market. As a result, these fixed costs do not affect firms' strategic choice of quantities and degree of VI. We will consider the role of F and F_{ex} in equilibrium.

We go through the oligopoly market solution proceeding in two stages and by backward induction to get subgame perfection.

2.1 Backward induction: second stage

In the quantity stage, each firm chooses the quantity to sell in the home and in the foreign market by maximizing its profit function. The maximization problem for firm h writes as:

$$\max_{q_h^H, q_h^W} \left[\pi_h\right] = \max_{q_h^H, q_h^W} \left[\left(p^H - c_h - \gamma_h\right) q_h^H + \left(tp^W - c_h\right) q_h^W - G\frac{\left(1-\gamma_h\right)^2}{2} - F - F_{ex}\right]$$

The first order conditions (FOCs) are then:

$$\begin{aligned}
\frac{\partial \pi_h}{\partial q_h^H} &= q_h^H \frac{\partial p^H}{\partial q_h^H} + p^H - c_h\left(1+\gamma_h\right) = 0 && (7)\\
\iff \quad q_h^H &= \frac{a^H - Q_H^{H-h} - tQ_W^H - c_h\left(1+\gamma_h\right)}{2} \\
\frac{\partial \pi_h}{\partial q_h^W} &= t\left(q_h^W \frac{\partial p^W}{\partial q_h^W} + p^W\right) - c_h = 0 && (8)\\
\iff \quad q_h^W &= \frac{a^W - Q_W^W - tQ_H^{W-h} - \frac{c_h}{t}}{2t}
\end{aligned}$$

Solving for the quantity competition in market H, we obtain:[1]

$$q_h^H = \left(\frac{a^H t + C_W + t\left(C_H + \Gamma_H\right)}{t\left(N_W + N_H + 1\right)}\right) - c_h\left(1+\gamma_h\right), \tag{9}$$

and

$$q_w^H = \frac{a^H t + C_W + t\left(C_H + \Gamma_H\right)}{t^2\left(N_W + N_H + 1\right)} - \frac{c_w}{t^2}, \tag{10}$$

where

$$C_H \equiv \sum_{h=1}^{N_H} c_h \text{ and } \Gamma_H \equiv \sum_{h=1}^{N_H} c_h\gamma_h$$

Notice that $\left(C_H + \Gamma_H\right) = \left(\sum_{i=1}^{N_H} c_i\left(1+\gamma_i\right)\right)$ can be seen as an aggregate measure of domestic firms inefficiency augmented by the (aggregate sector-level) degree of vertical disintegration. From equations 9 and 10, we get that:

$$q_h^H = tq_w^H + \frac{c_w - c_h\left(1+\gamma_h\right)t}{t}$$

so that

$$q_h^H - tq_w^H = \frac{c_w - c_h\left(1+\gamma_h\right)t}{t}$$

this difference is negative if and only if$c_w < c_h\left(1+\gamma_h\right)t$. In words, in market H, the quantity sold by the foreign firm w is larger than the quantity sold by the domestic firm h when the cost advantage of the foreign firm is sufficiently large; note that this condition is less stringent the lower are the trade costs (the larger is t): $c_w < c_h\left(1+\gamma_h\right)t \iff t > \frac{c_w}{c_h\left(1+\gamma_h\right)}$.

We shall use (9) and (10) as structural equations to estimate.

[1] Formal details are in Appendix.

2.2 Backward induction: first stage

We move to the degree of vertical disintegration choice. The control variable is then γ_h.

From the second stage, we can write the second stage equilibrium profit as:

$$\pi_h(\gamma_h) = \left(q_h^H\right)^2 + \left(tq_h^W\right)^2 - G\frac{(1-\gamma_h)^2}{2} - F - F_{ex} \tag{11}$$

The FOC for the VI stage is then:

$$\frac{\partial \pi_h(\gamma_h)}{\partial \gamma_h} = 0 \iff 2q_h^H\left(\frac{\partial q_h^H}{\partial \gamma_h}\right) + 2t^2 q_h^W\left(\frac{\partial q_h^W}{\partial \gamma_h}\right) + G(1-\gamma_h) = 0 \tag{12}$$

Also, the second order condition writes as:

$$\frac{\partial^2 \pi_h(\gamma_h)}{\partial (\gamma_h)^2} = 2\left(\frac{\partial q_h^H}{\partial \gamma_h}\frac{\partial q_h^H}{\partial \gamma_h} + q_h^H\frac{\partial^2 q_h^H}{\partial (\gamma_h)^2}\right) + 2t^2\left(\frac{\partial q_h^W}{\partial \gamma_h}\frac{\partial q_h^W}{\partial \gamma_h} + q_h^W\left(\frac{\partial^2 q_h^W}{\partial (\gamma_h)^2}\right)\right) - G < 0.$$

where

$$\frac{\partial q_h^W}{\partial \gamma_h} = 0, \frac{\partial q_h^H}{\partial \gamma_h} = -\frac{(N_H+N_W)c_h}{N_W+N_H+1}.$$

So that (12) reduces to:

$$-2q_h^H\left(\frac{(N_H+N_W)c_h}{N_W+N_H+1}\right) + G(1-\gamma_h) = 0.$$

and the SOC can be rewritten as

$$2\left(-\frac{(N_H+N_W)c_h}{N_W+N_H+1}\right)^2 < G.$$

In words, for the solution to be interior we need the relevance of the internal organization cost, G, to be sufficiently low.

Solving for the first stage (see Appendix) we find:

$$\gamma_h = A_h - B_h\left[\frac{\sum_{h=1}^{N_H} c_h A_h}{\left(1+\sum_{h=1}^{N_H} c_h B_h\right)}\right] \tag{13}$$

where

$$A_h \equiv \frac{-2\left((N_H+N_W)c_h\right)\left(\frac{a^H t + C_W + tC_H}{t(N_W+N_H+1)}\right) + 2(N_H+N_W)(c_h)^2 + (N_W+N_H+1)G}{(N_W+N_H+1)G - 2(N_H+N_W)(c_h)^2}$$

$$B_h \equiv \left(\frac{2(N_H+N_W)c_h}{(N_W+N_H+1)\left[(N_W+N_H+1)G - 2(N_H+N_W)(c_h)^2\right]}\right)$$

2.3 Duopoly and simulation: a theoretical discussion

In this section we analyse the duopoly version of the model (i.e., N_H and $N_W = 1$) and we simulate the results obtained.[2] Notice that in this simulation we assume that $a^F > a^H$ (i.e., the foreign market is bigger) and that $c_h > c_w$ (i.e., the foreign firm is more efficient than the home firm).

