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Firm heterogeneity and the integration trilemma: The utility of Joint ventures in integration versus outsourcing models.

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Firm heterogeneity and the integration trilemma: The utility of Joint ventures in integration versus outsourcing models.

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Abstract

The traditional Grossman-Hart-Moore (GHM) property right theory of the firm does not consider shared ownership as an optimal solution because of the incentive loss it would be responsible for.

This paper examines the rationale for specific cases of shared ownership: International Joint Ventures (JVs), with heterogeneous firms in various host-countries.

Specifically, we built a theoretical model that extends the Antràs & Helpman (2008) integration dilemma under partially incomplete contracts to international joint-ventures. These turn to be the optimal ownership structure in two different cases. Specifically, for medium-productive firms when the most productive would opt for full integration. More interestingly JVs turns to be the optimal ownership choice, even for most productive firms in countries with lower quality of contractual institutions.

The model insists then on the interaction between firm-level and country-level parameters, with higher productivity giving increasing access to higher ownership share in countries with stronger contractual enforceability.

Keywords : Property Right Theory; Asset Ownership; Shared Ownership; International Joint Ventures.
JEL codes : D23 ; L24

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1 Introduction

International joint-ventures are a widespread practice among multinational enterprises (MNEs). For French firms, around 46% of them are engaged in such an arrangement in 2011 according to the LiFi survey. Yet, investigating international Joint Ventures (JVs) is a continuing concern within mainstream approaches to international trade, mainly based on the Property Right Theory (PRT) of the firm, which rule out shared ownership as a sub-optimal arrangement, because of the net investments incentives loss it would be responsible for (see Gattai and Natale (2015); Holmstrom (1999)).

Assuming the foreign ownership share to be actually a crucial choice in expansion strategies of MNEs, with deep consequences, this paper investigates the role of firm heterogeneity in foreign ownership. More specifically, we focus on its interaction with host countries' contractual institutions.

The mainstream approach of the international integration issue is the "global sourcing" line of models, mostly develops by Pol Antras (Antràs, 2014; Antràs and Helpman, 2004, 2008), which deepens the PRT conception with the inclusion of firm heterogeneity to investigate differences in integration choices within-industry. Because of its PRT fundations, it doesn't consider shared ownership as a possible ownership structure, as it would virtually give null disagreement payoffs because no one has the residual rights over the totality of the firm's assets[1].

Among subsequent work, Cui (2011) differs a little from traditional PRT assumptions on the investments characteristics to allow partial ownership and international joint-ventures, and found vertical integration -either through JV or full integration- to be associated with greater productivity of the parent firm. Another recent extension, close to Antràs and Helpman (2008) model, would be Eppinger and Kukharskyy (2017). They investigate the role of countries' contractual institutions into the optimal ownership share within joint-venture. Moreover, they interact it with the intensity of input's relationship-specificity defined as an industry-level parameter. Yet the first article doesn't allow for partially incomplete contracts, which prevents to investigate the role of varying host-countries' contractual institutions, while the latter doesn't

[1] Throughout this paper, *disagreement payoffs* refer to the revenue the party could obtain outside the relationship once its investments made (*ex-post*, in case of bargaining failure). *Outside option* refer to *ex-ante* revenue the party could chose instead of engaging into the relationship.

consider firms' productivity heterogeneity.

This paper aims at reconsidering joint-venture as a possible international integration solution. Our baseline is the Antràs and Helpman (2008) model, which insists on partial contractibilty. Yet, we add a mechanism of division of surplus in liquidation in case of shared ownership, when the two parties fail to reach an agreement. This mechanism ensures the two parties a disagreement payoff[2].

Removing the systematic suboptimality of shared ownership in PRT lines model, with heterogeneous firms and several host countries; our model leads to two conclusions. First, generally the most productive firms should reach higher foreign ownership shares, but also that this relationship's elasticity depends on host country contractual institutions. Specifically, the better the contractual enforcement, the more the firm productivity increases its foreign ownership share. Second, joint ventures dominate full integration in some destinations, even for top productive firms. This is a major difference from the few other works that have linked firm heterogeneity and ownership which never showed JV to be the best integration solution for all firms engaged in FDI. Moreover, as far as we know this is the first work interacting firm-level with host country parameters to investigate ownership share.

This paper is built as follows. In the second section I detail the conceptual background of our model, and its position regarding existing works. The third section details the game the two parties play. In section 4, I identify the ownership share that ensures the equilibrium within joint venture. In a fifth section, I compare the JV solution to outsourcing or full integration. The following section precises the role of the host-country in the optimal ownership structure to be chosen. The last section concludes and discuss our results.

2 Conceptual background

The standard Property Rights Theory (PRT) of the firm, also known as the GHM framework after the seminal contributions of Grossman and Hart (1986) Hart and Moore (1990) Hart (1995), has made significant progress in the understanding of Coase's 1937 interrogation about firm boundaries. Their central assumption is about contracts' incompleteness, which stresses what

[2]The introduction a this mechanism later detail is therefore Pareto optimal, such that no parties should be opposed to its application

has been known as the hold-up problem[3], and leads to under-investment. Because of incomplete contracts, ownership gives the owner access to residual rights over the use of the assets, i.e. she is free to use the assets at its own discretion when it comes to unforeseen contingencies. Hence, ownership is the only control arrangement that would affect ex-ante investments incentives. Ownership should thus be given to the partner whose input is more important in the final good production, to minimize the inefficiencies losses.

As noted by Antràs (2014), the incomplete contracts assumption fits particularly well with international contracts who carry greater uncertainty about their enforceability. This led the GHM approach to be adapted to an international background to focus on Foreign Direct Investments (FDI) versus outsourcing dilemma. This recent "global sourcing" line of research is led by Gene Grossman, Elhanan Helpman, and especially by Pol Antràs from Harvard university (Antràs, 2003, 2014; Antràs and Helpman, 2004, 2008; Grossman and Helpman, 2002).

The "global sourcing" line shares the PRT's conception of ownership as control[4]. Actually it opts for an even more restricted conception of ownership where *"ownership of physical assets (buildings, machines) is associated with ownership of the inputs that are produced with those assets"* as states Antràs (2014, p.126). Because of this narrow conception of ownership, joint-ventures fit awkwardly in those models and are rarely evoked. Actually in these frameworks shared ownership would correspond to shared residual rights, which is by definition impossible over the totality of the assets, since the two parties cannot both freely dispose of them all. In addition, since the inputs are valueless in the outside market in standard GHM, giving each party residual rights over only a fraction of the inputs is also suboptimal. Therefore, in traditional GHM and global sourcing, joint-ventures are merely evoked, and rapidly considered as suboptimal control arrangement in which neither party has the residual rights.

Hence, for joint-ventures to be an optimal control arrangement, one should step aside

[3]The hold-up problem refers to *ex-ante* inefficiencies on the level of non-contractible and relationship-specific investments engaged by the two parties. This leads both parties to under-invest.
Although the GHM approach faced severe critics on this points, notably by Maskin and Tirole (1999) who suggest that revelation mechanisms could be inserted in the initial contracts, to make information verifiable to third parties (and to courts). The range of this critic was such that Oliver Hart and John Moore developed a new approach of the theory of the firm based on contracts seen as "reference points" by the two parties. See Hart and Moore (2007, 2008) for the premises and Hart (2009) for a discussion over asset ownership in this new framework, which yet yields similar conclusion than original GHM framework. However, as underline Aghion and Holden (2011), these revelation mechanisms are seldomly used in practice, a statement that makes the critics lose most of its bite.

