Chapter 7

The Property-Rights Approach

The transaction-cost theory of firm boundaries reviewed in the last chapter has fundamentally enhanced our understanding of the sources and nature of inefficiencies that arise when transacting via the market mechanism. The pioneering work of Ronald Coase and its operationalization in the writings of Oliver Williamson spun a successful empirical agenda on the determinants of the internalization decision of firms.

At the same time that this empirical research agenda was flourishing, theorists began questioning some of the basic tenets of the transaction-cost approach. The most notable criticism of the theory was that, even if one bought the notion that the transaction-cost literature had correctly identified the costs of transacting via the market, there still remained the issue of what exactly were the benefits of the market mechanism. In other words, if market transactions are plagued by contract incompleteness, opportunistic behavior and inefficient haggling over prices, why do firms use the market at all? Why is world production not carried out within the boundaries of one huge multinational firm that circumvents the need to use contracts to provide incentives to producers to carry out relationship-specific investments?

Naturally, these are not questions that Coase or Williamson ignored in their writings.[1] To obtain a nontrivial tradeoff in internalization decisions, transaction-cost models typically appeal to some vague notion of "governance costs", but these governance costs are treated as exogenous parameters unrelated to the sources of transaction costs in market transactions. Sometimes these costs are associated with a limited span of control by managers, but

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[1]For instance, Coase (1937, p. 394) writes: *"A pertinent question to ask would appear to be [...], why, if by organising one can eliminate certain costs and in fact reduce the cost of production, are there any market transactions at all? Why is not all production carried on by one big firm?"*

this still left the theory open to the criticism that, in the absence of contracting and incentive concerns, the firm could always hire more and more managers to expand its scale indefinitely.

Of course, in the real world, the challenge of incentivizing the agents involved in a production process does not disappear when those agents become employees of the firm. The example of the recent divestures of Sony Corporation mentioned at the beginning of Chapter 6 illustrates the fact that firms often come to the (painful) realization that certain parts of the production process can be done more efficiently by external subcontractors than by internal divisions. And in many instances, the reason for the poor performance of employees is associated with the lack of high-powered incentives.

The remainder of this chapter will be centered on the study of the Property-Rights Theory of the firm, which arguably constitutes the most compelling and influential theory of the firm explaining in a unified framework *both* the benefits as well as the costs of vertical integration.

The Property-Rights Approach: A Non-Technical Overview

The property-rights theory of the firm, as first exposited in Grossman and Hart (1986), and further developed in Hart and Moore (1990) and Hart (1995), begins by arguing that it is not satisfactory to assume that the contractual frictions that plague the relationship between two nonintegrated firms will simply disappear when these firms become an integrated entity. After all, intrafirm transactions are not secured by all-encompassing contracts, and there is no reason to assume that relationship specificity will be any lower in integrated relationships than in nonintegrated ones. For these reasons, opportunistic behavior and incentive provision are arguably just as important in within-firm transactions as they are in market transactions.

If one accepts the notion that within-firm transactions typically entail transaction costs and that the source of these transaction costs is not too distinct from those in market transactions, then a natural question is: what defines then the boundaries of the firm? To answer this question, Grossman and Hart (1986) resort to the legal definition of ownership. From a legal perspective, integration is associated with the ownership (via acquisition or creation) of non-human assets, such as machines, buildings, inventories, patents, copyrights, etc.

The central idea of the property-rights approach is that internalization matters because ownership of non-human assets is a source of power when contracts are incomplete. More specifically, when parties encounter contingencies that were not foreseen in an initial contract, the owner of these assets

naturally holds *residual* rights of control, and he or she can decide on the use of these assets that maximizes his payoff at the possible expense of that of the integrated party. For instance, the owner can insist or impose certain courses of action (such as production ramp-ups) that might be good for him or her but less appealing to the integrated party.

The seminal paper by Grossman and Hart (1986) shows that, in the presence of relationship-specific investments, these ideas lead to a theory of the boundaries of the firm in which both the benefits and the costs of integration are endogenous. In particular, vertical integration entails endogenous (transactions) costs because it reduces the incentives of the integrated firm to make investments that are partially specific to the integrating firm, and that this underinvestment lowers the overall surplus of the relationship.

The property-rights theory of the firm has featured prominently in the international trade literature on multinational firm boundaries, beginning with the first chapter of my Ph.D. thesis, published as Antràs (2003). I will next develop a variant of that model that is closely connected to the global sourcing model with heterogeneous firms we have worked with in the last chapter as well as in Chapters 2 and 4. This framework is closely related to those in Antràs and Helpman (2004, 2008) though we shall discuss richer variants of the model than the simpler models in those papers.

A Property-Rights Model of Multinational Firm Boundaries

Let us then go back to our two-country model of global sourcing. I will continue to assume that the source of contractual inefficiencies in market transactions is well captured by the models in Chapter 4. As a result the profitability of domestic outsourcing and offshore outsourcing are still represented by the profit flows $\pi_{DO}(\varphi)$ and $\pi_{OO}(\varphi)$ in equations (6.4) and (6.5), which for convenience I reproduce here

$$
\begin{aligned}
\pi_{DO}(\varphi) &= (w_N)^{1-\sigma} B\Gamma_{DO}\varphi^{\sigma-1} - w_N f_{DO}; \\
\pi_{OO}(\varphi) &= \left((w_N)^{\eta}(\tau w_S)^{1-\eta}\right)^{1-\sigma} B\Gamma_{OO}\varphi^{\sigma-1} - w_N f_{OO}.
\end{aligned}
\tag{7.1}
$$

In these equations, Γ_{DO} and Γ_{OO} summarize the level of contractual efficiency associated with domestic and international arm's-length sourcing purchases and they are themselves a function of the primitive parameters of the various variants of the model, as derived in Chapter 4 and overviewed in Chapter 6. For the time being, and to keep matters simple, I will assume that the contracts governing domestic transactions are complete, so that $\Gamma_{DO} = 1$, while contracts governing international sourcing transactions are totally incomplete. I will also assume that there is only one supplier, that investments

are fully relationship specific, that bargaining power is symmetric, and that there are no constraints on ex-ante transfers. This effectively brings us back to what I referred to as the 'Basic' model in Chapter 4, in which recall that

$$\Gamma_{OO} = (\sigma + 1) \left(\frac{1}{2} \right)^{\sigma} < 1 \ \text{ for } \sigma > 1. \tag{7.2}$$

The key innovation in this property-rights framework is that I will now assume that integrated transactions also entail transaction costs. Following Grossman and Hart (1986) and Hart and Moore (1990), the source of these costs is related to the fact that intrafirm transactions are also governed by incomplete contracts.[2] In particular, I shall assume that when F decides its mode of organization at t_0, it anticipates playing an analogous game with a manufacturing operator M regardless of whether the operator is an employee of F or an independent contractor. Both the 'outsourcing' and 'integration' branches of the game feature an ex-ante contracting stage t_0, an investment stage t_1, and an ex-post bargaining stage t_2. The only difference between the two branches of the game is at t_2, where the outside options available to F and M will now be a function of the ownership decision at t_0.

How does the ownership structure decision shape the outside options at t_2? Remember that in the outsourcing branch of the game we have assumed that in the absence of an agreement at t_2, F was left with a zero payoff (since it could not create output without an input m and there was no time to find an alternative M that could provide an input). Similarly, M's investment was also fully customized to F, and thus M's outside option was zero as well.

In the case of integration, the above formulation of the outside options is unrealistic. It seems natural to assume instead that H will hold property rights over the input m produced by M, and thus F has the ability to fire a stubborn operator M that is refusing to agree on a transfer price, while still being able to capture part, say a fraction $\delta < 1$, of the revenue generated by combining h and m. The fact that δ is assumed to be lower than one reflects the intuitive idea that F cannot use the input m as effectively as it can with the cooperation of its producer, i.e., M.

In the ex-post bargaining at t_2, each party will capture their outside option plus an equal share of the ex-post gains from trade. Denote by β_k the share of revenue accruing to F at t_2 under organizational form $k = V, O$.

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[2] As discussed below, our framework could easily accommodate variation in contractibility *across* organizational forms but we will refrain from doing so in the spirit of the property-rights approach.