Duopoly: As in the case of oligopoly, in this simplified version we first compute the second stage of the Backward Induction and we obtain each quantity as a function of the vertical disintegration (γ):

$$q_h^H = \frac{c_w + t\left(a^H - 2c_h\left(1+\gamma_h\right)\right)}{3t}, \tag{14}$$

$$q_w^H = \frac{\left(a^H + c_h\left(1+\gamma_h\right)\right)t - 2c_w}{3t^2}. \tag{15}$$

Finally,, solving the first stage of the Backward Induction, we obtain that

$$\gamma_h = \frac{-4c_h\left[\frac{c_w}{t} + a^H - 2c_h\right] + 9G}{9G - 8\left(c_h\right)^2}, \tag{16}$$

where

$$\frac{\partial \gamma_h}{\partial t} = 4c_h \frac{c_w}{t^2\left(9G - 8c_h^2\right)} > 0. \tag{17}$$

Finally, let us define the average integration cost of firm h and w as $\frac{G(1+\gamma_h)^2}{2\left(q_h^H + q_h^W\right)}$ and $\frac{G(1+\gamma_w)^2}{2(q_w^H + q_w^W)}$ respectively.

Vertical disintegration and trade openness

In this subsection, we analyse the results obtained by simulating the duopoly model. According the simulation, we obtain the following remarks:

Remark 1 *The higher is the trade openness, the higher is the vertical disintegration of each firm.*

Remark 2 *When the market is more closed (open), a decrease of the trade cost implies that: i) the gap between export and domestic production increases (decreases); ii) the total production increases (decreases); iii) the average integration cost decreases (increases).*

Remark 3 *The vertical disintegration increases rapidly (slowly) when the market is more closed (open).*

These remarks can be explained by using the simulation's results depicted in following figures

[Figure 1]

Figure 1 shows that γ, the share of input outsourced (i.e., the degree of vertical disintegration) increases with trade openness. Moreover, the results show that, for each level of trade openness, the more efficient firm (i.e., $c_h > c_w$) is also the less vertical disintegrated (i.e., $\gamma_h > \gamma_w\ \forall t$).

[Figure 2]
[Figure 3]

Figures 2 and 3 show that an increase of trade openness implies higher (lower) exports (domestic production). Furthermore, the more efficient firm (w Figure 3) exports more than the less efficient one (h Figure 2).

Since we expect that, according to the economic intuition, if there is an increase in trade openness (i.e., lower trade cost), firms increase the quantities exported and viceversa. Differently, our simulation shows that this latter relationship between quantities and trade openness can change when t is very high or very low.

[2] We use the software Wolfram Mathematica.

This result arises because there are both a direct and an indirect effect of the trade openness on quantities. The direct effect can be explained by analyzing the second stage equilibrium variables (equations 15 and 14), where the quantities q_h^H and q_w^H are functions of γ. This direct effect implies that, for a given level of vertical disintegration, there is a is negative (positive) impact for domestic production (exports): as the trade cost decreases (that is, as t increases) q_h^W increases and q_h^H decreases (because the market becomes more opened). Moreover, the indirect effect arises because the trade openness increases also the vertical disintegration level for each firm (equation 17). The sum of these two effects is captured by analyzing the first stage equilibrium variables:

$$
\begin{aligned}
q_h^H &= \frac{c_w}{3t} + \frac{\left(a^H - 2c_h\right)}{3} - \frac{2c_h\left(9Gt - 4c_h\left(c_w + t\left(a^H - 2c_h\right)\right)\right)}{3t\left(9G - 8\left(c_h\right)^2\right)}, \\
q_w^H &= \frac{\left(-2c_w + a^H t\right)}{3t^2} + \frac{c_h\left(18G - 8\left(c_h\right)^2\right)}{3t\left(9G - 8\left(c_h\right)^2\right)} - \frac{4\left(c_h\right)^2\left(c_w + t\left(a^H - 2c_h\right)\right)}{3t^2\left(9G - 8\left(c_h\right)^2\right)}, \\
q_w^W &= \frac{c_h}{3t} + \frac{\left(a^W - 2c_w\right)}{3} - \frac{2c_w\left(9Gt - 4c_w\left(c_h + t\left(a^W - 2c_w\right)\right)\right)}{3t\left(9G - 8\left(c_w\right)^2\right)}, \\
q_h^W &= \frac{\left(-2c_h + a^W t\right)}{3t^2} + \frac{c_w\left(18G - 8\left(c_w\right)^2\right)}{3t\left(9G - 8\left(c_w\right)^2\right)} - \frac{4\left(c_w\right)^2\left(c_h + t\left(a^W - 2c_w\right)\right)}{3t^2\left(9G - 8\left(c_w\right)^2\right)}.
\end{aligned}
$$

On the one hand, Figures 2 and 3 show that, when trade cost is low (i.e., t is high), an increase of trade openness implies higher (lower) exports (domestic production). In this case prevails the direct effect of the trade openness on quantities. On the other hand, Figures 2 and 3 show that when trade cost is very high (i.e., t is low), if there is an increase in trade openness, then firms increase (decrease) the domestic quantities (quantities exported). In this case prevails the indirect effect of the trade openness on quantities.

A key element to understand the relationship between γ and t is given by studying the effect of trade openness on the average integration cost of firm h and w: $\frac{G(1+\gamma_h)^2}{2\left(q_h^H+q_h^W\right)}$ and $\frac{G(1+\gamma_w)^2}{2(q_w^H+q_w^W)}$ respectively.

[Figure 4]

Figure 4 shows that the average integration cost decreases with trade openness when the trade openness is low and increases when the trade openness is sufficient high. Furthermore, the simulation shows that this cost is higher for the more efficient firms.