[4]As explicitly said by Grossman and Hart (1986): "We define a firm to consist of those assets that it owns or over which it has control; we do not distinguish between ownership and control and virtually define ownership as the power to exercise control."

from standard PRT assumptions. To our knowledge, only two papers explicitly inscribe in the line of Antràs and Helpman (2004, 2008) works, and try to make room for JV in a model in which crucial assumptions are still based on the GHM game. The first is Cui (2011), as noted by Gattai and Natale (2015), and we would add the recent contribution of Eppinger and Kukharskyy (2017) although the authors remove firm heterogeneity feature. Let's detail their contributions:

The theoretical model developed by Cui (2011) shares most of the GHM assumption, notably on ownership, still perceived as an access to assets (and to intermediate inputs for the final-good producer). However by assuming the non-contractible ex-ante investments to be not (entirely) in human assets but highly relationship-specific, it allows a mechanism providing disagreement payoffs to both parties in case of a bargaining failure: the division of surplus in liquidation. Already reported by Cai (2003) to be a common practice in the real-world, it assumes that when a bargaining failure occurs, the two parties jointly sell their inputs and each recover a share of the revenue equal to their ownership share in the common entity[5]. Hence, the disagreement payoff, and therefore the equilibrium revenue share, increase with ownership share. However, Cui (2011) embraces both joint-ventures and full ownership into "vertical integration" and his model does not conclude to any impact of firm heterogeneity on the ownership structure chosen within vertical integration, but only in the outsourcing versus integration dilemma.

The model of Eppinger and Kukharskyy (2017) is based on Antràs and Helpman (2008) contribution, with notably the use of the partial contractibility feature, which divides the initial contract between contractible tasks, and non contractible ones[6]. The lower the contractibility, the higher the hold-up problem, and the more incentives should be given to the intermediate supplier. As in GHM, ownership arrangements are the only tool to shift incentives, so that the degree of contractibility has a direct (positive) effect on the multinational ownership share. However, their model had to differ from Antràs and Helpman (2008) in the conception of inputs. Because in the baseline model, only full ownership or outsourcing were considered, the owner always recovered all intermediate inputs (but his efficiency in using them depends on the collaboration of the supplier). Yet, Eppinger and Kukharskyy (2017) assume the inputs to be divisible

[5]This practice assumes that inputs are (more) valuable when jointly sold, while relationship-specifity make these inputs' value close to zero when sold independently.

[6]The author therefore assume the inputs to be a continuum of inputs that can be divided at any points, whereas this assumption was absent from Antràs and Helpman (2008)

to fit with partial ownership. The final-good producer receives thus the contractible share of inputs plus its equity share of non contractible inputs. The authors had then to assume some outside value of inputs even when they are not all recovered. So they remove the assumption of a null value of inputs in the outside market, and instead value the intermediate inputs with regard to their degree of relationship-specificity.

Another intuition of them, is to interpret the contractibility degree as a country-level indicator of contractual institution quality. The key feature of their model is therefore to look at the interaction between this host-country institutional index and the relationship specificity of investments over the ownership share held by the MNE. They find a positive interaction, supported by a large worldwide empirical analysis, between relationship-specificity and institutional quality on the ownership share held by the foreign investor. Highly relationship-specific final-good producers face higher hold-up problem, and try to overcome it by integrating (more) their intermediate good supplier.

Table 1: Main models differences

Assumption	A&H 2004	A&H 2008	Cui 2011	E&K 2017
Partial ownership	No	No	Yes	Yes
Outsourcing vs Integration	Yes	Yes	Yes	No
Partial incomplete contracts	No	Yes	No	Yes
↪ for both inputs	-	Yes	-	No
Firm heterogeneity (in TFP)	Yes	Yes	Yes	No
Disag. payoffs from selling	outputs	outputs	outputs(I); inputs jointly(JV)	inputs separately
Disag. payoffs vary w/ ownership	Yes	Yes	Yes	Yes
Disag. payoffs vary w/ contractib.	-	No[7]	-	Yes
Up-front payment	Yes	Yes	Yes	No
owners. share = resid. rights share	-	-	No	Yes
TFP fosters FDI vs outsourcing	Yes	Yes	Yes	-
own. factors interact w/ institutions	No	No	No	Yes

A&H 2004 refers to Antràs and Helpman (2004); A&H 2008 to Antràs and Helpman (2008), and E&K 2017 to Eppinger and Kukharskyy (2017)

As reveals this short review of closely related works inspired by the GHM original game framework, there is room for another model which would embody heterogeneous firms as in Cui (2011), but would investigate the impact of firm heterogeneity over the choice of joint ventures over wholly owned subsidiaries (WOS). Moreover, with a similar inspiration as Eppinger and Kukharskyy (2017), but including firm heterogeneity, we aim at investigating whether contractual institutions influence this choice using partial contractibility from Antràs and Helpman (2008). Actually their findings comfort our investigation, since we could legitimately assume that more productive firms are engaged in more relationship-specific inputs, which would lead to a positive relationship between total factor productivity and higher foreign control.

Table 1 summarizes the differences between these four models' assumptions. Frames indicate the assumption we kept in this model. Dashes correspond to assumptions that are irrelevant in the models' premises.

In our model, we decided to merge the partially incomplete contract framework from Antràs and Helpman (2008), with a possible partial ownership, as done by Eppinger and Kukharskyy (2017), but including firm heterogeneity, and comparing joint-ventures to outsourcing and full integration. Moreover, we reject their conception of shared ownership and its repercussion on the disagreement payoffs, opting for the mechanism described in Cui (2011). Our model could thus also be seen as an extension of the latter to partially incomplete contracts, to study the role of host-country in organizational choices, and still very close to Antràs and Helpman (2008) baseline.

3 Basic set up

Consider a three countries world, one is referred as domestic (D) and two as foreign (a Western one W and another Eastern E), populated by a unit measure of consumers with identical preferences represented by:

$$U = q_0 + \frac{1}{\upsilon}\sum_{g=1}^{G} Q_g^{\upsilon} \quad , \qquad 0 < \upsilon < 1 \tag{1}$$

q_0 is the consumption of a homogeneous good. There are another G industries and Q_g is an index of aggregate consumption in industry g, which is a CES function.

$$Q_g = \Big[\int q_g(f)^{\alpha} df\Big]^{1/\alpha} \quad , \qquad 0 < \upsilon < \alpha < 1 \tag{2}$$

The elasticity of substitution between any two varieties in a given industry is $\frac{1}{1-\alpha}$, greater than unity. υ denotes inter-industry elasticity of substitution, and is supposed to be lower than α. Labour is the only production factor and is immobile between countries. International trade is free such that in equilibrium, the price of q_0 is the same in each country, and normalized to one. The productivity of producing q_0 is fixed in each country, and determines the wage level.