Given our assumptions, we have

$$\beta_V \equiv \frac{1}{2}\left(1 + \delta\right) > \frac{1}{2} \equiv \beta_O, \tag{7.3}$$

which captures the key property-rights idea that F holds more *power* under integration than under outsourcing.

Because the degree of contractibility or relationship-specificity and the other contractual aspects of the model are common in the outsourcing and integration branches of the game, the equilibrium under integration is identical to the one under outsourcing but with $\beta_V = \left(1 + \delta\right)/2$ replacing $\beta_O = 1/2$ throughout. We can then refer back to the generalized Nash bargaining variant of the global sourcing model in Chapter 4, and more specifically to equation (4.14), to conclude that the profitability of foreign integration will be given by

$$\pi_{OV}\left(\varphi\right) = \left(\left(w_N\right)^{\eta}\left(\tau w_S\right)^{1-\eta}\right)^{1-\sigma} B\Gamma_{OV}\varphi^{\sigma-1} - w_N f_{OV}, \tag{7.4}$$

where

$$\Gamma_{OV} = \left(\sigma - \left(\sigma - 1\right)\left(\beta_V \eta + \left(1 - \beta_V\right)\left(1 - \eta\right)\right)\right)\left(\beta_V^{\eta}\left(1 - \beta_V\right)^{1-\eta}\right)^{\sigma-1}. \tag{7.5}$$

Given our assumption of complete contracting in domestic transactions, ownership of physical assets is immaterial for the profitability of domestic integration, and $\Gamma_{DV} = 1$. Furthermore, since Γ_{DO} is also equal to 1 while the fixed costs of sourcing are larger for domestic integration than for domestic outsourcing, we necessarily have that $\pi_{DO}\left(\varphi\right) > \pi_{DV}\left(\varphi\right)$ for all φ and no firm in the industry integrates domestic suppliers. When discussing the empirical implementation of the model in Chapter 8, I will re-introduce contractual frictions in domestic transactions and consider equilibria with some firms engaged in domestic integration.

The Choice Between Offshore Outsourcing and Foreign Integration

To build intuition, let us first consider the choice between offshore outsourcing and foreign integration. This amounts to comparing the profit flows in (7.1) and (7.4). These two profit flows only differ in the fixed costs and transaction costs associated with these strategies. We shall continue to assume that fixed costs of foreign integration are higher than those of offshore outsourcing ($f_{OV} > f_{OO}$). A key aspect of the property-rights model is the extent to which contractual efficiency is higher in integrated versus non-integrated transactions, as summarized in the relative size of Γ_{OV} and Γ_{OO}. In fact, as

we shall demonstrate later in this chapter and again in Chapter 8, the ratio Γ_{OV}/Γ_{OO} is a central determinant of the share of intrafirm trade.

In our basic model with one input, totally incomplete contracting in international transactions, no financial constraints and full relationship-specificity, this ratio is given by:

$$\frac{\Gamma_{OV}}{\Gamma_{OO}} = \frac{\sigma - (\sigma-1)\left(\beta_V \eta + (1-\beta_V)(1-\eta)\right)}{\sigma - (\sigma-1)\left(\beta_O \eta + (1-\beta_O)(1-\eta)\right)} \left(\frac{\beta_V}{\beta_O}\right)^{\eta(\sigma-1)} \left(\frac{1-\beta_V}{1-\beta_O}\right)^{(1-\eta)(\sigma-1)}.$$
(7.6)

Under symmetric Nash bargaining, β_V and β_O are given in equation (7.3). Even with generalized Nash bargaining, the ratio Γ_{OV}/Γ_{OO} would still continue to be given by (7.6), but with

$$\beta_V = \beta + (1-\beta)\delta > \beta = \beta_O,$$

where β is the primitive bargaining power of F.

In Chapter 8, when studying the properties of the level of contractual efficiency Γ_{OO}, we showed that whether increases or decreases in the bargaining power of the final good producer increased or decreased this term crucially depended on the level of headquarter intensity η. This naturally implies that whether the ratio Γ_{OV}/Γ_{OO} is higher or lower than one will also depend as well on the value of η. Indeed, it is easily verified that $\Gamma_{OV} > \Gamma_{OO}$ when $\eta \to 1$, while $\Gamma_{OV} < \Gamma_{OO}$ when $\eta \to 0$.[3] In words, for sufficiently high level of headquarter intensity, the transaction costs of using the market mechanism are higher than those of transacting within firm boundaries, just as is assumed in the transaction-cost theory. When η is sufficiently low, however, the converse is true and the contractual efficiency of outsourcing is actually higher than that of integration.

We can provide a sharper characterization of this result by noting that for any $\beta_V > \beta_O$, the ratio Γ_{OV}/Γ_{OO} is necessarily increasing in η (see the Theoretical Appendix for a proof). This in turn implies that there exists a unique threshold headquarter intensity $\hat{\eta}$ such that, if the fixed costs of these two organization forms were to be identical, the profitability of foreign integration would be higher than that of offshore outsourcing for $\eta > \hat{\eta}$ and lower for $\eta < \hat{\eta}$. This result, which corresponds to Proposition 1 in Antràs (2003), resonates with one of the central results in the property-rights theory: with incomplete contracting, ownership rights of assets should be allocated to parties undertaking noncontractible investments that contribute disproportionately to the value of the relationship. The relative importance

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[3]Note, in particular, that $(\sigma - (\sigma-1)x)\,x^{\sigma-1}$ is increasing in x for $x \in (0,1)$.

of the operator M's investment is captured in (7.6) by the elasticity of output with respect to that agent's investment, i.e., $1 - \eta$, and thus the lower is η, the higher the need for F to give away ownership rights to M by engaging in outsourcing.

As suggested by Antràs and Helpman (2004, 2008), another pedagogically useful way to characterize the optimal choice of ownership structure is to consider the hypothetical case in which F could freely choose β from the continuum of values in $[0, 1]$, rather than choosing from the pair (β_V, β_O). Formally, this amounts to solving the problem

$$
\begin{aligned}
\max_{\beta_k \in [0,1]} \quad & \beta_k R\left(h_k, m_k\right) - w_N h_k - w_N f_{Ok} - s_k \\
\text{s.t.} \quad & s_k + \left(1 - \beta_k\right) R\left(h_k, m_k\right) - \tau w_S m_k \geq 0 \\
& h_k = \arg\max_h \{\beta_k\left(h, m_k\right) - w_N h\} \\
& m_k = \arg\max_m \{\left(1 - \beta_k\right)\left(h_k, m\right) - \tau w_S m\},
\end{aligned}
\tag{7.7}
$$

where remember that the revenue function $R\left(h_k, m_k\right)$ is given in (4.20). This problem can in turn be reduced to

$$
\max_{\beta_k \in [0,1]} \Gamma\left(\beta\right) = \left(\sigma - \left(\sigma - 1\right)\left(\beta\eta + \left(1 - \beta\right)\left(1 - \eta\right)\right)\right)\left(\beta^\eta \left(1 - \beta\right)^{1-\eta}\right)^{\sigma - 1}.
$$

As already mentioned in Chapter 4, the value β^* that minimizes transaction costs (or maximizes $\Gamma\left(\beta\right)$) is given by

$$
\frac{\beta^*}{1 - \beta^*} = \sqrt{\frac{\eta}{1 - \eta} \frac{\sigma - \left(\sigma - 1\right)\left(1 - \eta\right)}{\sigma - \left(\sigma - 1\right)\eta}},
\tag{7.8}
$$

and is an increasing function of η. This function is plotted in Figure 7.1 together with two potential values of β_V and β_O. As is clear from the graph, when η is low, β_O is closer to the optimal β^* than β_V is, but the converse is true when η is high.