Concluding, the left side of Figure 2 shows that, when the market is closed, an increase in the market openness implies that the gap between export and domestic production increases and that the total production increases (i.e., there is not cannibalization between the domestic and export channels of selling). Consequently, the firms benefit from lower average integration cost (the left side of Figure 4) because of the total production increase and because of the rapidly increase of the vertical disintegration (Figure 1).

On the contrary, the right side of Figure 2 shows that, when the market is more open, an increase in the market openness implies that the gap between export and domestic production decreases and the total production decreases (i.e., there is cannibalization from export to domestic production). Consequently, the firms suffer from an increase of the average integration cost (the right side of Figure 4) because of the total production decreasing and because of the very slowly increase of the vertical disintegration (Figure 1).

3 EFIGE dataset and variables definition

The empirical analysis is based on firm level data provided by EU-EFIGE / Bruegel-UniCredit. The sample is stratified according to size class, geographical area and industry in order to significantly represent the population of manufacturing firms across European countries.

The dataset is based on the Survey on European Firms in a Global Economy carried out by GFK professional contractor. Survey data are integrated with balance sheet information derived from the AMADEUS repository, a database elaborated by Bureau Van Dijk. The survey covers about 3000 firms for each large European country of the survey (France, Germany, Italy, Spain and the UK) and around 500 companies for each small country of the survey (Austria and Hungary).

The EFIGE dataset allows to analyze the relationship between export intensity and firms' vertical integration. In particular, survey data provide details on firms' exporting activity and they allow to identify exporters in 2008 as well as to account for their export intensity. On average, 53% of firms in EFIGE exported in 2008 (with small differences across countries). In particular, as shown in Table 1 the share of exporters is slightly lower than the average of the sample in Germany, France, Hungary and Spain. The export intensity of exporters (*expint*), defined as the ratio of firms' export sales over turnover, is on average about 32%. Exporting firms characterized by higher average value of export intensity are in Austria, Hungary and Italy.

Table 1: Exporting activity in EFIGE countries. Year 2008

EFIGE countries	Exporters	Export Intensity
Austria	58%	43%
France	48%	30%
Germany	45%	31%
Hungary	51%	47%
Italy	65%	36%
Spain	50%	27%
UK	59%	30%

Note. Second column shows the percentage of exporters (with respect to the total number of firms) in each country in 2008; third column displays the average export intensity of exporting firms in each country in 2008.

Combining balance sheet data and information from the survey, the EFIGE dataset allows to measure firms' vertical structure. As suggested by Adelman (1955), we proxy the degree of vertical integration within a firm in 2008 with the ratio between added value and turnover in 2008. Where added value accounts for profits, depreciation, taxation, interests paid and cost of employees; while turnover is defined as total operating revenues (including net sales, other operating revenues and stock variations). In line with the existing empirical literature the degree of firms' vertical integration for firms included in the EFIGE dataset is around 0.36; as shown in Table 2, firms in France and Spain have a more vertical integrated structure than firms in the other EFIGE countries. Differences across countries, in terms of vertical structure, might be at least partially explained by the fact that data on firms' vertical structure are scant for firms in Austria, Germany and the UK. For these countries the measure of vertical integration is available only for the 6%, 18% and 14% of firms in the sample, respectively. Contrarily, the share of firms with information on the degree of vertical integration in France, Hungary, Italy and Spain ranges between 60% and 92%.

As shown in Table 3, with the exception for Austria and Manufacture of tobacco products sector (sector 12 NACE Rev. 2), the vertical integration measure is available for firms operating in all manufacturing sectors. Looking at the whole EFIGE sample (last column of Table 3), firms show, on average, higher level of vertical integration in the following sectors: Manufacture of wearing apparel (sector 14 NACE Rev. 2), Printing and reproduction of recorded media (sector 18 NACE Rev. 2), Manufacture of basic pharmaceutical products and pharmaceutical preparations (sector 21 NACE Rev. 2), Manufacture of fabricated metal products, except machinery and equipment (sector 25 NACE Rev. 2), Manufacture of computer, electronic and optical products (sector 26 NACE Rev. 2) and Manufacture of other transport equipment(sector 30 NACE Rev.2).[3] However, among these sectors, looking at each EFIGE

[3]Firms operating in these sectors show higher values of the degree of vertical integration than the average of the whole sample.

Table 2: Vertical integration in EFIGE countries. Year 2008

EFIGE countries	Vertical Integration
Austria	0.28
France	0.40
Germany	0.33
Hungary	0.31
Italy	0.31
Spain	0.39
UK	0.32

Note. For each country, we show the average value of the degree of vertical integration in 2008.

country,(with the exception of Austria), only in sectors NACE Rev. 2 18 (Printing and reproduction of recorded media) and 25 (Manufacture of fabricated metal products, except machinery and equipment) firms shows,on average in all countries, values of the degree of vertical integration higher that average of the whole sample. Thus, differences in terms of firms' vertical structure between EFIGE countries seems to mainly depend on country specific characteristics; while sectoral specific characteristics and firms sectoral distributions seems to only partially explain differences between firms in EFIGE countries.

Table 3: Vertical structure in EFIGE countries by sectors. Year 2008

NAVE Rev 2	Austria	France	Germany	Hungary	Italy	Spain	UK	all countries
10	.	0.33	0.20	0.27	0.20	0.31	0.28	0.28
11	.	0.21	0.26	0.26	0.25	0.36	0.35	0.27
12	.	.	.	.	.	0.47	.	0.47
13	0.16	0.41	0.36	0.32	0.31	0.38	0.246	0.35
14	0.25	0.53	0.21	0.46	0.37	0.52	0.16	0.43
15	.	0.43	.	0.26	0.27	0.39	.	0.33
16	0.35	0.35	0.29	0.18	0.30	0.37	0.24	0.34
17	0.25	0.31	0.30	0.25	0.26	0.32	0.28	0.29
18	0.25	0.44	0.48	0.36	0.36	0.50	0.40	0.43
19	.	0.28	0.28	.	0.18	.	0.22	0.22
20	.	0.34	0.34	0.25	0.26	0.31	0.24	0.30
21	.	0.38	0.44	.	0.35	0.45	0.43	0.40
22	0.33	0.16	0.29	0.30	0.29	0.39	0.36	0.35
23	.	0.41	0.29	0.30	0.32	0.34	0.29	0.35
24	0.20	0.32	0.29	0.16	0.23	0.31	0.29	0.28
25	0.27	0.45	0.37	0.38	0.36	0.44	0.41	0.42
26	0.35	0.42	0.35	0.29	0.39	0.44	0.41	0.41
27	0.56	0.38	0.379	0.33	0.34	0.37	0.33	0.36
28	0.35	0.35	0.36	0.32	0.31	0.41	0.30	0.35
29	.	0.31	0.32	0.26	0.28	0.34	0.29	0.31
30	0.52	0.44	0.22	.	0.35	0.47	0.18	0.41
31	.	.	0.31	0.31	0.27	0.41	0.45	0.36
32	0.22	0.42	0.34	0.43	0.31	0.37	0.34	0.35
33	.	.	0.34	0.37	0.35	0.51	0.62	0.32