As labour allocation and wages are fixed, the labour income in each country is fixed as well. Utility maximization gives the inverse demand function as:

$$p_g(f) = Q_g^{\mu-\alpha} q_g(f)^{\alpha-1} \tag{3}$$

Where $p_g(f)$ is the market price of variety f. Henceforth, we drop industry and firm subscripts (g and f), for clarity purposes when detailing the production process under partial contractibility. Equation (3) could be rewritten:

$$q = Ap^{-1/(1-\alpha)} \tag{4}$$

With $A = Q^{\frac{\alpha-\mu}{1-\alpha}} > 0$, a demand shifter. This demand function yields the revenue

$$R = q^{\alpha} A^{(1-\alpha)} \tag{5}$$

The production of a final good q requires the cooperation of two types of producers: a final-good producer and a (manufacture) intermediate-good supplier. We assume that only domestic workers (from country D) have the know-how to produce final goods through their headquarter services h, but that intermediate goods m can only be produced by a manufacture supplier M, located in a foreign country (W or E) for natural endowment reasons. This assumption is a convenient tool to simultaneously explain why an agency problem between two producers rises, and to focus only on international transactions. Rather than focusing on the choice of country W over E, that the headquarters first face, we make trivial this decision, by assuming it exogenous and randomly distributed such that a share $0 < w < 1$ of firms chose to source in country W, and $(1 - w)$ in E. This way we only focus on the integration strategy of the headquarters, as done by Cui (2011). This integration strategy consists in choosing the ownership structure of the foreign supplier, between outsourcing, full integration, or any intermediate ownership share by H, within a joint-venture.

The production function of the final good combines both inputs using a Cobb-Douglas function:

$$q = \theta\Big(\frac{h}{\eta}\Big)^{\eta}\Big(\frac{m}{(1-\eta)}\Big)^{(1-\eta)} \quad , \qquad 0 < \eta < 1 \tag{6}$$

Following the contribution of Acemoglu, Antràs, and Helpman (2007), each of the two inputs is produced with a set of activities indexed by points on the interval [0, 1], according to the Cobb-Douglas production function

$$j = exp\Big[\int_0^1 \log\, x_j(i)di\Big], \quad j = h, m$$

where $x_j(i)$ is the investment in activity i for inputs $j = h, m$. Investments in activities are input-specific and can only be used to produce the input for which they were designed.

As in all Melitz (2003) like models, the θ parameter in the production function (6) corresponds to the firm's total factor productivity. It is worth noting that this firm-specific level of productivity affects the final-good production function but doesn't play a role in the investments payoffs. As in Antràs and Helpman (2008), more productive firms do not benefit from neither lower variable costs of investment c_j per unit x_j, $j = h, m$; nor from increased inputs production[8].

We further assume that an exogenous threshold $0 \leq \mu \leq 1$ exists for M's input activity, such that activities in the range $[0; \mu]$ are contractible *ex-ante*. Conversely, the set of activities in $]\mu; 1]$ is not contractible, in the sense that they cannot be fully specified in an *ex-ante* contract, or at least cannot be verified by third parties (courts), which makes the contract not enforceable *ex-post*[9]. As Eppinger and Kukharskyy (2017), we believe this degree of contractibility to reflect the legal system quality, and thus to vary across countries. Such that $\mu \equiv \mu_l$, with $l = W, E$, the location choice. Specifically, we assume $\mu_W > \mu_E$, corresponding to a higher legal enforcement of contracts in country W.

We summarize the timing of events in this game:

- In $t = 1$, H enters the industry , she draws a productivity level θ, and her country preferences, and then decides whether to exit the market or not. If she stays, she decides of her organizational structure.

- In $t = 2$ H offers a contract to a foreign manufacture supplier (M), which stipulates: (i) the organizational structure for the venture decided in $t = 1$; (ii) the supplier's required

[8]This assumption could be justified by assuming common investments of all firms in a given industry. However, it could be released without qualitative changes in the model predictions, as long as the productivity in intermediate inputs is positively correlated with H's TFP.

[9]For simplicity purposes we assume h to be fully non-contractible ex-ante, such that the partial (and varying) contractual incompleteness only affects m, as done by Eppinger and Kukharskyy (2017).

investments in the contractible activities $m_c \equiv exp\left[\int_0^{\mu_l} \log x_m(i)di\right]$, and (iii) an upfront payment of τ_m (positive or negative) from H to M. We assume M's outside option to be null.

- In $t = 3$, both parties invest in non-contractible activities and provide their amount of inputs.

- In $t = 4$, the parties bargain over the surplus from the relationship (or the "quasi-rent").

- In $t = 5$: If an agreement has been reached in $t = 4$ final goods are produced and sold, and the revenue is distributed across the parties. Otherwise, the two parties proceed to a division of surplus in liquidation as detailed above.

In the following section, we solve this game by backward induction.

4 Equilibrium within Joint-Ventures

In $t = 4$, the two parties find an agreement, because the result of this Nash-bargaining game gives each party its disagreement payoff plus a fraction of the quasi-rent $Q = (1 - \delta)R$. Where $0 < \delta < 1$ is the fraction of the final revenue recovered through selling jointly all inputs to another final-good producer during the liquidation instead of selling the final good. The fraction of this cooperation surplus the parties obtain corresponds to their bargaining power, assumed exogenous, such that H recovers a share βQ of this quasi rent, besides its disagreement payoffs, and M gets $(1 - \beta)Q$, with $0 < \beta < 1$ [10]

In $t = 3$, both parties simultaneously and non-cooperatively invest in their non-contractible activities. Each party anticipates the outcome of the forthcoming bargaining game, and chooses the amount of non-contractible activities that will maximize her payoff. Because we assumed all h to be non contractible, the final-good producer's problem is

[10]Cui (2011) and Eppinger and Kukharskyy (2017) both considered cases where β is endogenous, without notable change in their conclusions. It would also be the case here if firm-level β_i is positively correlated with the firms' total factor productivity (TFP) θ_i.

$$\max_{\{x_h(i)\}_{i=0}^{1}} \pi_H = s\delta R + \beta Q - c_h \int_0^1 x_h(i)di \ - \tau_m$$

The first term $s\delta R$ corresponds to its disagreement payoff, i.e. its revenue in case of liquidation, because s stands for the ownership share held by H. The second term corresponds to H's share of the quasi-rent.

Final-good producer program could be rewritten :

$$\max_{\{x_h(i)\}_{i=0}^{1}} \pi_H = \big(s\delta + \beta(1-\delta)\big)R - c_h \int_0^1 x_h(i)di - \tau_m \tag{7}$$

Following Antràs and Helpman (2004, 2008), we note β_h the final share of revenue that goes to the final-good producer, with here $\beta_h = (s\delta + \beta(1-\delta))$, from the division of surplus in liquidation mechanism.