Equilibrium Sorting in the Property-Rights Model

Having provided a primer on the choice between different organizational forms, let us now turn to a more formal exposition of the sorting of different firms into different organizational forms depending on their productivity level φ. Formally, we seek to characterize the optimal organizational form $(\ell, k) \in \{DO, DV, OO, OV\}$ that solves $\max \pi_{\ell k}\left(\varphi\right)$. For the time being, we
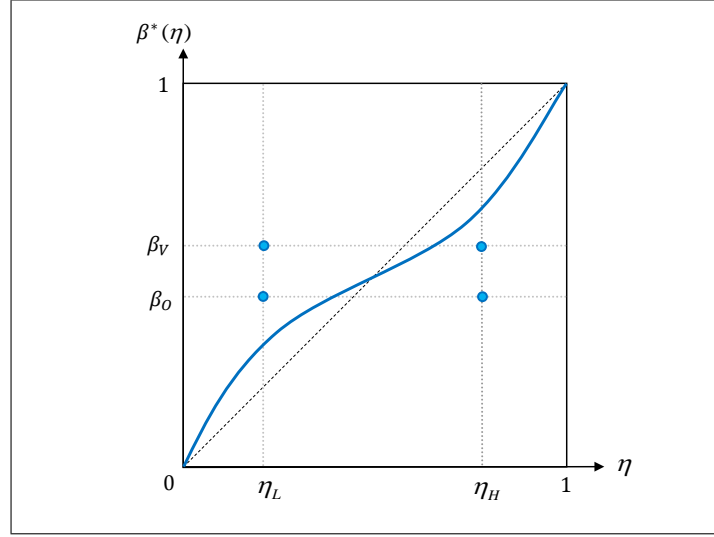
Figure 7.1: Optimal Bargaining Share

shall do so under the maintained assumption that $\Gamma_{DO} = \Gamma_{DV} = 1$ and thus domestic integration is a dominated strategy.

A first obvious observation in light of our above discussion of the choice between offshore outsourcing and integration is that whenever headquarter intensity η is sufficiently low, foreign integration will also be a dominated strategy. More specifically, we have shown above that for η below a certain threshold level, outsourcing features higher contractual efficiency (i.e., $\Gamma_{OV} < \Gamma_{OO}$), which coupled with the higher fixed costs of integration, necessarily implies that $\pi_{OV}(\varphi) < \pi_{OO}(\varphi)$ for all φ. When foreign integration is a dominated strategy, the sorting of firms into organizational forms is analogous to that in Figure 6.2, with the most productive firms engaging in foreign outsourcing, and the least productive firms (among the active ones) relying on domestic outsourcing.

For higher levels of headquarter intensity η, richer sorting patterns can emerge. In particular, the effective marginal cost is now lower under integration than under outsourcing ($\Gamma_{OV} > \Gamma_{OO}$), but outsourcing continues to be a strategy associated with lower fixed costs, and thus a subgroup of relatively unproductive firms might continue to prefer outsourcing over integration. For certain parameter configurations, one can then construct an industry equilibrium in which three organizational forms – domestic outsourcing, foreign outsourcing and foreign integration – coexist in equilibrium, as depicted in Figure 6.4 in Chapter 6, and reproduced in Figure 7.2 below. In such an equilibrium, firms with productivity $\varphi^{\sigma-1}$ below $\tilde{\varphi}_D$ do not produce, those with

$\varphi^{\sigma-1} \in (\tilde{\varphi}_D, \tilde{\varphi}_{OO})$ outsource domestically, those with $\varphi^{\sigma-1} \in (\tilde{\varphi}_{OO}, \tilde{\varphi}_{OV})$ outsource abroad, and those with $\varphi^{\sigma-1} > \tilde{\varphi}_{OV}$ integrate abroad, i.e., they engage in foreign direct investment.
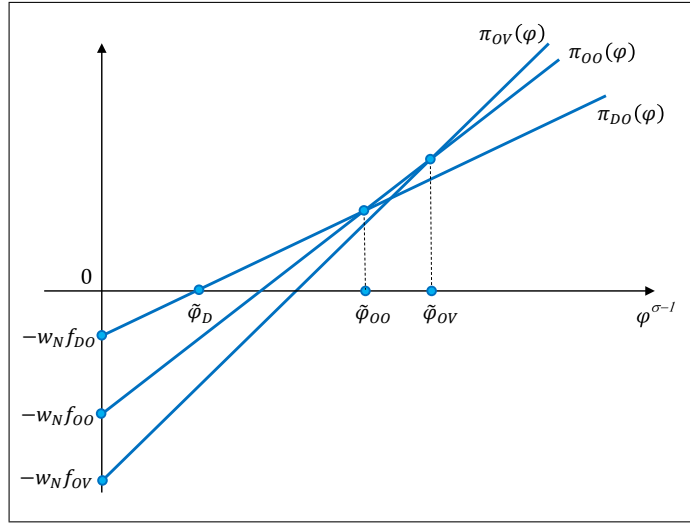

Figure 7.2: Equilibrium Sorting with High Headquarter Intensity

Naturally, for certain configuration of parameter values, it may be the case that no firm finds it optimal to outsource abroad, in which case the sorting pattern is as depicted in Figure 6.3 in Chapter 6. Note, however, that in any equilibrium in which different organizational forms coexist, their ranking by productivity will not be affected. In particular, in any industry with a share of intrafirm trade strictly between 0 and 1, it is necessarily the case that firms offshoring within firm boundaries are more productive than firms offshoring at arm's-length.

Implications for the Share of Intrafirm Trade

We next use the model to aggregate all firms' decisions within an industry to characterize the relative prevalence of different organizational forms within a sector or industry. As in the case of the transaction-cost model developed earlier in this chapter, I will restrict the analysis to computing the relative prevalence of offshore outsourcing and foreign integration, as measured by the share of intrafirm input imports over total input imports. I will also focus on equilibria with a positive measure of firms relying on domestic outsourcing, offshore outsourcing and offshore integration.

Following the same steps as in the derivation of equation (6.9), one finds that whenever φ is distributed according to a Pareto distribution, this share is given by

$$Sh_{i-f} = \frac{\Gamma_{OV}/\Gamma_{OO}}{\left[\left(\frac{\tilde{\varphi}_{OV}}{\tilde{\varphi}_{OO}}\right)^{\kappa-\sigma-1} - 1\right] + \Gamma_{OV}/\Gamma_{OO}} \tag{7.9}$$

where

$$\frac{\tilde{\varphi}_{OV}}{\tilde{\varphi}_{OO}} = \left[\frac{f_{OV} - f_{OO}}{f_{OO} - f_{DO}} \times \frac{1 - (w_N/\tau w_S)^{-(1-\eta)(\sigma-1)}/\Gamma_{OO}}{\Gamma_{OV}/\Gamma_{OO} - 1}\right]^{1/(\sigma-1)}. \tag{7.10}$$

In order to derive these equations, I have assumed again that foreign inputs are priced such that these input expenditures constitute the same multiple $(1 - \eta)(\sigma - 1)$ of operating profits under all organizational forms. This is a restrictive assumption, but note that it does not impose that transfer prices within firms are identical to those under offshore outsourcing. It would be interesting to trace the implications of this framework for the transfer pricing practices of multinational firms, but I will not attempt to do so here.[4]

Equations (7.9) and (7.10) can be used to formally study the determinants of the share of intrafirm trade. Notice first that, holding constant the indices of contractual efficiency Γ_{OV} and Γ_{OO}, the share of intrafirm imports Sh_{i-f} is decreasing in κ (since $\tilde{\varphi}_{OV} > \tilde{\varphi}_{OO}$) and in the term $(w_N/\tau w_S)^{-(1-\eta)(\sigma-1)}$. Because Γ_{OV} and Γ_{OO} in equations (7.2) and (7.5) are in turn independent of κ and $w_N/\tau w_S$, we can conclude that the share of intrafirm imports is increasing in productivity dispersion, trade costs, and Southern labor costs. These effects are identical to those I derived in the transaction-cost model, and the mechanisms behind these effects are also the exact same ones. The productivity dispersion effect relies on the sorting pattern by which firms that integrate abroad are more productive than those that outsource abroad, while the effect of trade costs and wage difference stems from the fact that the extensive margin of offshoring affects outsourcing disproportionately.