Note. Each column shows the average value of the degree of vertical integration for each 2-digit manufacturing NACE Rev 2 sector, in each country, in 2008. The last column refers to the whole EFIGE sample.

In line with predictions from the theoretical model on the relationship between firms' exporting activity and their vertical structure, data suggest that, on average, non-exporters exhibit a higher degree of vertical integration than exporting firms (0.40 vs 0.33). However, there are some differences across countries. In particular, as shown in Table 4, there are only small differences between non-exporters and exporters, in terms of their vertical structure, in Germany, Hungary and the UK. Contrarily, in Austria, Italy, France and Spain there are relevant differences between the vertical structure of non-exporters and exporting firms.

In order to empirically test the theoretical model described in the previous sections, for each country and 2-digit NACE rev 2 manufacturing sector, we estimate the following equations:

$$q^H_{i,t,j,H} =$$

Table 4: Trade and Vertical Integration in EFIGE countries. Year 2008

	Vertical Integration	
EFIGE countries	Non_exporters	Exporters
Austria	0.33	0.26
France	0.43	0.37
Germany	0.33	0.33
Hungary	0.32	0.31
Italy	0.36	0.29
Spain	0.42	0.36
UK	0.34	0.32

Note. First (second) column shows the average value of the degree of vertical integration for non-exporters (exporters) in EFIGE dataset in 2008.

$$\alpha + \beta_1 A^H_{t,j,H} + \beta_2 C^{H,W}_{t,j,H} + \beta_3 \Gamma^H_{t,j,H} + \beta_4 \gamma_{i,t,j,H} + \beta_5 c_{i,t,j,H} + u_{i,t} \quad (18)$$

$$q^W_{i,t,j,H} =$$

$$\alpha + \beta_1 A^W_{t,j,H} + \beta_2 C^{W,H}_{t,j,W} + \beta_3 \Gamma^W_{t,j,W} + \beta_4 \gamma_{i,t,j,H} + \beta_5 c_{i,t,j,H} + u_{i,t} \quad (19)$$

where H denotes home country and W foreign countries. i identifies firm, t year (2008) and j refers to 2-digit NACE rev 2 manufacturing sectors.

The dependent variables, in equations 18 and 19, are proxies for the quantity that firm i in home country produces in sector j for the domestic market ($q^H_{i,t,j,H}$) and the corresponding quantity that the same firm produces for the foreign market ($q^W_{i,t,j,h}$). The two measures as shown below, respectively:

$$q^H_{i,t,j,H} = turn_{i,t,j,H} * (1 - expint_{i,t,j,H}); \quad (20)$$

$$q^W_{i,t,j,h} = turn_{i,t,j,H} * expint_{i,t,j,H} \quad (21)$$

We use firm' sales on domestic market, measured as turnover multiplied by 1 minus export intensity, and export sales, measured as turnover multiplied by export intensity, as proxies for $q^H_{i,t,j,H}$ and $q^W_{i,t,j,h}$, respectively.

We identify sectoral variables with capital letters, while we use lowercase letters for firm level data. The explanatory variables at firm level are $\gamma_{i,t,j,H}$ and $c_{i,t,j,H}$. The explanatory variable that we are mostly interested in consist of the firm' level of vertical disintegration ($\gamma_{i,t,j,H}$). As we mentioned above, we proxy the firm' vertical structure with the ratio of firm' added value over its turnover and we compute the degree of vertical disintegration as $1 - VI_{i,t,j,H}$. Moreover, we include the cost of production at the firm level ($c_{i,t,j,H}$), which is computed as the inverse of firm i labour productivity ($\frac{1}{LP_{i,t,j,H}}$).[4]

As for the explanatory variables at the sectoral level we account for: $\Gamma^H_{t,j,H}$, $\Gamma^W_{t,j,W}$, $A^H_{t,j,H}$, $A^W_{t,j,H}$, $C^{H,W}_{t,j,H}$ and $C^{W,H}_{t,j,W}$, respectively.

In both the equations, we include the vertical structure of firms at the sectoral level in the national ($\Gamma^H_{t,j,H}$) and foreign ($\Gamma^W_{t,j,W}$) markets, respectively. Focusing on equation 18, we measure $\Gamma^H_{t,j,H}$ as the average value of the degree of vertical disintegration of firms in EFIGE operating in home country (H) and sector j; while $\Gamma^W_{t,j,W}$, in equation 19, is the average value of vertical disintegration of firms in EFIGE operating in foreign countries (W) and sector j. We only focus on trade (import and export) among the seven countries included in the EFIGE dataset (Austria, France, Germany, Hungary, Italy, Spain and the UK). This choice might be a limitation in this work. However, as shown in Table 5, for each country, trade with other EFIGE countries in 2008 accounts on average for more than 40% of both total imports and total export (around 60% of import and export with other 28 EU countries,

[4]We measure firm' labour productivity as the ratio between firm' added value and number of employees.

respectively), respectively. Our strategy to limit the analysis to trade among the EFIGE countries might lead to an underrepresentation of both import and export for Germany and the UK. Indeed, in these countries trade with other EFIGE countries only cover about the 30% of total trade (around 50% of trade with other 28 EU countries). The decision to focus on trade between EFIGE countries is related to the necessity to identify an accurate measure of the degree of vertical disintegration for all countries included in the model. Indeed, by considering worldwide trade, we would find difficulties in identifying average value of the degree of vertical disintegration at the sectoral level for all foreign countries.