From eq. (5) and (6), we find the amount of non contractible activities $h_n = exp[\int_0^1 logx_h(i)di]$:

$$h_n = \frac{1}{c_h}\ \eta\ \alpha\ R\ \beta_h \tag{8}$$

Meanwhile, M sets the amount of non-contractible activities to invest in, to maximize its own profit.

$$\max_{\{x_m(i)\}_{i=\mu}^{1}} \pi_M = (1-\beta_h)R - c_m \int_\mu^1 x_m(i)di + \tau_m$$

Whereby $(1-\beta_h)$ is the share of the revenue recovered by M and is equal to $(1-\beta_h) = \big(\delta(\beta - s) + (1-\beta)\big)$

The maximization program yields

$$m_n = \frac{1}{c_m}(1-\eta)\ \alpha\ R\ (1-\beta_h) \tag{9}$$

These two values are expressed as functions of revenue, which in turn could be rewritten using equations (6), (8) and (9) into equation (5)).

$$R = \Bigg([exp \int_0^{\mu} \ln\, x_m\ (i)\ di]^{\alpha\ (1-\eta)}\ (\frac{\delta\ (\beta - s) + (1-\beta)}{(1-\mu)\ c_m})^{\alpha\ (1-\mu)(1-\eta)}\ (1-\eta)^{-\alpha\ \mu(1-\eta)} \\ (\frac{\alpha\ (s\ \delta + \beta\ (1-\delta)}{c_h})^{\eta\ \alpha}\ \ A^{1-\alpha}\ \ \Bigg)^{\frac{1}{1-\alpha[1-\mu(1-\eta)]}} \tag{10}$$

From equations (8) and (9), we directly see that the ownership share determines the investments in the non-contractible activities. The higher its ownership share, the more the party will engage into non-contractible investments, because it limits the hold-up issue, by increasing the disagreement payoff.

Following Antràs and Helpman (2008), H specifies in the contract the investments in contractible activities that would maximize its own payoff $\beta_h R - c_h \int_0^1 x_h(i)di - \tau_m$. However, the final-good producer must consider the participation constraint of M. Since we assume no *ex-ante* outside options, this constraint is

$$(1-\beta_h)R - c_m \int_0^1 x_m(i)di + \tau_m \geq 0$$

Therefore, H satisfies this participation constraint by setting

$$(1-\beta_h)R - c_m \int_0^1 x_m(i)di = -\tau_m$$

We can substitute the result into the final-good producer's objective function. In $t = 2$ the final-good producer's choice of contractible investments is the solution to

$$\max_{\{x_m(i)\}_{i=0}^{\mu}} \pi_H = R - c_h \int_0^1 x_h(i)di - c_m \int_0^1 x_m(i)di - \tau_m \tag{11}$$

Using eq. (8), (9) and (10) into (11), we obtain:

$$m_c = \frac{\alpha\ \mu\ (1-\eta)}{c_m[\ 1 - \alpha\ (1 - \mu\ (1-\eta\ ))]}\ R \tag{12}$$

Now, combining eq. (9) and (12), we find the total investments done by M using $m \equiv (m_n)^{(1-\mu)}(m_c)^{\mu}$

$$m = \frac{(1-\eta)}{c_m} \alpha R (1-\beta_h)^{(1-\mu)} (\frac{\mu}{1-\alpha(1-\mu(1-\eta))})^{\mu} \tag{13}$$

Recall that all h's investments are non-contractible, such that $h \equiv h_n$, given in eq. (8).

Plugging these values of h and m (from equations (13) and (8) into eq. (6) and then into (5), we obtain the final expression of the total revenue, expressed as a function of the demand level, the firm productivity, M's and H's revenue shares, and the other fixed parameters from the model.

$$R = A \left[\theta^{\alpha} \alpha^{\alpha} (\frac{\eta}{c_h})^{\alpha\eta} (\frac{(1-\eta)}{c_m})^{\alpha(1-\eta)} \ \beta_h^{\alpha\eta} (1-\beta_h)^{\alpha(1-\eta)(1-\mu)} (\frac{\mu}{1-\alpha(1-\mu(1-\eta))})^{\mu\alpha(1-\eta)} \right]^{\frac{1}{1-\alpha}} \tag{14}$$

Eventually, in $t=1$, H chooses the optimal ownership share. As reminds Antràs (2014), given the existence of ex ante transfers, firms will agree on the ownership structure that maximizes the joint payoff of H and M.

The formal problem is therefore

$$\max_{s} \Pi = R(s) - c_h \int_0^1 x_h(i) di - c_m \int_0^1 x_m(i) di - \tau_m$$

From the first-order condition, we have :

$$\frac{\partial \Pi}{\partial s} = 0 \quad \Leftrightarrow \frac{\partial R(s)}{\partial s} = 0$$

which yields (calculus details are given in appendix A)

$$s^* = \beta - \frac{\beta}{\delta} + \frac{\eta}{\delta(\omega+\eta)} \tag{15}$$

Where, as in Antràs and Helpman (2008), $\omega = (1-\mu)(1-\eta)$, reflecting the importance of non-contractible investments activities of M in the final good.

Note that the optimal ownership share s^* is not bounded in [0;1], since $s^* < 0$ when $\frac{\eta}{\omega+\eta} < \beta(1-\delta)$, which could happen if η is low (or ω high). Conversely $s^* > 1$ arrives when $\beta + \frac{\eta}{\delta(\omega+\eta)} > 1 + \frac{\beta}{\delta}$, hence when η is high or ω low. As the real values s could take are bounded in $[0;1]$, we conclude this theoretical optimal ownership share isn't always reachable by foreign investors, and they would opt for the closest optimal ownership share to s^*.

Obvious partial derivations of (15) show the expected signs about s^* variation: it declines in ω, the importance of M's non contractible inputs, but rises in η, the final good intensity in headquarter services.

Interestingly, the optimal ownership share within JV is independent from the firms' productivity level, when no fixed costs are considered (or at least considered as independent from the ownership share), because there is no trade-off between fixed and variable costs. Therefore, the ownership allocation structure has no other role than maximizing the partners' incentives.

In the following subsection, we broaden the analysis to other organizational structures than JVs, namely outsourcing and full integration. Following Antràs and Helpman (2004, 2008), we assume each one to imply different levels of sunk costs. These fixed costs are non-continuous with the ownership share, although increasing in it, such that the fixed cost function isn't suited for differential calculus, as developed above[11]. Instead we simply compare the profit offered by each case.

5 Joint-Venture, Outsourcing and Integration.

Until now our model doesn't explicitly distinguish outsourcing and full integration from joint-venture, as if they would be only extreme JV cases. We have at least two reasons to reject this implicit assumption. The first lies on the liquidation mechanism detailed above, which is adapted for JV but not for sole ownership of one or the other party. Actually why would they keep on selling inputs jointly if one could assembly them all and sell the output? This issue is not addressed in Eppinger and Kukharskyy (2017). The second reason would be the fixed costs. As explained above, we assume different fixed costs for each ownership structure, such that a tradeoff may occur between increasing revenue share and fixed costs, whose solution is given by the firm's TFP.

Following Antràs and Helpman (2004, 2008), we first compare the revenue share that gives each integration solution, denoting it $\beta_{h,k}$, with $k = \{O, J, V\}$ (O, and V respectively indicate Outsourcing and (full) Vertical integration, J stands for Joint-Venture).

In this model, we assumed that under joint venture, the two parties proceed to a division of

[11] Actually, when assuming fixed costs to be differentiable in ownership share s, we fail to determine the optimal ownership share s^*. See appendix A for more details.

surplus in liquidation if the bargaining in $t = 4$ fails[12]. The disagreement payoff of H being $s\ \delta R$, the solution of the Nash bargaining game for H's payoffs is $\beta_{h,J}(s) = \big(s\delta + \beta(1-\delta)\big) = \beta + \delta\ (s - \beta)$.