In our basic transaction-cost model with one input, symmetric Nash bargaining, and totally incomplete contracts, we also concluded from the effect of the term $(w_N/\tau w_S)^{-(1-\eta)(\sigma-1)}$ that the share of intrafirm trade is also predicted to increase in the level of headquarter intensity η. This is because governance costs λ and the contractual efficiency of outsourcing $\Gamma_{OO} = (\sigma + 1)/2^{\sigma}$ were both independent of η. In the present property-rights

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[4]For recent work on transfer pricing and multinational firm organizational decisions see Keuschnigg and Devereux (2013) and Bauer and Langenmayr (2013).

model, matters are a bit more complex because Γ_{OV} in (7.5) does depend on the value of η. Nevertheless, we showed above that for any $\beta_V > \beta_O$, the ratio Γ_{OV}/Γ_{OO} is increasing in η. As a result, the share of intrafirm imports is positively correlated with η for reasons *distinct* from those in the transaction-cost model. These distinct effects are in turn of two types. First, there is an extensive margin effect related to firms selecting into foreign direct investment when η is high, and second, there is an intensive margin effect associated with the relatively higher contractual efficiency (and thus firm's size) of integration relative to outsourcing whenever η is high.

Extensions of the Basic Model

In order to guide the empirical analysis in Chapter 8, I next turn to studying more general environments that relax some of the strong assumptions of our basic model. This will serve to expand the range of predicted determinants of the share of intrafirm trade and compare those predicted effects to those derived in the transaction-cost model in Chapter 6.

When generalizing that transaction-cost model, we were able to simply invoke the results in Chapter 4 regarding the determinants of the offshore contractual efficiency Γ_{OO}, or the results in Chapter 5 (and the Theoretical Appendix) regarding the determinants of the ratio Γ_{OO}/Γ_{DO}. The reason for this is that the costs of integration were captured by a 'governance-costs' term that was assumed independent of the determinants of the contractual efficiency of outsourcing. As I have shown above, however, in the property-rights model, the same parameters that shape the efficiency of offshore outsourcing also affect the efficiency of foreign direct investment (i.e., offshore integration). And, more specifically, we have seen that the share of intrafirm trade is not only affected negatively by Γ_{OO}, as in the transaction-cost model, but it is also positively affected by the ratio Γ_{OV}/Γ_{OO}.

In order to simplify the exposition, in the remainder of this chapter, I will focus attention on the effect of different primitive parameters of our global sourcing model on this ratio Γ_{OV}/Γ_{OO}, capturing the relative marginal-cost efficiency of integration versus outsourcing. When motivating the empirical specifications in Chapter 8, I will reconsider how this ratio Γ_{OV}/Γ_{OO}, together with the level of Γ_{OO} shape the share of intrafirm trade in a multi-industry and multi-country environment. For pedagogical reasons, I will also abstract for now from contractual frictions in domestic sourcing and will also stick to the benchmark ranking of fixed costs $f_{OV} > f_{OO} > f_{DV} > f_{DO}$. In the next chapter, when discussing the empirical implementation of the model, I will relax these assumptions in a similar way as I did when presenting the

transaction-cost global sourcing model in Chapter 6.

To save space, all proofs of the theoretical results discussed below are relegated to the Theoretical Appendix.

Generalized Bargaining and General Functional Forms

I begin the discussion of extensions of the framework with the case in which the primitive bargaining power of F agents is different than $1/2$ and is given by some general value $\beta \in (0, 1)$. As already mentioned before, this has little impact on the ratio Γ_{OV}/Γ_{OO}, which continues to be given by expression (7.6) but now with $\beta_V = \beta + (1 - \beta)\delta > \beta = \beta_O$. I also anticipated above (and offer a formal proof in the Theoretical Appendix), that for any $\beta \in (0, 1)$ – and not just $\beta = 1/2$ –, this ratio Γ_{OV}/Γ_{OO} is increasing in the level of headquarter intensity η.[5]

Although the positive effect of headquarter intensity on the efficiency of integration relative to outsourcing is robust to the specification of the bargaining process, one might wonder whether it is driven by the very special functional forms of the model. To investigate this, in Antràs (2014) I solved the above problem (7.7) for a general revenue function $R(h_k, m_k)$, rather than the Cobb-Douglas function in equation (4.20). In such a case, the profit maximizing division of surplus β^* is characterized by

$$\frac{\beta^*}{1 - \beta^*} = \frac{\eta_{R,h} \cdot \xi_{h,\beta}}{\eta_{R,m} \cdot (-\xi_{m,\beta})}, \tag{7.11}$$

where $\eta_{R,j} \equiv jR_j/R$ is the elasticity of surplus to investments in input $j = h, m$ and $\xi_{j,\beta} \equiv \frac{dj}{d\beta}\frac{\beta}{j}$ is the elasticity of investment in j to changes in the distribution of surplus β. In words, the (hypothetical) optimal share of revenue allocated to an agent is again increasing in the elasticity of revenue with respect to that agent's investment and in the elasticity of that agent's investment with respect to changes in the distribution of surplus.

This characterization is intuitive but it is expressed in terms of investment elasticities $\xi_{h,\beta}$ and $\xi_{m,\beta}$ that are themselves functions of subtle features of the revenue function (see Antràs, 2014, for details). It can be shown, however, that whenever the revenue function is homogenous of degree $\alpha \in (0, 1)$ in h and m, equation (7.11) can be expressed as:

$$\frac{\beta^*}{1 - \beta^*} = \sqrt{\frac{\eta_{R,h}}{\eta_{R,m}} \frac{\alpha\left(1 - \eta_{R,m}\right) + (1 - \alpha)\left(\sigma_{h,m} - 1\right)\eta_{R,m}}{\alpha\left(1 - \eta_{R,h}\right) + (1 - \alpha)\left(\sigma_{h,m} - 1\right)\eta_{R,h}}}, \tag{7.12}$$

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[5]This ratio is also a function of the elasticity of demand σ, but such dependence is complex and depends in nontrivial ways on the values of β and δ.

where $\eta_{R,h}$ and $\eta_{R,m}$ again denote the revenue elasticities of headquarter services and components, respectively, and $\sigma_{h,m}$ is the elasticity of substitution between headquarter services h and the input m in revenue. Simple differentiation then confirms that for any constant $\sigma_{h,m} > 0$, β^* continues to be increasing in $\eta_{R,h}$ and decreasing in $\eta_{R,m}$, and as a result it continues to be efficient to allocate residual rights of control and thus "power" to the party whose investment has a relatively larger impact on surplus. In other words, the prediction of the model that integration is more attractive in headquarter-intensive sectors than in component-intensive sectors appears robust.[6]

Financial Constraints

I next consider the extension of the model discussed in Chapter 4 featuring constraints on the exchange of ex-ante lump-sum transfers between F and M. More specifically, the only new assumption is that M agents can pledge to external financiers in their domestic economy at most a share ϕ of the net income they receive from transacting with F. As a result, their ex-ante transfer to F can be no larger than a fraction ϕ of their ex-post surplus, which is given by $\phi\left[(1 - \beta_k)\, p\,(q\,(\varphi))\, q\,(\varphi) - \tau w_S m\,(\varphi)\right]$ under organizational form $k = \{V, O\}$. Solving the problem (7.7) with this additional financial constraint, one finds that the ratio Γ_{OV}/Γ_{OO} is now given by

$$
\begin{aligned}
\frac{\Gamma_{OV}}{\Gamma_{OO}} &= \frac{\beta_V\left(\sigma - (\sigma - 1)\,\eta\right) + \phi\,(1 - \beta_V)\left(\sigma - (\sigma - 1)\,(1 - \eta)\right)}{\beta_O\left(\sigma - (\sigma - 1)\,\eta\right) + \phi\,(1 - \beta_O)\left(\sigma - (\sigma - 1)\,(1 - \eta)\right)} \\
&\quad \times \left(\frac{\beta_V}{\beta_O}\right)^{\eta(\sigma-1)} \left(\frac{1 - \beta_V}{1 - \beta_O}\right)^{(1-\eta)(\sigma-1)}.
\end{aligned} \tag{7.13}
$$

It is straightforward to verify that this ratio is decreasing in ϕ. Hence, as in our transaction-cost model, the relative profitability of foreign integration vis à vis foreign outsourcing is particularly large whenever suppliers face tighter financial constraints. Intuitively, and although a low ϕ also reduces the efficiency of intrafirm offshoring, the share of ex-post surplus by M agents is higher under outsourcing than integration, and thus it is natural that financial constraints affect disproportionately F's profits under outsourcing.