Table 5: Trade between EFIGE countries. Year 2008

	IMPORTS		EXPORTS	
EFIGE countries	Total	28 EU	Total	28EU
Austria	62.51	76.62	48.91	66.41
France	43.55	57.67	40.47	62.84
Germany	29.85	43.72	34.92	51.35
Hungary	51.32	61.36	48.22	57.34
Italy	38.95	60.20	38.96	64.12
Spain	45.23	65.15	40.97	61.52
UK	28.35	49.90	27.12	45.50

Note. Elaboration of Comext-Eurostat data for year 2008. Second and third (fourth and fifth) columns show, for each country, the share of imports (exports) with respect to total imports (total exports) and with respect to import from (exports to) 28 EU countries.

In the equations 18 and 19 we account for the dimension of the national and foreign markets, respectively. We measure the dimension of national market at the sectoral level, for each country in year 2008, as follow:

$$A^{H}_{t,j,H} = \sum_{i=1}^{N_j} turn_{i,t,j,H}(1 - expint_{i,t,j,H}) + TOT\_IMPORT_{t,j,H} * \Lambda_{t,j,H} \quad (22)$$

where N_j is the total number of firms in home country (H) and sector j included in the EFIGE dataset. Moreover, considering data at sectoral level, $TOT\_IMPORT_{t,j,H}$ is the total values of import of country H from all EFIGE countries and $\Lambda_{t,j,H}$ is the relative importance of imports in country H, sector j, with respect to the value of production sold in the national market.

We proxy the dimension of the foreign market as the weighted average dimension of foreign EFIGE markets. We consider as weights both the importance of each foreign market, with respect to total exports of home country and sector j, and the distance between the home country and each foreign EFIGE country. Thus we compute the average dimension of the foreign market as follows:

$$A^{W}_{t,j,H} = \sum_{c=1}^{6} (A^{Wc}_{t,j,H} * \mathrm{H\_}Wc_{t,j,H} * t\_Wc\_h)/6 \quad (23)$$

where $A^{Wc}_{t,j,H}$ is the dimension of each foreign EFIGE country (computed as in equation 22), $\mathrm{H\_}Wc_{t,j,H}$ is the share of exports from home country (H, in sector j) to each foreign EFIGE country (Wc, c varies from 1 to 6)[5], and t_Wc_h is an index which accounts for the geographical distance between the country H (home) and each foreign EFIGE country.

In order to account for production costs of national and foreign competitors, we include among regressors $C^{H,W}_{t,j,H}$ and $C^{W,H}_{t,j,W}$, in equations 18 and 19, respectively. In particular, focusing on equation 18, we proxy $C^{H,W}_{t,j,H}$ with the weighted average of the inverse of labour productivity for the home country and the EFIGE partners from which the home country import, at the sectoral level.[6] We consider as

[5] The sum of all $\mathrm{H\_}Wc_{t,j,H}$, with c that ranges from 1 to 6, is equal to one.

[6] Coherently with what we did for firms'level data, we measure productivity at the sectoral level as the ratio between added value and employees.

weights both the importance of each foreign market, in terms of imports, with respect to total imports of home country and sector j ($\Theta\_Wc_{t,j,H}$),[7] and the relative importance of total import and production for the national market in the home country ($\Lambda_{t,j,H}$ and $1-\Lambda_{t,j,H}$, respectively). Thus, we compute the average production cost in home country as follows:

$$C_{t,j,H}^{H,W} = (1-\Lambda_{t,j,H}) * \frac{1}{LP_{t,j,H}} + \Lambda_{t,j,H} * \sum_{c=1}^{6} \left(\frac{1}{LP_{t,j,Wc}} * \Theta\_Wc_{t,j,H} \right) \tag{24}$$

Looking at the production costs in the foreign markets, in equation 19, we proxy $C_{t,j,W}^{H,W}$ with the weighted average of the inverse of labour productivity for the home country and the EFIGE partners in which the home country export, at the sectoral level. We consider as weights the importance of each foreign markets, with respect to total exports from home country and sector j ($\mathrm{H}\_Wc_{t,j,H}$).[8] Thus, we compute the average production cost in foreign country as follows:

$$\mathrm{C}_{t,j,W}^{W,H} = \frac{1}{LP_{t,j,H}} + \sum_{c=1}^{6} \left(\frac{1}{LP_{t,j,Wc}} * \mathrm{H}\_Wc_{t,j,H} \right)$$

(25)

Having information on exporting activity only for the year 2008, we have to perform the econometric analysis resorting to cross-section techniques. Thus, we estimate the two equations 18 and 19 at the sector-country level by applying OLS with robust standard errors. Moreover, in order to empirically test the validity of the theoretical model presented in the previous sections, we only consider firms that both sell their production in the national markets and export.

4 Extensions of the theoretical model

So far, we have implicitly assumed that firms can sustain the fixed costs of producing, outsourcing and exporting. However, depending on their level of efficiency, firms might be able to start-perform some or all these three activities (assuming that to start the export activity you first should start producing for the domestic market). Our aim is to study the role of the fixed costs to find different efficiency thresholds. Namely, if you are efficient enough to enter the market but you cannot afford the fixed cost of export, then $q_h^W = 0$ and, in turn, outsourcing is twice as expensive as insourcing $\pi_h = p^H q_h^H - c_h (1-\gamma_h) \left(q_h^H\right) - \gamma_h \left(q_h^H\right) c_h (1+1) - G\frac{(1-\gamma_h)^2}{2} - F - F_{ex} = p^H q_h^H - c_h q_h^H (\gamma_h + 1) - G\frac{(1-\gamma_h)^2}{2} - F - F_{ex}$. The incentive to make (partial) outsourcing decreases. Indeed, profits are decreasing in the firm own marginal cost c_h (indeed, as c_h increases, *ceteris paribus*, it becomes more costly to produce (both in-house and outsourcing). We can call c_h a level of inefficiency. So that there will be an upper bound for c_h, say $\bar{c}_h$ such that $\pi_h(\bar{c}_h) = 0$. So that firms characterized by $c_h > \bar{c}_h$ do not enter the market.