Under outsourcing, we follow the standard assumption that gives no disagreement payoff to both parties. Hence we find H's payoff to be $0 + \beta(R - 0 - 0) = \beta R$, such that $\beta_0 = \beta$.

Consider (entire) vertical integration now. Standard GHM models assume that total integration will not remove agency issues and that M's cooperation is still required, such that in case of bargaining failure, even under integration, the final-good producer face an efficiency loss, and is only able to recover a fraction $0 < \delta_p < 1$ of the potential revenue from producing on its own with M's input. Our producer has therefore a choice in case of bargaining failure under full integration. As explained it can produce and sell the outputs and receives $\delta_p\ R$. Also, the liquidation mechanism explained above still hold, though not to be divided. Since H has access to all the inputs, they can be all sold together to a third party, resulting in a revenue δR, as explained above. We have no valuable reason to think that $\delta_p = \delta$. To the contrary, we believe the (costless) assembly to be valued in the market. Basic economic statements confirm that transformed products are more valuable than raw materials. We therefore assume $\delta_p > \delta$, such that at the end of the day, the final-good producer doesn't face a real choice, since it would always choose $-$ if bargaining fails under complete integration $-$ to produce and sell on its own and would get $\delta_p\ R$.

The disagreement payoff of the final-good producer under full integration is therefore $\delta_p\ R$, while M has no disagreement payoffs. $\pi_{H,V} = \delta_p\ R + \beta(R - \delta_p\ R - 0) = (\beta + (1-\beta)\delta_p)\ R$. So that $\beta_{h,V} = \beta + \delta_p\ (1 - \beta)$

Let's now compare the revenue share each integration solution offers. From $\delta_p > \delta$ and since in a JV s is such as $0 < s < 1$, we deduce $\beta_{h,V} > \beta_{h,J}(s) \ \ , \forall s \in]0;1[$

Obviously, we also have the traditional result in Antràs and Helpman (2004) derived models that $\beta_{h,V} \ > \ \beta_{h,O}$ because $0 < j < 1$, $j = \beta, \delta$.

The sorting is less clear for the revenue share granted by joint-venture and outsourcing. Actually $\beta_{h,J}(s) > \beta_{h,O}$ iif $s > \beta$

This means that a JV would give H more than outsourcing revenue share, only if she owns a share higher than its relative bargaining weight. The reason for that is simple: under outsourc-

[12]Unlike traditional GHM models, the two parties have then a disagreement payoff.

ing, she will get her bargaining power times the final revenue (βR), but under JV, she gets β over a fraction of R (namely, the relationship-surplus ($(1-\delta)R$)), but s over the remaining part of R (the sum of disagreement payoffs (δR))[13].

We therefore have

$$\beta_{h,O} < \beta_{h,J}(s) < \beta_{h,V} \text{ , } \forall \ s \in]\beta; 1[$$

$$\beta_{h,J}(s) \leq \beta_{h,O} < \beta_{h,V} \text{ , } \forall \ s \in]0; \beta]$$

Yet, in our model, as in seminal Antràs and Helpman (2004) model, there are two types of frictions in determining the integration level. (i) The total revenue share that goes to H detailed above, and (ii) the fixed costs borne by H. Specifically, as in all global-sourcing like models, we assume full integration to allow an increasing revenue share, but entails a higher fixed costs than outsourcing[14]. Concerning the fixed costs of joint-ventures, not evoked in Antràs and Helpman (2004), we assume them to be superior to outsourcing fixed costs F_O (because a local plant needs to be settled), but inferior to full integration ones. This point deserves to be detailed. Indeed, Joint-Venture fixed costs are shared between the two owners. However, we know the participation constraint of M being satisfied with equality, through the ex-ante lump-sum transfer, such that the fixed costs borne by M (reducing M's profit), ends up entirely in increasing the up-front payment from H to M. So that actually H bears entirely the fixed costs of a JV, because it compensates M for its part. Therefore if the total fixed costs of setting up a JV were the same as those of a wholly owned affiliate, H wouldn't see any difference between F_V and F_J. However, we make the reliable assumption that it is less costly for M to open an affiliate in his own country, than it would be for H to open it in a foreign country[15]. Such that the costs H should compensate M for, are lower than the costs it would have payed for by itself. Therefore we assume M to open the local affiliate at a costs F_J, with $F_O < F_J < F_V$, and H offsets this costs through the lump-sum payment. For ease of understanding though, we do not include

[13]Until now, we assumed the bargaining power β to be exogenous, as it is in GHM line models. However, it is interesting to think of a (partially) endogenous β as evoked at the end of the previous section. If this bargaining weight is increasing with the firm productivity, hence more productive firms would either set a higher s, or proceed to outsourcing, but not proceed to JV with a low ownership share s. It would be an interesting alternative explanation of higher control by more productive MNEs.

[14]To our knowledge, only Defever and Toubal (2013) assumed a reverse order: $F_O > F_V$, based on Williamson (1979) Transaction Costs Theory argument. However, transaction costs are operating costs, and not the entry sunk costs we picture here in the line of Melitz (2003) and Antràs and Helpman (2004).

[15]This assumptions is grounded in Antràs and Helpman (2004, p.558) statement that "*the fixed costs of search, monitoring, and communication are significantly higher in the foreign country*". Which means that for any producer, investing at home is cheaper than investing abroad.

these costs into τ_m the ex-ante transfer, but as a separated flow, to distinguish F_J in the profit function. Yet, we deduce from this assumption that the total fixed costs of a JV borne by H is common to all JVs, and do not depend on its ownership share.

Considering fixed costs F_k varying with the ownership structure k, after satisfying M's participation constraint, H's profits are:

$$\pi_H = R - c_h \int x_h(i)di - c_m \int x_m(i)di - F_k$$

Using the expressions (8) and (13), and (14), we can rewrite the profit function as:

$$\pi_H = \Theta\ Z_k - F_k \tag{16}$$

Where $\Theta = \theta^{\alpha/(1-\alpha)}$ and

$$Z = \big(1-\eta\alpha\beta_h - \frac{\alpha\mu(1-\eta)}{1-\alpha(1-\mu(1-\eta))}\big) A \left[\alpha^{\alpha}\big(\frac{\eta}{c_h}\big)^{\alpha\eta}\big(\frac{1-\eta}{c_m}\big)^{\alpha(1-\eta)}\ \beta_{h,k}^{\alpha\eta}(1-\beta_{h,k})^{\alpha\omega}\big(\frac{\mu}{1-\alpha(1-\mu(1-\eta))}\big)^{\mu\alpha(1-\eta)}\right]^{\frac{1}{1-\alpha}}$$

is a derived parameter which is proportional to the demand level; it depends on the costs of inputs, on the bargaining shares, and on the importance of contractual frictions for headquarter services and intermediate inputs. The fraction $\big(1 - \eta\alpha\beta_h - \frac{\alpha\mu(1-\eta)}{1-\alpha(1-\mu(1-\eta))}\big) \geq 0$ corresponds to the final share of revenue that goes to H, after paying his variable costs, and compensating M for its own costs. Therefore it cannot be negative, H refusing to produce if it were the case. As one could expect, H's profits are increasing in the demand level A, and in the fraction of M's contractible inputs μ, as in the importance of headquarter services in the final good η.