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[6]Under which circumstances will the revenue function be homogenous of degree $\alpha \in (0, 1)$ in h and m? This would be the case, for instance, if the inverse demand faced by the final-good producer is homogenous of degree $\alpha_r - 1 < 0$ in output – as with the type of CES preferences assumed throughout the book – and the production function combining h and m is *any* homogenenous function of degree $\alpha_q \in (0, 1]$. In such a case, we would have $\alpha = \alpha_r \alpha_q$.

In the Theoretical Appendix, I also show that the ratio Γ_{OV}/Γ_{OO} continues to be increasing in η. This is the combination of two effects. On the one hand, the standard role of headquarter intensity in the property-rights theory continues to be operative here, and on the other hand, the larger is η, the larger is the loss of rents for F of tight financial constraints, and thus again the bigger the incentive to integrate suppliers.

Partial Contractibility

Consider now the variant of the model with partial contractibility in international transactions in which the degree of contractibility is allowed to vary across inputs and countries, along the lines of the modeling in Antràs and Helpman (2008). In Chapter 4, we discussed their framework in some detail, and derived the equilibrium profitability of offshoring under symmetric Nash bargaining with zero outside options (so ex-post surplus is shared equally between agents). As shown in section A.2 of the Theoretical Appendix, one can follow the approach in Antràs and Helpman (2008) to obtain a formula for the level of contractual efficiency for *any* ex-post division of revenue (β_h, β_m). Applying this formula to the cases (i) $\beta_h = \beta_V$, $\beta_m = 1 - \beta_V$, and (ii) $\beta_h = \beta_O$, $\beta_m = 1 - \beta_O$, one can then express the ratio Γ_{OV}/Γ_{OO} as a function of these bargaining shares, headquarter intensity and the degree of contractibility of headquarter services μ_{hS} and manufacturing μ_{mS} under offshoring:

$$\frac{\Gamma_{OV}}{\Gamma_{OO}} = \left(\frac{\sigma - (\sigma - 1)\left(\beta_V \eta\left(1 - \mu_{hS}\right) + \left(1 - \beta_V\right)\left(1 - \eta\right)\left(1 - \mu_{mS}\right)\right)}{\sigma - (\sigma - 1)\left(\beta_O \eta\left(1 - \mu_{hS}\right) + \left(1 - \beta_O\right)\left(1 - \eta\right)\left(1 - \mu_{mS}\right)\right)} \right)^{\sigma - (\sigma - 1)\mu_S}$$

$$\times \left(\frac{\beta_V}{\beta_O}\right)^{\eta(1 - \mu_{hS})(\sigma - 1)} \left(\frac{1 - \beta_V}{1 - \beta_O}\right)^{(1 - \eta)(1 - \mu_{mS})(\sigma - 1)} \tag{7.14}$$

Consistently with the spirit of the property-rights theory, I assume that the space of contracts available to agents within and across firm transactions is the same, so the levels of contractibility μ_{hS} and μ_{mS} are common across organizational forms. This framework could, however, flexibly accommodate differences in contractibility depending on the ownership structure.

As shown in the Theoretical Appendix, the ratio Γ_{OV}/Γ_{OO} is monotonically increasing in η and μ_{mS}, and monotonically decreasing in μ_{hS}. The rationale for the positive effect of headquarter intensity is analogous to that in the benchmark model and illustrates again the robustness of this result.

The opposite effects of μ_{mS} and μ_{hS} on the attractiveness of integration relative to outsourcing are more novel and interesting. As opposed to our

previous transaction-cost model in which *any* type of increase in contractibility enhanced the relative profitability of outsourcing, in our property-rights model the relative degree of contractibility of different production processes plays a central role in the integration decision. While improvements in the contractibility of headquarter services in international transactions (a higher μ_h) continue to increase the relative profitability of outsourcing, improvements in the contractibility of offshore manufacturing have the opposite effect. The key behind the latter result is that, in the property-rights theory, the integration decision is crucially shaped by the relative intensity (or importance) of the *noncontractible* investments carried out by each agent. Fixing the level of headquarter intensity η and the contractibility of headquarter services μ_h, increases in μ_m necessarily reduce the relative importance of the *noncontractible* investments carried out by M, and as a result the benefits of arm's-length contracting are reduced relative to their costs.

Another way to illustrate this result is by reviewing the determination of the (hypothetical) optimal ex-post division of surplus that would lead to investment levels that maximize ex-ante surplus. In our Benchmark model, this led to equation (7.8), which was depicted in Figure 7.1. In the current extension of the model with partial contractibility, equation (7.8) is slightly modified to

$$\frac{\beta^*}{1-\beta^*} = \sqrt{\frac{(1-\mu_h)\,\eta}{(1-\mu_m)\,(1-\eta)}\frac{\sigma-(\sigma-1)\,(1-\mu_m)\,(1-\eta)}{\sigma-(\sigma-1)\,(1-\mu_h)\,\eta}}. \qquad (7.15)$$

Note that this expression collapses back to (7.8) when $\mu_h = \mu_m = 0$, and the relative intensity of noncontractible investments carried out by F and M again equals η and $1-\eta$ rather than $(1-\mu_h)\,\eta$ and $(1-\mu_m)\,(1-\eta)$. Figure 7.3 depicts the effect of changes in different types of contractibility on this optimal β^*. In the left panel, an increase in μ_h reduces β^* and makes it more likely that outsourcing is the optimal organizational form. Conversely, in the right panel, an increase in μ_m increases β^* and expands the range of parameter values for which integration is the optimal organizational form.

In the Theoretical Appendix, I also study how the effect of changes in contractibility on the ratio Γ_{OV}/Γ_{OO} depends on other characteristics of production. First, I show that high levels of headquarter intensity tend to magnify the negative effect of μ_h and attenuate the positive effect of μ_m on Γ_{OV}/Γ_{OO}. Thus, the model predicts a positive cross-partial effect of headquarter intensity and contractibility on the relative attractiveness of integration, regardless of the source of increased contractibility. Second, I show that high levels of the elasticity of demand σ attenuate the effect of μ_h and μ_m on Γ_{OV}/Γ_{OO},
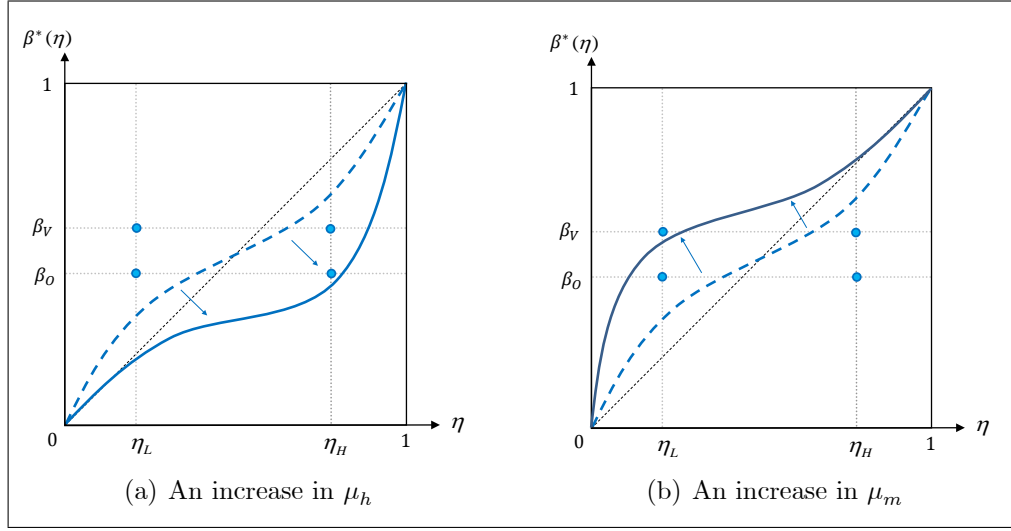
Figure 7.3: Optimal Bargaining Share with Partial Contractibility

which suggest that the sign of cross-partial derivative of Γ_{OV}/Γ_{OO} with respect to σ and the level of contractibility will depend crucially on the source of increased contractibility. The cross-partial derivative is positive in the case of μ_m but negative in the case of μ_h.