Moreover, and related to the above point, outsourcing in the domestic rather than in the foreign market are quite different strategies. A further aim is to extend the theoretical model by distinguishing between the degree of vertical disintegration abroad or in the domestic market (or, equivalently, vertical integration at home or vertical integration in the foreign market, i.e., FDI). In particular, what we aim to add to existing contributions, comes from the observation that when firms export they usually procure some inputs in the foreign country of destination. To say the least they buy commercial services to deliver the goods to the final buyers. In many cases, the amount of inputs bought in the foreign country goes beyond this minimum threshold. For instance, products have to be most of the times country customized and this task may be accomplished only buying local inputs. Secondly, by buying local inputs a foreign firm may be able to appease country authorities who may ease custom and control red tape. Indeed, some country may have Local Content Requirements (LCRs) that compel foreign

[7] The sum of all $\Theta\_Wc_{t,j,H}$, with c that ranges from 1 to 6, is equal to one.

[8] As in equation 23, the sum of all $\mathrm{H}\_Wc_{t,j,H}$, with c that ranges from 1 to 6, is equal to one.

firms to source a certain amount of inputs in the country of destination of exports. These practices are sometimes banned and partly tolerated under specific circumstances waivers by the WTO, such as country security, or safeguard clauses. Finally, local producers may be able to provide cheaper and good quality inputs. These opportunities are not well known before exporting to a specific country making for exporting as a stimulus of international outsourcing. As for the existing contributions, Tomiura (2007) examines manufacturing firms of many sizes in Japan finding that only a small percentage export, adopt outsourcing and/or carry out foreign direct investments. Outsourcing is used by firms less capital intensive and less efficient than those undertaking FDI. In a similar vein, in an empirical paper based on data on Italian firms Federico (2010) establishes an efficiency ranking in terms of productivity where firms adopting FDI are at the top, followed by vertically integrated enterprises, then by those doing international outsourcing and, finally, firms confined to domestic outsourcing. Kohler and Smolka (2014) reach a similar conclusion on a sample of Spanish manufacturers. Opening has generated an expansion of trade, due, not only to final goods, but also to the increased exchange of intermediates. In a recent paper Monarch, Park and Sivadasan (2017) use a data set of foreign outsourcing cases matching Trade Adjustment Assistance (TAA) program petition data with U.S. Census Bureau firm level data. They discover that the "*average offshoring firm in the TAA sample is larger, more productive, older, and more likely to be an exporter, than the average non-offshorer. After initiating offshoring, TAA-certified offshorers experience large declines in employment (0.38 log points), output (0.33log points) and capital (0.25log points), and a concomitant increase in capital and skill intensity, relative to their industry peers [...] no significant change in average wages or productivity measures [...] the substitution of domestic activity by offshoring is stronger for relatively lower wage, lower capital intensity, lower productivity offshorers.*" (Monarcha, Parkb and Sivadasan, 2017 p. 150). Fenga, Lie and Swensonc (2016) go through the effect of foreign outsourcing on export performance on a sample of Chinese manufacturing firms. A higher level of foreign outsourcing leads to higher export levels. Moreover, outsourcing inputs from advanced high income countries boosts exports in more sophisticated markets. Then, there seems to be a link between specificity of inputs produced by countries and ability to export to these markets by firms using a few local inputs. Leahy and Montagna (2016) theoretically show, in an oligopoly framework, that higher competitive pressure due to trade opening leads firms to adopt more outsourcing, again seen as an alternative to FDI.

Finally, we aim at extending the model to several geographical areas. Indeed, for the time being, we consider a world made of two areas, however, it is clearly different to export, say, to a country of the EU rather than to Canada, both in terms of variable and fixed trade costs.

5 Appendix

5.1 Second stage

Summing up the N_H reaction curves in country (market) H, and using the fact that $\sum_{h=1}^{N_H} Q_H^{H-h} = (N_H - 1)\sum_{h=1}^{N_H} q_h^H \equiv (N_H - 1)Q_H^H$, gives the total quantity produced.

$$\begin{aligned}
Q_H^H &= \sum_{h=1}^{N_H} q_h^H = \frac{1}{2}\left(\sum_{h=1}^{N_H} a^H - \sum_{h=1}^{N_H} c_h\left(1+\gamma_h\right) - \sum_{h=1}^{N_H} Q_H^{H-h} - t\sum_{h=1}^{N_H} Q_W^H\right) \\
&= \frac{1}{2}\left(N_H a^H - C_H - \Gamma_H - \left(N_H - 1\right) Q_H^H - tN_H Q_W^H\right)
\end{aligned}$$

where

$$C_H = \sum_{h=1}^{N_H} c_h \text{ and } \Gamma_H = \sum_{h=1}^{N_H} c_h\gamma_h$$

and

$$\begin{aligned}
Q_H^W &= \sum_{h=1}^{N_H} q_h^W = \frac{1}{2t}\left(\sum_{h=1}^{N_H} a^W - \frac{\sum_{h=1}^{N_H} c_h}{t} - \sum_{h=1}^{N_H} Q_W^W - t\sum_{h=1}^{N_H} Q_H^{W-h}\right) \\
&= \frac{1}{2t}\left(N_H a^W - \frac{C_H}{t} - \left(N_H\right) Q_W^W - t\left(N_H - 1\right) Q_H^W\right)
\end{aligned}$$

Solving for Q_H^H and Q_W^H:

$$\begin{aligned}
Q_H^H &= \frac{N_H a^H t - t\left(N_W + 1\right)\left(C_H + \Gamma_H\right) + N_W C_W}{t\left(N_W + N_H + 1\right)} \\
Q_W^H &= \frac{a^H N_W t - C_W\left(N_H + 1\right) + \left(C_H + \Gamma_H\right) N_W t}{t^2\left(N_W + N_H + 1\right)}
\end{aligned}$$

Substituting Q_W^H and Q_H^H into the reaction functions (7 and 8), we find the second stage equilibrium quantities (9) and (10).