Note that the profits are not monotonic in β_h, because increasing β_h could result in receiving an increasing share of a decreasing revenue, due to M's lower willingness to cooperate.

Let β_h^* be the value of β_h that maximizes H's revenue $\Theta\ Z_k$, this reduces to find β_h^* that maximizes $\big(\beta_h^{\alpha\eta+1-\alpha}(1-\beta_h)^{\alpha\omega}\big)$, which yields

$$\beta_h^* = \frac{\alpha\eta + 1 - \alpha}{(\alpha\eta + 1 - \alpha) + \omega\alpha} = \frac{1 + \alpha(\eta - 1)}{1 - \alpha\mu(1-\eta)} \quad \text{See Appendix B for details}$$

This optimal revenue share has the expected characteristics, being positive, but inferior to one as the denominator is always greater or equal to the numerator (obvious from the first expression as $\omega\alpha \geq 0$. We see this optimal revenue share to increase in η and in μ, and decrease in $\omega = (1-\mu)(1-\eta)$[16]

Because of the slights modifications we made, we find the β^* curve drawn in figure 1 to be different from the on in Antràs and Helpman (2004), but still increasing in η. The shape of the curve depends on the value of μ. We considered two illustrative values of μ (i.e. μ_{Low} and μ_{High})[17]

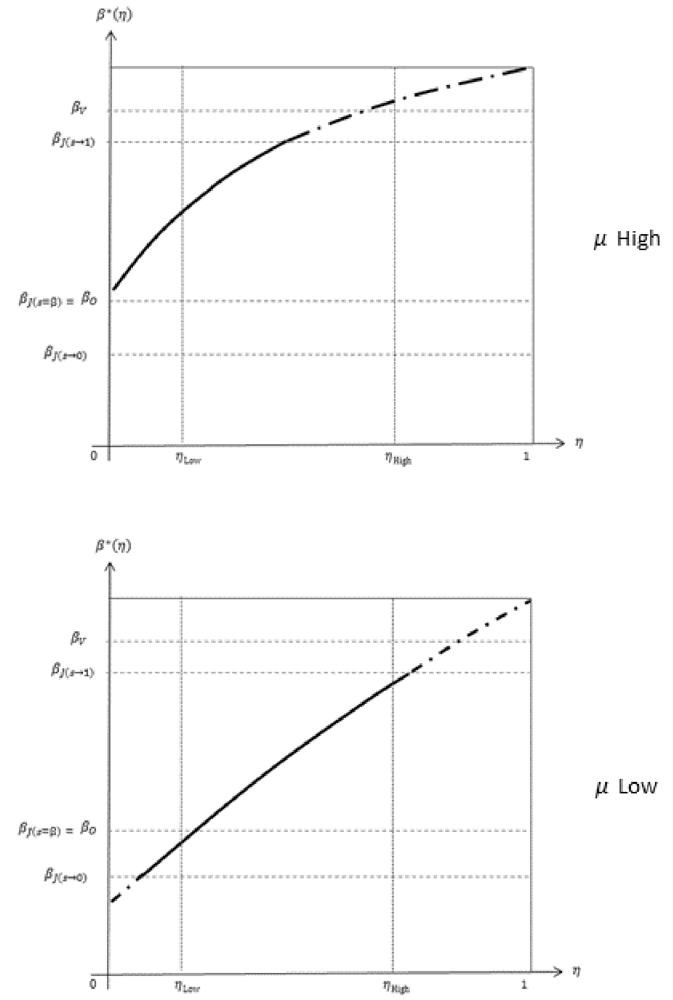

Figure 1: Revenue share that maximizes joint revenue

On this figure, the bold curve represents the optimal revenue share β_h^*. The dashed part

[16]Actually due to our asymmetric game, where all H's inputs are non-contractible, contrary to M's ones we find a lower bound of $\beta^* = 1-\alpha$. Extending the game to H partially contractible inputs would make the lower bound of $\beta^* \to 0$ when both H's importance in the final-good and non-contractible fraction of inputs are close to zero. However, this lower bound in our model doesn't modify our predictions, as soon as we picture this value to be low.

[17]The curves in figure 1, are drawn with $\mu_{Low} = 0.25$ and $\mu_{High} = 0.75$, and $\alpha = 0.85$

corresponds to values of β^* that cannot be reached by adjusting s within a Joint-Venture. Conversely, each point on the plain part of the curve could be reached by choosing the corresponding level of s in a JV.

The following table 2 summarizes the ownership structure and the ownership share chosen by H in each of the four combination possible between η and μ values.

μ	η	ω	$\beta_{h,k}$	s
μ_{High}	η_{High}	ω_{Low}	$\beta_{h,V}$	1
μ_{High}	η_{Low}	ω_{Med}	$\beta_{h,J}(s)$	$\beta < s < \beta_{h,V}$
μ_{Low}	η_{High}	ω_{Med}	$\beta_{h,J}(s)$	$\beta < s < \beta_{h,V}$
μ_{Low}	η_{Low}	ω_{High}	$\beta_{h,J}(s)$	$s < \beta$

Table 2: Ownership structure chosen in each of the identified case.

In our example, the optimal level of β^* for $\omega = \omega_{Low}$ (i.e. η_{High} and μ_{High}) cannot be reached neither by JV, nor by full integration. Nevertheless the closest level of β_k from β^* is $\beta_{h,V}$, such that H will fully integrate the foreign supplier ($s = 1$). In the opposite case, when $\omega = \omega_{High}$ (i.e. η_{Low} and μ_{Low}), the optimal structure is JV with a low ownership share that allows H to give some of its bargaining power to M, such that $\beta_h^* < \beta$ could be reached.

In the two other possibilities, when ω is intermediate, we see that JV is the best ownership structure, since it enables H to reach β_h^*, between $\beta_{h,O}$ and $\beta_{h,V}$.

However, reaching (or getting the closest possible to) β^*, only ensures the firm to be on the profit function with the higher slope $Z\Theta$. Yet it could not be the one maximizing the profit, due to fixed costs, since $F_O < F_J < F_V$.

Following Antràs and Helpman (2004, 2008), we simply compare a few number of environments, according to the cases distinguished above: those with highly important, medium-important and low-important non-contractible activities of M, measured by $\omega = (1-\mu)(1-\eta)$.

When ω is low, we find an expected selection effect, similar to the one in Antràs and Helpman (2004, 2008) for headquarter intensive sectors, except that JVs appear to be an intermediate solution between Outsourcing and full vertical integration (see figure 2, left panel). In such environments, Joint-Ventures are then the optimal integration solution for firms with a productivity level $\theta_J \leq \theta \leq \theta_V <$. But complete vertical integration still dominates JV for most productive firms.