Partial Relationship-Specificity

Let us next consider the extension of the model with partial relationship-specificity sketched in Chapter 4. Remember that a secondary market for inputs was introduced, where each input could potentially command a price equal to a share $1 - \epsilon$ of the value of the marginal product of this input when combined with the headquarter services of the intended (primary) buyer F. A large value of ϵ was thus associated with a high degree of customization or relationship specificity. In Chapter 4 we showed that, given an organizational form, the equilibrium of this extension of the model was isomorphic to that of the full relationship-specificity Benchmark model, but with the share of ex-post revenue accruing to each agent given by $\beta_h = \beta_m = 1 - \epsilon/2$ rather than $\beta_h = \beta_m = 1/2$. Naturally, the lower is ϵ, the lower the inefficiencies arising from incomplete contracting. Although we did not do so in Chapter 4, it is straightforward to extend this result to the case of generalized Nash bargaining. In such a case, the equilibrium is isomorphic to one with full relationship-specificity but with F capturing a share $1 - (1 - \beta)\epsilon$ of revenue

and M capturing a share $1 - \beta\epsilon$.[7]

Adapting this modeling of partial specificity to within-firm transactions raises some difficult issues. As readers may recall, the higher *perceived* share of revenue accruing to agents reflected their expectation that their ex-ante investments would pay off in a secondary market for the components they produce. Nevertheless, our rationalization of the higher bargaining share of F agents in related-party transactions invoked the notion that F would hold property rights over the fruits of M's investments (i.e., the manufacturing input), and thus it becomes less clear that M would be able to access that secondary market. It seems clear, however, that some of the investments incurred by M agents will not be fully embodied in manufacturing inputs, and thus their outside options are likely to remain positive even under integration.

Rather than attempting to fully specify how specificity and firm boundaries interact with each other, consider the case in which equilibrium behavior in intrafirm transactions is isomorphic to that of our benchmark model with full relationship-specificity but with F capturing a share $1 - (1 - \beta_V)\epsilon$ of revenue and M capturing a share $1 - \beta_V\epsilon$, where $\beta_V > \beta_O = 0$. Needless to say, this is a stark assumption to make, but it is not worth devoting too much space to fleshing out a potential microfoundation for this specification, since the results I am about to discuss are not entirely general or robust to begin with.

Applying the general formula in Antràs and Helpman (2008) (see section A.2 of the Theoretical Appendix), one can then express the ratio Γ_{OV}/Γ_{OO} as follows:

$$
\frac{\Gamma_{OV}}{\Gamma_{OO}} = \left(\frac{\sigma - (\sigma - 1)\left((1 - (1 - \beta_V)\epsilon)\omega_h + (1 - \beta_V\epsilon)\omega_m\right)}{\sigma - (\sigma - 1)\left((1 - (1 - \beta_O)\epsilon)\omega_h + (1 - \beta_O\epsilon)\omega_m\right)} \right)^{\sigma(1 - \omega_h - \omega_m)}
$$
$$
\times \left(\frac{1 - (1 - \beta_V)\epsilon}{1 - (1 - \beta_O)\epsilon} \right)^{\sigma\omega_h} \left(\frac{1 - \beta_V\epsilon}{1 - \beta_O\epsilon} \right)^{\sigma\omega_m}. \tag{7.16}
$$

where $\omega_h = (\sigma - 1)\eta(1 - \mu_{hS})/\sigma$ and $\omega_m = (\sigma - 1)(1 - \eta)(1 - \mu_{mS})/\sigma$. When studying this ratio, we cannot simply invoke the comparative static results in Antràs and Helpman (2008) regarding this ratio because F and M's bargaining shares do not add up to one.[8] In fact, a first disappointing result is that it is no longer necessarily the case that Γ_{OV}/Γ_{OO} is increasing in η and

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[7]Note that $1 - (1 - \beta)\epsilon + 1 - \beta\epsilon = 2 - \epsilon > 1$ for $\epsilon < 1$. To be clear, in the bargaining, F and M obtain shares of the ex-post gains from trade that add up to exactly one, but their investment behavior is *as if* they captured shares of revenue that strictly exceed one.

[8]As mentioned in Chapter 4, the positive effect of μ_{hS} and μ_{mS} on Γ_{OO} holds for *any* (β_h, β_m). Their results regarding the ratio Γ_{OV}/Γ_{OO} instead use the fact that $\beta_h = 1 - \beta_m$.

μ_{mS}, and decreasing in μ_{hS} for any values of β_O, β_V or ϵ. Furthermore, when studying the effects of ϵ on this ratio, we find this effect to be ambiguous.

As I show in more detail in the Theoretical Appendix, one can make a bit more progress with this extension by assuming that the degree of relationship-specificity is different for different inputs. Let us denote this specificity levels by ϵ_h and ϵ_m for headquarter services and manufacturing, respectively. In such a case, the expression (7.16) needs to be modified by replacing $(1 - (1 - \beta_k)\epsilon)$ with $(1 - (1 - \beta_k)\epsilon_h)$ and $(1 - \beta_k\epsilon)$ with $1 - \beta_k\epsilon_m$ for $k = V, O$. When studying this more general ratio Γ_{OV}/Γ_{OO}, one finds that it generally increases in ϵ_h and decreases in ϵ_m. The result is not fully general, however, as one can find numerical examples in which such dependence is non-monotonic for all possible parameter values, particularly when bargaining shares β_O and β_V are extremely high or low. But in the Theoretical Appendix, I show formally that when $\beta_O = 1/2$, the negative effect of ϵ_m on the ratio Γ_{OV}/Γ_{OO} holds unambiguously. Similarly, I show that when $\beta_V = 1/2$ (and thus $\beta_O = (1/2 - \delta)/(1 - \delta)$), the positive effect of ϵ_h on the ratio Γ_{OV}/Γ_{OO} is also unambiguous.[9]

Multiple Inputs and Multilateral Contracting

Up to now, we have focused on variants of our property-rights model in which only one manufacturing input was necessary for production and contracting was only bilateral in nature. I next turn to the variant of the model with multiple inputs and suppliers presented in Chapter 4, which in turn built on tools developed by Acemoglu, Antràs and Helpman (2007). Remember from our analysis in that chapter that a key parameter shaping the contractual efficiency of offshoring was ρ, which in equation (4.25) governed the degree of substitutability across inputs. When $\rho \to 1$, these inputs become perfect substitutes, while when $\rho \to 0$, they are all essential in production. Adopting the Shapley value as the solution concept for the multilateral contracting between F and the different suppliers, we showed in Chapter 4 that the final-good producer ended with a share of surplus $\sigma\rho/((\sigma - 1)(1 - \eta) + \sigma\rho)$ and the set of suppliers jointly captured the remaining share $(\sigma - 1)(1 - \eta)/((\sigma - 1)(1 - \eta) + \sigma\rho)$. Nevertheless, in the Nash equilibrium of the investment stage t_1, the relevant payoff of each supplier held constant the investment of other suppliers, and this led to novel effects relative to the one-supplier model. More specifically, the payoff for

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[9]Numerical simulations also indicate that the effect of changes in specificity levels ϵ_h and ϵ_m tend to be magnified when the levels of contractibility are low, an intuitive result. Yet, again these results do not hold for *all* possible values of parameters.

supplier $M(v)$ was given by

$$P_m(v) = \frac{(\sigma - 1)(1 - \eta)}{(\sigma - 1)(1 - \eta) + \sigma\rho} R(\varphi) \left(\frac{m_n(v)}{m_n(-v)}\right)^\rho, \qquad (7.17)$$

and thus ρ – rather than $(\sigma - 1)(1 - \eta)/\sigma$ – governed the elasticity of each supplier's payoff to its investment level. An implication of this result is that the equilibrium profitability of offshoring in the model was identical to that of our single-supplier benchmark model but with $\beta_h = \beta_m = \rho\sigma/((\sigma - 1)(1 - \eta) + \sigma\rho)$.

In our specification of the model in Chapter 4, we assumed that in the ex-post bargaining, each supplier could withhold the services from the non-contractible manufacturing activities in production. In that sense, it is natural to interpret that solution as corresponding to one in which all suppliers are subcontractors. How would the integration of suppliers affect the ex-post negotiations between the firm and its suppliers?

