Ownership and Control in Joint Ventures*

Robert Hauswald
Kogod School of Business, American University
Washington, DC 20016-8044
Email: *hauswald@american.edu*

Ulrich Hege
HEC School of Management
78351 Jouy-en-Josas CEDEX, France
Email: *hege@hec.fr*

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Ownership and Control in Joint Ventures: Theory and Evidence

Abstract

Joint ventures afford unique opportunities to study how firms assert property rights over jointly used assets because parents clearly delineate control. We argue that ownership allocations trade off investment incentives with control-related inefficiencies. We show how residual control rights can create a discontinuity in parent incentives that explains the observed clustering of ownership at 50-50 and 50-plus-one-share equity allocations. At the same time, the incentive benefits of ownership preserve a rationale for a wide spectrum of asymmetric shareholdings. Analyzing the determinants of ownership in US joint ventures, we find that, consistent with our model, the higher the potential for unilateral value extraction the more parents prefer equal shareholdings regardless of their attributes. Similarly, parent-specific spillovers make 50-50 ownership more attractive to the detriment of one-sided control whereas complementarities in parent resources have the opposite effect.

1 Introduction

In January 2006, the US car-parts manufacturer Johnson Controls announced a joint venture with Saft, a French company specializing in industrial batteries, to develop lithium-ion batteries for hybrid cars. "We think our skills are complementary," explained Johnson Controls who hold 51% of the venture.[1] When firms enter into such agreements they grant each other access to their assets and expertise to exploit synergies. At the same time, they expose themselves to conflicts over the common assets' control and to the risk of expropriation. Joint ventures (JVs for short) offer a particularly good opportunity to investigate how firms address such problems and define property rights at their boundaries because the partners incorporate their cooperation, thereby explicitly allocating ownership rights over jointly used resources.[2] This popular form of inter-firm cooperation exhibits the following intriguing ownership pattern: both in the US and in Europe, the vast majority, but not all JVs, allocate equal or almost equal equity stakes to the parent firms. Figure **??** or Table **??** in the Appendix show that about two thirds of two-parent joint ventures have 50-50 equity allocations, while up to 12% show 50.1% or 51% majority stakes ("50 plus one share").[3]

However, as Holmström (1999) points out, the observed clustering of ownership at 50-50 is at odds with central tenets of the property-rights view of the firm that predict sole ownership of complementary assets (Grossman and Hart, 1986, and Hart and Moore, 1990). In particular, this literature argues that 50-50 ownership and shared control are suboptimal because they provide the least efficient incentives (Hart, 1995, p. 48; see also the discussion in Holmström, 1999). In a similar vein, previous work on joint ventures has found that optimal ownership allocations should be asymmetric due to differences in parent characteristics such as resource costs (Belleflamme and Bloch, 2000), private information (Darrough and Stoughton, 1989), or incentive requirements (Bhattacharyya and Lafontaine, 1995 or Chemla, Habib and Ljungqvist, 2004).

To study these issues, we present a simple model in which two firms contribute noncontractible resources to a jointly owned, but independent corporate entity in an effort to exploit asset complementarities ("synergies"). Following the standard premise of the property-rights literature,

[1] *Financial Times*, February 4 2006.

[2] Robinson (2001) finds that joint ventures are the organizational vehicle of choice for corporate alliances precisely when the parties wish to clearly delineate control. He also reports that 80% of all recorded alliance deals in the Joint Venture and Strategic Alliance database of Thomson Financial Securities Data (TFSD) are joint ventures when the value of contributed resources exceeds a modest $100,000 in disclosed total estimated costs.

[3] The data drawn from TFSD consists of two-parent US joint ventures (about 80% of all recorded joint ventures) announced between 1985 and 2000; see Section **??** for a detailed discussion of our sample.