The major findings though arise in the two other environments, when ω is high or interme-

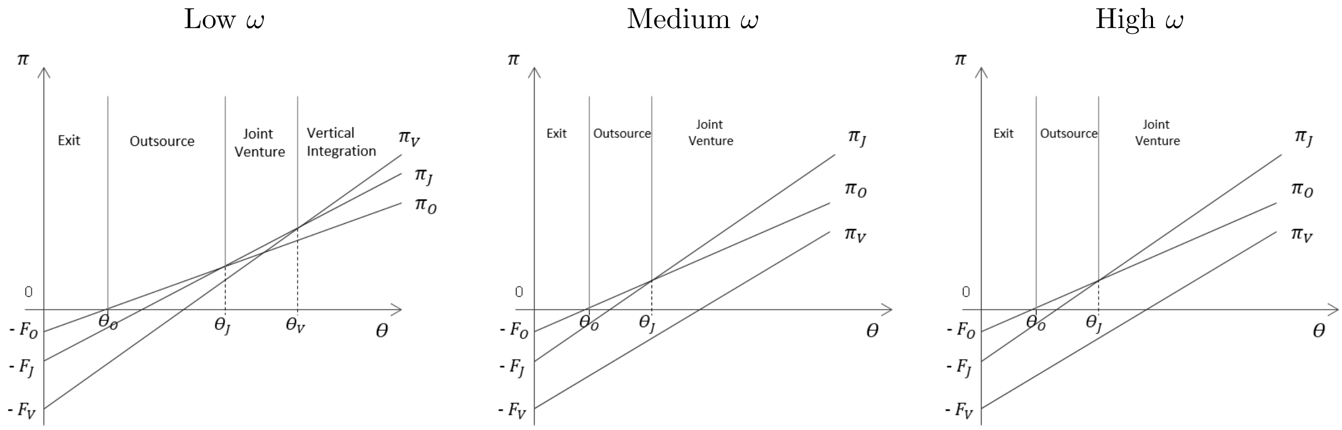

Figure 2: Profit functions by importance of M's non contractible activities.

diate. In these two backgrounds, the profit curves have a similar aspect, with Joint Ventures being the sole optimal integration strategy, dominating full integration even for most productive firms, because as seen in figure 1, the optimal level of β is only reachable via a Joint-Venture, so that the curve of π_V is flatter than the one in π_J.

The only difference between these two last backgrounds is the ownership share held by the MNE in the JV. When the importance of M's non contractible activities in the final good is intermediate, more productive firms would opt for JV over outsourcing because in spite of a higher fixed costs, it allows them to recover a greater share of the joint revenue by setting $s > \beta$.

To the contrary, when ω is high, the MNE would set-up a JV with a low ownership share ($s < \beta$), to foster M's non contractible investments, by giving up some of its initial bargaining power. In this case, the final-good producer aims at reducing its share of the joint revenue compared to what it would obtain under outsourcing, to maximize its final revenue through a higher production. However, only productive enough multinationals could do so, for the gain on the extensive margins of production to overcome lower per-unit profits. Anyway in both cases, higher TFP encourages integration − even in less favorable destinations for H, but does not lead to full vertical integration. Therefore, JVs are no longer an intermediate solution between outsourcing an integration, but an third organizational structure that can be optimal, and preferred to both standard solutions.

6 The role of host countries

As evoked in introduction μ is country-specific, reflecting the host-country contract enforceability. Assume $\mu_W = \mu_{High}$ while $\mu_E = \mu_{Low}$, because we assume the contractible environment to be more secured in country W, and weak in E.

The optimal organizational structure in each country is detailed in table 3, derived from table 2, and figure 2.

Host-Country	Sector	Low TFP ($\theta_O < \theta_i < \theta_J$)	Med. TFP ($\theta_J < \theta_i < \theta_V$)	High TFP ($\theta_i > \theta_V$)
W	η_{High}	Outsourcing	Joint-Venture	Full integration
W	η_{Low}	Outsourcing	Joint-Venture	Joint-Venture
E	η_{High}	Outsourcing	Joint-Venture	Joint-Venture
E	η_{Low}	Outsourcing	Outsourcing	Joint-Venture

Table 3: Organizational structure chosen by H, by firm, sectoral and host-country characteristics

Only the most productive firms would opt for full integration, and only when they invest in a country-sector association where the non contractible activities of their partner are low enough. At the opposite, only low productive firms would choose to outsource in all cases, since they prefer the solution that limits fixed costs. Multinational firms are firms that have done at least one FDI, either in JV or full integration, such that they necessarily have a productivity of at least θ_J. Our model concludes therefore to a higher productivity of MNEs as standard models do.

We also show that the TFP might allow to undertake FDI in more uncertain countries, while low productive MNEs would outsource in such countries, when the final good isn't intensive in headquarters' services. The role of the foreign country is therefore as important as the one of sector affiliation in standard GHM models, since it would shift the optimal integration strategy for two identical firms (in terms of TFP).

However, this model main contribution to the literature is to show that within multinationals, the TFP might allow the MNE to own more (entirely) its foreign affiliate compared to a least productive MNE, when investing in a country with good contractual institutions, and in a sector intensive in H's inputs.

7 Concluding remarks

We built a model of complex integration strategies in the line of the Grossman-Hart-Moore framework, using their conception of ownership as an access to assets (and more precisely, to inputs, as adopted since Antràs and Helpman (2004)); and of non-contractible ex-ante specific inputs that rises the hold-up problem as *ex-ante* inefficiencies at the core of GHM. Using Cai (2003) and Cui (2011) mechanism that gives both parties a disagreement payoff if the bargaining fails under a Joint-Venture, shared ownership is shown not to be always sub-optimal. To the contrary, we show it to be an optimal choice in two different cases: (i) For medium-productive firms where top productive firms would opt for full integration. (ii) As a dominant integration choice over full integration in country-sectors associations that make non-contractible M's input important enough.

The second case is a major step this paper does into the vast literature of rationale for (international) joint-ventures, highlighting the utility of considering JV as a possible organizational structure the mainstream models *à la* Antràs and Helpman (2004) do not account for, while staying close to their assumptions (only changing the disagreement payoffs in case of shared ownership).

This model also underlines the role of the host-country in the integration choice widening it to a firm - industry - host-country model, where the combination of all three parameters is important in defining the optimal ownership share.

Predictions on the aggregate behaviour of MNEs could easily be drawn from this extension of heterogeneity firms models. Our model concludes to a wider range of host-country more productive firms could invest in, and that most productive firms should own more their foreign affiliates, at least in favorable country-sector associations, opting for full integration when least productive MNE would opt for joint-ventures.

Our model is in line with most of aggregate empirical observations on the global distribution of joint-ventures, shown to be more frequent in "southern" countries (Beamish, 2012). Moreover it provide a clearer comprehension of the ownership choices of multinationals, when increasing research shows this choice to have potential local welfare implications (Iršová and Havránek, 2011, 2013).

Further works should explore whether this optimality of joint-ventures holds when breaking with the GHM conception of ownership and specifically distinguish ownership from control, as in Rajan and Zingales (1998) or Holmstrom (1999), or adding *ex-post* inefficiencies, as in Bai, Tao, and Wu (2004) or Wang and Zhu (2005).

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A Optimal ownership share

A.1 Without fixed costs

First, we show the resolution of optimal ownership share without considering fixed costs (or at least that fixed costs are independent from the ownership share, and therefore included in τ_m), as in the first part of our GHM-like model. We know the optimal ownership share maximizes the net joint-profit, such that we aim at maximizing R.