For simplicity, consider the polar case in which all suppliers are integrated by F.[10] Assume that in such a case, suppliers cannot withhold the full value of their marginal contribution to revenue (given in equation (4.26)), but only a share $1 - \delta$ of it, as in our benchmark model above.[11] Following analogous derivations to those in Chapter 4, this results in t_1 payoffs for suppliers equal to

$$P_{mV}(v) = \frac{(1 - \delta)(\sigma - 1)(1 - \eta)}{(\sigma - 1)(1 - \eta) + \sigma\rho} R(\varphi) \left(\frac{m_n(v)}{m_n(-v)}\right)^\rho. \qquad (7.18)$$

Remembering that, in equilibrium, $m_n(v) = m_n$ for all v, note that F is left with a share $(\sigma\rho + (\sigma - 1)(1 - \eta)\delta)/((\sigma - 1)(1 - \eta) + \sigma\rho)$ of revenue. In the spirit of the property-rights theory, vertical integration enhances the bargaining power of F agents (and the more so the larger is δ), while reducing that of suppliers.

As in the case of outsourcing, one can also easily verify that the equilibrium of this multi-agent model turns out to be isomorphic to that of a

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[10] As recently shown by Schwarz and Suedekum (2014), this is not without loss of generality, as hybrid sourcing, where some suppliers are vertically integrated while the others remain independent, might emerge in equilibrium even with our symmetry assumptions on technology and contracting. See also Du, Lu and Tao (2009) and Van Biesebroeck and Zhang (2014) for alternative frameworks with hybrid sourcing strategies.

[11] Acemoglu, Antràs and Helpman (2007) consider an alternative formulation in which suppliers withhold a share $1 - \delta$ of their intermediate input (rather than of their contribution). This generates analogous predictions for how input substitutability shapes the integration decision, but the proofs are much more cumbersome in that case.

single-supplier model with an appropriately redefined bargaining share β_m. Under integration, this equivalent bargaining share is given by

$$\beta_m = (1 - \delta)\, \rho\sigma / \left((\sigma - 1)(1 - \eta) + \sigma\rho \right).$$

With this equivalent representation in hand, it is a simple matter of applying the general formula in Antràs and Helpman (2008) (see equation (A.10) in the Theoretical Appendix) to express the ratio Γ_{OV}/Γ_{OO} as

$$
\begin{aligned}
\frac{\Gamma_{OV}}{\Gamma_{OO}} \;=\;& \left(1 - \frac{(\sigma - 1)(1 - \eta)\,\delta\omega_h - \sigma\rho\delta\omega_m}{(\sigma - 1)(1 - \eta) + \sigma\rho\,(1 - \omega_h - \omega_m)} \right)^{\sigma(1 - \omega_h - \omega_m)} \\
& \times \left(1 + \frac{(\sigma - 1)(1 - \eta)\,\delta}{\sigma\rho} \right)^{\sigma\omega_h} (1 - \delta)^{\sigma\omega_m}.
\end{aligned}
\tag{7.19}
$$

where $\omega_h = (\sigma - 1)\eta\,(1 - \mu_{hS})/\sigma$ and $\omega_m = (\sigma - 1)(1 - \eta)(1 - \mu_{mS})/\sigma$. In the Theoretical Appendix, I show that Γ_{OV}/Γ_{OO} in (7.19) is increasing in ω_h and decreasing in ω_m, which immediately implies that this same ratio is decreasing in headquarter contractibility μ_h and increasing in manufacturing contractibility μ_m, just as in the model with a single supplier. This result does not imply, however, that the ratio Γ_{OV}/Γ_{OO} is necessarily increasing in headquarter intensity η, since this parameter enters the formula (7.19) independently of how it shapes ω_h and ω_m. In fact, it is not difficult to generate numerical examples in which the ratio is decreasing in η for a certain range of η. This is in turn related to the fact that headquarter intensity shapes the effective primitive bargaining power of agents and as η increases, the effective bargaining power of suppliers is reduced, and other things equal, the attractiveness of further reducing their bargaining power by integrating them is also reduced.

The main new result that emerges from the modelling of multiple suppliers is the role of input substitutability, as captured by ρ, in shaping the integration decisions of final-good producers. We showed in Chapter 4 that the contractual efficiency of outsourcing is higher, the more substitutable inputs are in the sense that $\partial\Gamma_{OO}/\partial\rho > 0$. Although a higher ρ also enhances the contractual efficiency of foreign integration, such an effect is less pronounced for integration than for outsourcing. More precisely, in the Theoretical Appendix, I show that there exists a unique threshold $\hat{\rho} > 0$ such that for all $\rho < \hat{\rho}$, the contractual efficiency of foreign integration is higher $\Gamma_{OV} > \Gamma_{OO}$, while the converse is true for $\rho \geq \hat{\rho}$ (i.e., $\Gamma_{OV} < \Gamma_{OO}$).[12] In sum, the incentives to integrate suppliers are higher the more complementary are inputs in production

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[12] When this threshold $\hat{\rho}$ is higher than one, then $\Gamma_{OV}/\Gamma_{OO} > 1$ for all $\rho \in (0, 1]$.

The intuition behind this result is as follows. When there is a high degree of technological complementarity across inputs, the ex-post payoff of F under outsourcing tends to be relatively low (note, in particular, that F's payoff under outsourcing is 0 when $\rho \to 0$) and the choice of headquarter services is particularly distorted. In such cases, vertical integration is particularly attractive because it helps restore the incentives of F to provide these headquarter services. Conversely, when ρ is high, suppliers face a particularly acute hold-up problem since their inputs are highly substitutable with each other; in those situations, strengthening the bargaining power of suppliers via an outsourcing contract constitutes the profit-maximizing organizational mode.

Sequential Production

I finally study the variant of the model in Antràs and Chor (2013), in which the production process is sequential in nature and the relationship-specific investments made by suppliers in upstream stages can affect the incentives of parties involved in later downstream stages. In Chapter 4, I already discussed that if final-good producers were able to choose the profit-maximizing division $\beta(v)$ of the surplus generated at every stage $v \in [0,1]$, they would set it equal to

$$\frac{\partial \beta^*(v)}{\partial v} = \frac{1 - \sigma_\rho/\sigma}{\sigma_\rho - 1} v^{\frac{-\sigma_\rho(\sigma-1)}{(\sigma_\rho-1)\sigma}}. \tag{7.20}$$

From this it followed that when $\sigma > \sigma_\rho$, the final-good producer would have an incentive to retain a higher share of the surplus in downstream stages than in upstream stages, while the converse is true when $\sigma < \sigma_\rho$. The reason for this is that in the former case, supplier investments are sequential complements, and thus high upstream values of $\beta(v)$ would be particularly costly since they would reduce the incentives to invest not only of these early suppliers but also of all suppliers downstream. Conversely, when $\sigma < \sigma_\rho$, supplier investments are sequential substitutes.

How does this result relate to the relative incentives to integrate suppliers along the value chain? To answer this question, consider the case in which instead of freely choosing $\beta^*(v)$ from the set $[0,1]$, final-good producers are constrained to choosing between two potential values, β_V and β_O with $\beta_V > \beta_O$. It is clear from equation (7.20) that when inputs are sequential complements (i.e., $\sigma > \sigma_\rho$), the firm will choose to forgo control rights over upstream suppliers in order to incentivize their investment effort, since this generates positive spillovers on the investment decisions to be made by

downstream suppliers. Conversely, when investments are sequential substitutes (i.e., $\sigma < \sigma_\rho$), if any suppliers are integrated at all, it will necessarily be those producing in upstream stages.

Antràs and Chor (2013) formalize this intuitive result by showing that in the complements case ($\sigma > \sigma_\rho$), there exists a unique $v_C^* \in (0, 1]$, such that: (i) all production stages $v \in [0, v_C^*)$ are outsourced; and (ii) all stages $v \in [v_C^*, 1]$ are integrated within firm boundaries. Conversely, in the substitutes case ($\sigma < \sigma_\rho$), there exists a unique $v_S^* \in (0, 1]$, such that: (i) all production stages $v \in [0, v_S^*)$ are integrated within firm boundaries; and (ii) all stages $v \in [v_S^*, 1]$ are outsourced.

As readers may recall from Chapter 6, these results resonate with those of the transaction-cost model, but the predictions of that model were actually the opposite ones. In that model, upstream integration was particularly beneficial in the sequential complements case, and downstream integration was particularly attractive in the sequential substitutes case. We shall return to this distinction in Chapter 8.