5.2 First stage

Given (12), from (9), we get:

$$-2\left(\left(\frac{a^H t + C_W + t\left(C_H + \Gamma_H\right)}{t\left(N_W + N_H + 1\right)}\right) - c_h\left(1+\gamma_h\right)\right)\left(\frac{\left(N_H + N_W\right) c_h}{N_W + N_H + 1}\right) + G - G\gamma_h = 0.$$

From this equation we derive γ_h as follows (in other to have it as a function of Γ_H)

$$\gamma_h = A_h - B_h\Gamma_H \tag{26}$$

where

$$\begin{aligned}
A_h &\equiv \frac{-2\left(\left(N_H + N_W\right) c_h\right)\left(\frac{a^H t + C_W + tC_H}{t\left(N_W + N_H + 1\right)}\right) + 2\left(N_H + N_W\right)\left(c_h\right)^2 + \left(N_W + N_H + 1\right) G}{\left(N_W + N_H + 1\right) G - 2\left(N_H + N_W\right)\left(c_h\right)^2} \\
B_h &\equiv \left(\frac{2\left(N_H + N_W\right) c_h}{\left(N_W + N_H + 1\right)\left[\left(N_W + N_H + 1\right) G - 2\left(N_H + N_W\right)\left(c_h\right)^2\right]}\right)
\end{aligned}$$

Multiplying equation (26) for c_h and summing up for the N_H firms we find:

$$\begin{aligned}
\sum_{h=1}^{N_H} c_h\gamma_h &= \sum_{h=1}^{N_H} c_h A_h - \sum_{h=1}^{N_H} c_h B_h \sum_{h=1}^{N_H} c_h\gamma_h \\
\Gamma_H &= \sum_{h=1}^{N_H} c_h A_h - \sum_{h=1}^{N_H} c_h B_h \Gamma_H \\
\Gamma_H &= \frac{\sum_{h=1}^{N_H} c_h A_h}{\left(1 + \sum_{h=1}^{N_H} c_h B_h\right)} \qquad (27)
\end{aligned}$$

Substituting (27) into (26) we obtain the optimal γ_h as defined in (13).

Call

$$\Gamma_H^{-h} = \sum_{j \neq h} c_j \gamma_j$$

$$-2\left(\left(\frac{a^H t + C_W + t\left(C_H + \Gamma_H^{-h}\right) + tc_h\gamma_h}{t\left(N_W + N_H + 1\right)}\right) - c_h\left(1+\gamma_h\right)\right)\left(\frac{\left(N_H + N_W\right)c_h}{\left(N_W + N_H + 1\right)}\right)$$
$$+G - G\gamma_h = 0$$
$$\frac{a^H t + C_W + t\left(C_H + \Gamma_H^{-h}\right) + tc_h\gamma_h}{t\left(N_W + N_H + 1\right)} - c_h\left(1+\gamma_h\right) - \left(\frac{N_W + N_H + 1}{2\left(N_H + N_W\right)c_h}\right)G$$
$$+\left(\frac{N_W + N_H + 1}{2\left(N_H + N_W\right)c_h}\right)G\gamma_h = 0$$
$$\frac{a^H t + C_W + t\left(C_H + \Gamma_H^{-h}\right)}{t\left(N_W + N_H + 1\right)} - c_h - \left(\frac{N_W + N_H + 1}{2\left(N_H + N_W\right)c_h}\right)G$$
$$+\left(\frac{c_h}{\left(N_W + N_H + 1\right)} - c_h + \left(\frac{N_W + N_H + 1}{2\left(N_W + N_H\right)c_h}\right)G\right)\gamma_h = 0$$

$$\frac{2\left(N_W + N_H\right)c_h\left[a^H t + C_W + t\left(C_H + \Gamma_H^{-h}\right) - c_h t\left(N_W + N_H + 1\right)\right] - t\left(N_W + N_H + 1\right)^2 G}{t\left(N_W + N_H + 1\right)2\left(N_W + N_H\right)c_h}$$
$$+\left(\frac{-2\left(c_h\right)^2\left(N_W + N_H\right)^2 + \left(N_W + N_H + 1\right)^2 G}{2\left(N_W + N_H + 1\right)\left(N_W + N_H\right)c_h}\right)\gamma_h = 0$$

$$\gamma_h = \frac{-2\left(N_W + N_H\right)c_h\left[a^H + \left(C_H + \Gamma_H^{-h}\right) - c_h\left(N_W + N_H + 1\right) + \frac{C_W}{t}\right] + \left(N_W + N_H + 1\right)^2 G}{\left(N_W + N_H + 1\right)^2 G - 2\left(c_h\right)^2\left(N_W + N_H\right)^2} \quad (28)$$

Notice that this is a reaction function (γ_h is a negative function of Γ_H^{-h})

5.3 EFIGE dataset

Table 6: 2 digit NACE Rev. 2 sectors

NACE Rev. 2 codes	Definitions
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
31	Manufacture of furniture
32	Other manufacturing
33	Repair and installation of machinery and equipment