From eq (14), we find our program to maximize

$$\max_s R = A \left[\theta^\alpha \alpha^\alpha (\frac{\eta}{c_h})^{\alpha\eta} (\frac{(1-\eta)}{c_m})^{\alpha(1-\eta)} \ \beta_h^{\alpha\eta} (1-\beta_h)^{\alpha\omega} (\frac{\mu}{1-\alpha(1-\mu(1-\eta))})^{\mu\alpha(1-\eta)} \right]^{\frac{1}{1-\alpha}}$$

With $\beta_h = (s\delta + \beta(1-\delta))$, and $(1-\beta_h) = (\delta(\beta - s) + 1 - \beta)$

First-order condition gives: $\frac{\partial R}{\partial s} = 0$

$$\Leftrightarrow T\frac{\alpha\eta}{1-\alpha}\delta(s\delta+\beta(1-\delta))^{\frac{\eta\alpha}{1-\alpha}}(s\delta+\beta(1-\delta))^{-1}(\delta(\beta-s)+1-\beta)^{\frac{\alpha\omega}{1-\alpha}}$$

$$= T\frac{\omega\alpha}{1-\alpha}\delta(s\delta+\beta(1-\delta))^{\frac{\eta\alpha}{1-\alpha}}(\delta(\beta-s)+1-\beta)^{\frac{\alpha\omega}{1-\alpha}}(\delta(\beta-s)+1-\beta)^{-1}$$

Where T is the component of R that is not directly affected by s

$T = A \left[\theta^\alpha \alpha^\alpha (\frac{\eta}{c_h})^{\alpha\eta} (\frac{(1-\eta)}{c_m})^{\alpha(1-\eta)} (\frac{\mu}{1-\alpha(1-\mu(1-\eta))})^{\mu\alpha(1-\eta)} \right]^{\frac{1}{1-\alpha}}$

This FOC could be easily simplified by

$$\Rightarrow \eta(\delta(\beta-s)+1-\beta) = \omega(s\delta+\beta(1-\delta))$$

$$\Rightarrow s = \frac{\beta(\omega+\eta)(\delta-1)+\eta}{\delta(\omega+\eta)}$$

Which could rewrote as in eq. (15)

$$\Rightarrow s^* = \beta - \frac{\beta}{\delta} + \frac{\eta}{\delta(\omega+\eta)} \tag{17}$$

A.2 With fixed costs

Even if we had considered fixed costs as a continuous function of ownership $F(s)$, the calculus complications prevent the precise identification of the optimal ownership share. Indeed, the net joint profits are now:

$$\Pi = R(s) - c_h \int x_h(i)di - c_m \int x_m(i)di - F(s)$$

Our program would thus be now :

$$\max_s R(s) - F(s)$$

The first order condition is now $\frac{\partial R}{\partial s} = \frac{\partial F}{\partial s}$
which gives

$$\Leftrightarrow T\frac{\alpha\eta}{1-\alpha}\delta(s\delta+\beta(1-\delta))^{\frac{\eta\alpha}{1-\alpha}}(s\delta+\beta(1-\delta))^{-1}(\delta(\beta-s)+1-\beta)^{\frac{\alpha\omega}{1-\alpha}}$$

$$-T\frac{\omega\alpha}{1-\alpha}\delta(s\delta+\beta(1-\delta))^{\frac{\eta\alpha}{1-\alpha}}(\delta(\beta-s)+1-\beta)^{\frac{\alpha\omega}{1-\alpha}}(\delta(\beta-s)+1-\beta)^{-1} = F'(s)$$

With $T = A\left[\theta^{\alpha}\alpha^{\alpha}\big(\frac{\eta}{c_h}\big)^{\alpha\eta}\big(\frac{(1-\eta)}{c_m}\big)^{\alpha(1-\eta)}\big(\frac{\mu}{1-\alpha(1-\mu(1-\eta))}\big)^{\mu\alpha(1-\eta)}\right]^{\frac{1}{1-\alpha}}$
Which could be rewritten in a more elegant manner:

$$\eta(1-\beta_h) = \omega(\beta_h) + \frac{F'(s)(1-\alpha)}{T\alpha\delta\beta_h^{\frac{\eta\alpha}{1-\alpha}}(1-\beta_h)^{\frac{\omega}{1-\alpha}}}$$

With $\beta_h = (s\delta+\beta(1-\delta))$
Which gives:

$$s = \frac{\beta(\omega+\eta)(\delta-1)+\eta}{\delta(\omega+\eta)} - F'(s)\ \ \frac{1-\alpha}{T\alpha\delta}\ \ (s\delta+\beta(1-\delta))^{1-\frac{\eta\alpha}{1-\alpha}}\ \ (\delta(\beta-s)+1-\beta)^{1-\frac{\omega}{1-\alpha}}$$

Therefore, even before considering in details $F'(s)$, we see that we cannot precisely identify s^*, because of the exponentiated sums that prevent us to develop more the equation; although we could show its solution to be unique.

Yet, we see that this optimal ownership share is lower than the one found previously (without fixed costs) $s^* = \beta - \frac{\beta}{\delta} + \frac{\eta}{\delta(\omega+\eta)}$, as soon as $F'(s) > 0$, which is assumed here. The increase in fixed costs that induces higher ownership share dissuades the firms to own as much as they would otherwise. Moreover, we see that firm-level characteristics such that TFP, embodied in the T parameter now play a role into this optimal ownership share, while they don't in the first case.

B Optimal revenue share

Here, we identify the optimal revenue share that maximizes H's revenue.

B.1 Without fixed costs

We have $s^* = \beta - \frac{\beta}{\delta} + \frac{\eta}{\delta(\omega+\eta)}$ The subsequent optimal revenue share $\beta_h^* \equiv \beta_h(s^*)$ is obtain from plugging s^* into $\beta_h = (s\delta+\beta(1-\delta))$

$$\Rightarrow \beta_h^* = \frac{\delta\big[\beta(\omega+\eta)(\delta-1)+\eta\big]+\beta(1-\delta)}{\delta(\omega+\eta)}$$

This gives $\beta_h^* = \frac{\eta}{\omega+\eta}$, again, independent from the firm-level characteristics such as the TFP.

When no fixed costs are considered, and if s^* is within the $[0;1]$ all firms should opt for the same ownership share $s^* = \beta - \frac{\beta}{\delta} + \frac{\eta}{\delta(\omega+\eta)}$ (or to the closer extreme value), and would end up with a revenue of $\frac{\eta}{\omega+\eta}R$.

B.2 With fixed costs

From eq. (16), we know β_h^* to be the value that maximizes $\left(\beta_h^{\alpha\eta+1-\alpha}(1-\beta_h)^{\alpha\omega}\right)$,

First-order condition gives

$$(\alpha\eta + 1 - \alpha)\beta_h^{(\alpha\eta+1-\alpha)}\beta_h^{-1}(1-\beta_h)^{\alpha\omega} = \alpha\omega(1-\beta_h)^{\alpha\omega}(1-\beta_h)^{-1}\beta_h^{\alpha\eta+1-\alpha}$$

$$\Rightarrow (\alpha\eta + 1 - \alpha)(1-\beta_h) = \alpha\omega\beta_h$$

which yields

$$\beta_h^* = \frac{\alpha\eta + 1 - \alpha}{(\alpha\eta + 1 - \alpha) + \omega\alpha} = \frac{1 + \alpha(\eta - 1)}{1 - \alpha\mu(1-\eta)}$$