So far, I have discussed the case with no investments in headquarter services and unconstrained ex-ante transfers between F and its suppliers. As shown in Antràs and Chor (2013), in this scenario it actually turns out to be the case that, whenever $\sigma > \sigma_\rho$, $\beta^*(v) < 0$ for all v and thus F finds it optimal to choose outsourcing along the *whole* value chain. Or in terms of our previous formalization of the result, $v_C^* = 1$. Nevertheless, one can show that integration and outsourcing can again coexist along the value chain regardless of the relative size of σ and σ_ρ whenever F cannot extract all surplus from suppliers via ex-ante lump-sum transfer or whenever the model includes headquarter service provision (see Antràs and Chor, 2013, for details). Interestingly, in those cases, Antràs and Chor (2013) show that the range of integrated stages (downstream stages in the complements case, upstream stages in substitutes case) is necessarily increasing in the level of headquarter intensity and decreasing in the degree of input substitutability, in line with the results obtained in the variants of the model with simultaneous investments.

To summarize, the main novel prediction that emerges from this extension of the model is that the position of an input in the value chain constitutes a new determinant of the extent to which a production process is integrated or not. Furthermore, such dependence is crucially determined by the size of the elasticity of demand faced by the final-good producer relative to the elasticity of substitution of inputs in production. Interestingly, in the transaction-cost model in Chapter 6, the effect of downstreamness also interacted with the relative size of these elasticities, but the prediction of that model for that

interaction was diametrically opposite to the one delivered by the property-rights theory.

Other Applications and Extensions

I have so far focused on studying various extensions of a benchmark property-rights model with heterogeneous firms. This model is most closely related to my joint work with Elhanan Helpman, particularly Antràs and Helpman (2004, 2008). In some of the extensions, I have borrowed from other work of mine, such as from Acemoglu, Antràs and Helpman (2007), Antràs and Chor (2013) or Antràs (2014). As I hope to convince the reader in the next chapter, I view this framework as a very useful toolbox to motivate cross-sectoral and cross-country studies of the intrafirm component of trade.

The general-equilibrium characteristics of this framework are, however, restrictive. The fact that the model features an outside sector that pins down factor costs regardless of the contractual aspects that shape the equilibrium in the differentiated-good sector, might be of particular concern. Likewise, the above framework imposes stark Ricardian assumptions on technology that immediately pin down the location of headquarter service provision.

In Antràs (2003), the first paper I wrote on this topic, I considered instead a general-equilibrium model of trade with two sectors subject to contractual frictions, each producing a continuum of differentiated varieties. As in our benchmark model, manufacturing varieties are produced combining head-quarter services provided by F and manufacturing services provided by M under a Cobb-Douglas technology. It is further assumed that headquarter services are produced with capital, while manufacturing production uses only labor. This is the key assumption of the paper, as it introduces a positive correlation between the abstract concept of headquarter intensity and an observable variable, namely capital intensity.[13] Sectors differ in the intensity with which these inputs (or factors) are combined, while countries differ in their relative abundance of physical capital. To simplify the complexities inherent in the general-equilibrium of such a model, I assumed that countries differ *only* in their relative factor endowments. In particular, I ruled intermediate trade costs and differences in contract incompleteness across countries, and also assumed that the fixed costs of sourcing are independent of ownership structure and feature the same factor intensity as variable costs (i.e.,

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[13]In the paper, I justified this assumption on empirical grounds, arguing that cost-sharing practices of multinational firms in their relations with independent subcontractors tend to be associated with physical capital investments rather than with labor input choices.

they combine h and m under the same Cobb-Douglas aggregator as these enter the firm's production function). Finally, I assumed that headquarter and manufacturing services were nontradable, but that the physical output embodying these services was perfectly tradable.

The combination of these assumptions made the equilibrium particularly easy to characterize because the ownership structure and location decisions could be treated independently from each other. In particular, from our results above, the ownership structure decision is such that, *worldwide*, F agents choose to integrate their suppliers if headquarter (i.e., capital) intensity is above a given threshold $\hat{\eta}$. Meanwhile, the location decision boils down to choosing the location of input production that minimizes the marginal cost of provision of inputs, which, for common contractual frictions, reduced to minimizing a Cobb-Douglas function of factor prices. The framework thus achieves a separation of an ownership decision à la Grossman-Hart-Moore, with a location decision familiar from the new trade theory model in Helpman and Krugman (1985). Still, these forces interact with each other in shaping bilateral trade across countries as well as its intrafirm component. As I showed in the paper, the model predicts a cross-industry positive correlation between the share of intrafirm imports in total imports and capital intensity in production, and a cross-country positive correlation between the share of intrafirm imports in total imports and the aggregate capital-labor ratio of the exporting country (as labor-abundant countries tend to export small amounts of capital-intensive goods).[14]

The insights of the property-rights theory have also been applied to dynamic, general-equilibrium models of international trade with the goal of understanding how ownership decisions vary along the life-cycle of a product or input. Antràs (2005), for instance, develops a model in which the incomplete nature of contracts governing international transactions limits the extent to which the production process can be fragmented across borders, thereby generating the emergence of Vernon-type product cycles, with new goods being initially manufactured in North (where product development takes place), and only later (when the goods are mature) is manufacturing carried out in South. Antràs (2005) also draws the boundaries of multinational firms and shows that the model gives rise to a new version of the product cycle in which, consistently with empirical evidence, manufacturing is shifted to the South first within firm boundaries, and only at a later stage to independent

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[14]Our benchmark model of global sourcing could also generate the latter result under the plausible scenario that relative wage differences w_N/w_S are increasing in aggregate capital-labor ratio differences, and are thus not pinned down by Ricardian differences in the outside sector.

firms in the South.

Above, I have discussed the effect of financial constraints on the relative contractual efficiency of foreign integration and outsourcing. That discussion builds on Antràs (2014), which in turn is inspired by the work of Carluccio and Fally (2011) and Basco (2013). Both of these papers develop open-economy models in which, consistently with our results above, multinationals are more likely to integrate suppliers located in countries with poor financial institutions. Furthermore, both papers predict that the effect of financial development should be especially large when trade involves complex goods, and both provide independent empirical evidence supporting this prediction.

As emphasized by Legros and Newman (2010), in the presence of financial constraints, equilibrium firm boundaries will also depend on the relative ex-ante bargaining power of each party and their ability to exchange lump-sum transfers. This idea has been fruitfully applied in open-economy environments by Conconi, Legros and Newman (2012), who show that vertical integration should be relatively more prevalent in industries in which (relative) prices are high, perhaps due to import-protecting trade policies. Intuitively, in their setup, which builds on Hart and Holmstrom (2010) and Legros and Newman (2013), ownership decisions are not ex-ante optimal, but instead trade off the pecuniary benefits of coordinating production achieved under integration and the managers' private benefits of operating in their preferred ways associated with non-integration. Consequently, the higher the industry price, the higher are the monetary benefits of integration and thus the more attractive this option is. Alfaro, Conconi, Fadinger and Newman (2014) provide evidence of a positive association between import tariffs and domestic integration decisions. Díez (2014) finds similar evidence in a cross-section of U.S. industries when looking at intrafirm trade flows, but interprets the result in light of the Antràs and Helpman (2004, 2008) models, which as mentioned above, also predict a positive effect of imports tariffs on foreign integration.

Throughout this chapter, I have restricted attention to reviewing papers that adopt variants of the property-rights approach to drawing firm boundaries in open-economy environments. In the presence of incomplete contracts, another important organizational decision of firms concerns the allocation of decision rights among employees. In particular, in the presence of non-contractible effort decisions by workers, managers face a trade-off between granting decision rights to workers or keeping these to themselves. The former option has the benefit of providing workers with 'initiative,' which may lead to higher effort, but delegation may result in decisions that are not necessarily optimal from the point of view of the manager. Avoiding delega-

tion (i.e., exerting 'authority') tends to inhibit the initiative of workers but entails more control over the course of production. This trade-off was first formalized by Aghion and Tirole (1997) and has been applied to general-equilibrium frameworks by Marin and Verdier (2003, 2008, 2009, 2012) and Puga and Trefler (2002, 2010).