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FIGURES

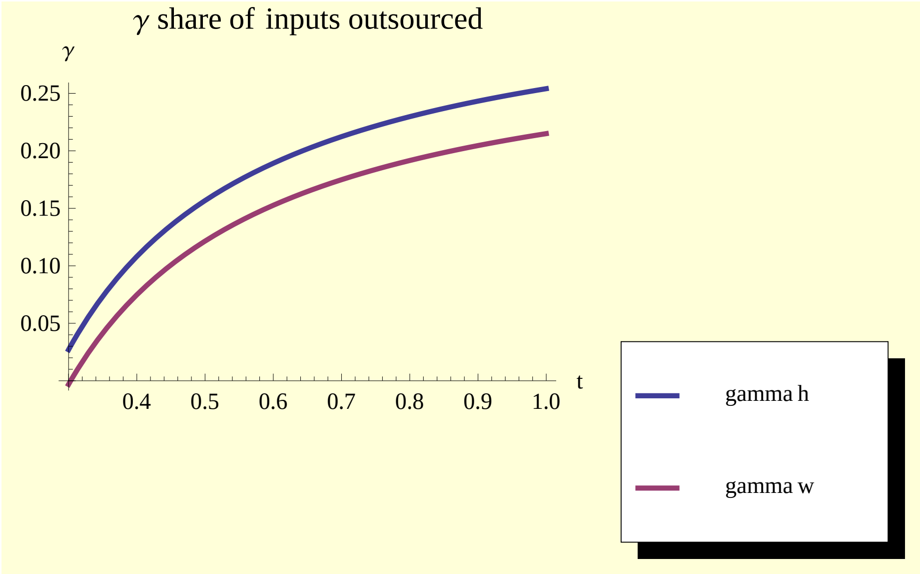

Figure 1: share of input outsourced

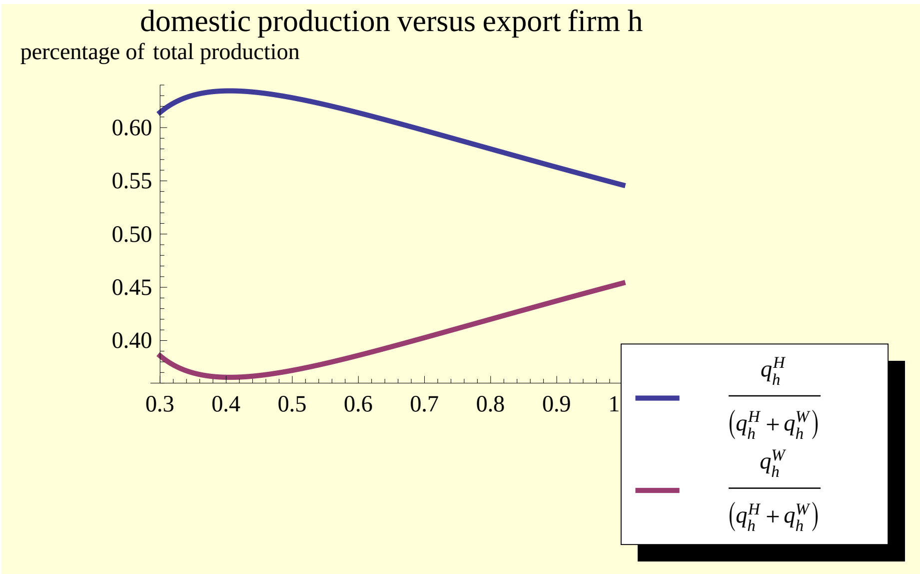

Figure 2: domestic and export of home firm

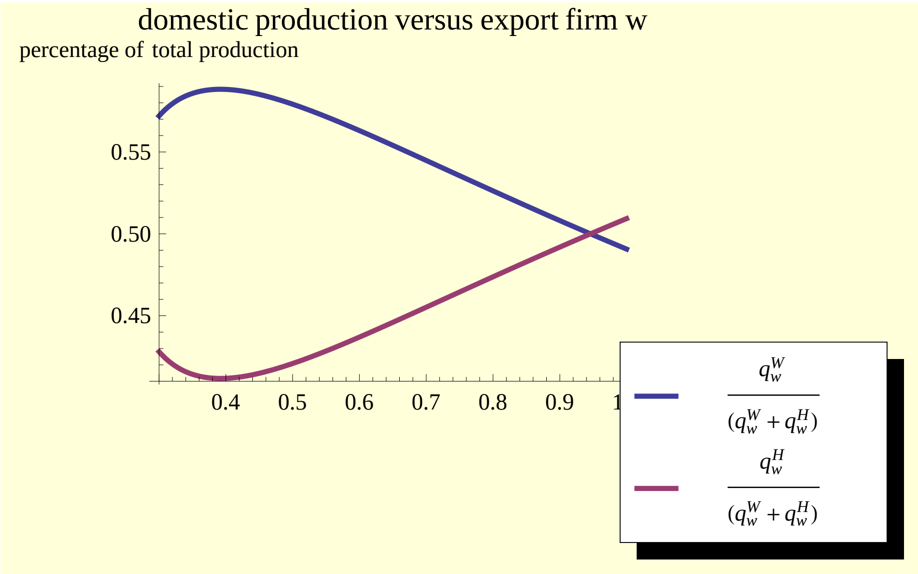

Figure 3: domestic and export of foreign firm

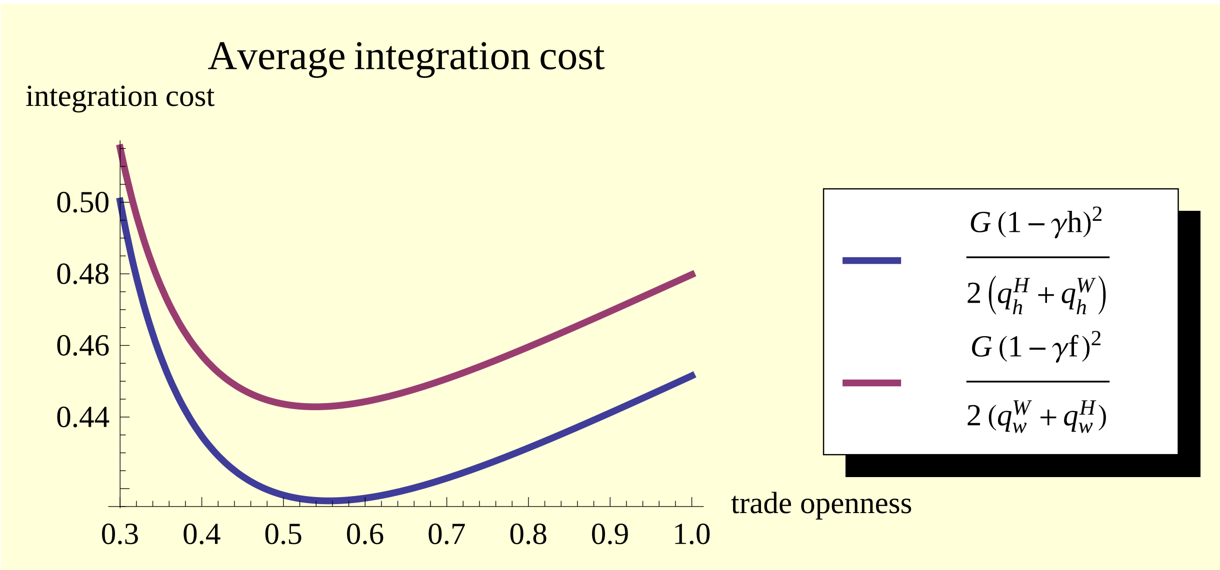

Figure 4: Average integration cost