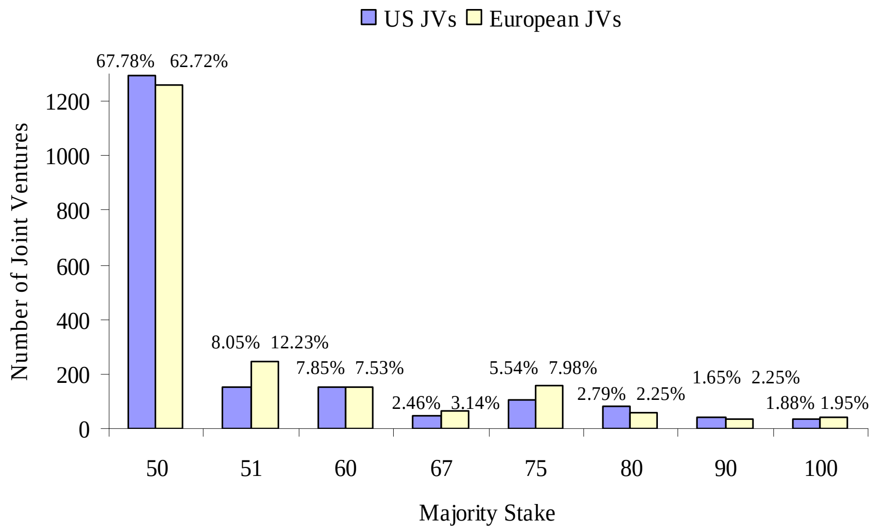


Figure 1: Ownership Distribution in 2,718 US and 2,004 European Joint Ventures (see Table **??**)

ownership provides incentives for such investments. However, we slightly extend this framework by assuming that ownership can confer socially costly control benefits on majority shareholders that adversely affect the incentives of a minority owner. Hence, the parties face a trade-off between investment incentives and control-benefits extraction in their choice of equity allocations.

Our analysis starts with the observation that equity alone suffices to eliminate free-riding in joint production (Holmström, 1982) when parent resources are strongly complementary (see also Legros and Matthews, 1993), a commonly cited rationale for JVs. As a consequence, we can focus on inefficiencies arising from the exercise of residual control rights and ignore free-riding issues in the allocation of ownership. The elimination of such moral hazard in the presence of strong synergy effects might also explain the popularity of all-equity joint ventures (see Robinson, 2001) because they are the only form of strategic alliances in which firms share explicit ownership.

We establish that the three observed ownership regimes - joint control (50-50), 50 plus one share (*50-plus*), and outright majority control - coexist in equilibrium and can each be optimal for a wide range of parent and joint-venture attributes. In particular, we show how relatively small inefficiencies arising from the exercise of control rights suffice to make joint control optimal even for dissimilar parent firms. However, the incentive benefits of outright-majority ownership still outweigh the advantages of implicit veto rights when synergy gains are large relative to control-related losses. For intermediate cases of synergies and control inefficiencies, 50-plus ownership combines (almost) equal cash-flow rights with one-sided control. Our results are robust to the introduction of spillovers from learning or technological leakages that simply shift the balance between the three ownership regimes.

To relate our model predictions to the empirical evidence, we first estimate unobservable opportunity costs, which determine optimal ownership together with control costs and benefits, from parent wealth gains. We next specify a discrete-choice model of ownership in joint ventures that provides strong evidence in favor of our framework. We find that parent firms are more likely to adopt 50-50 ownership allocations when the potential for value diversion or for parent-level spillovers are high, or when their opportunity costs are comparable. Conversely, ownership with one-sided control is more frequent when contribution values are more dissimilar, the extraction of control benefits and scope for spillovers less likely, or resource complementarities more important.

To better distinguish between the consequences of spillovers and control rents, we also include proxies for the extraction of private benefits by the dominant partner in our specifications. The higher is the potential for such private benefits, the more likely are partners to choose 50-50 rather than one-sided control, once again bearing out our predictions. Finally, we test our theoretical framework based on strong resource complementarity against a model of resource substitutability and reject the latter in favor of the former.

Our main contribution is to show and empirically verify how distortions in incentives arising from residual control rights optimally shape ownership concentrated around equal shareholdings while preserving a rationale for asymmetric equity allocations in joint ventures. By explicitly recognizing that ownership not only creates but can also hurt incentives through control-related externalities, we are able to reconcile the observed prevalence of joint control and 50-50 ownership with a property-rights approach to inter-firm cooperation. At the same time, we propose a novel methodology to estimate specifications and test predictions derived from incomplete contracts (see also the methodological discussion in Whinston, 2001 and 2003 on this point), thereby filling an important void in the empirical literature on contract theory recently pointed out by Chiappori and Salanié (2002). As a consequence, we also provide empirical evidence on the property-rights view of the firm that goes beyond investigating buy-versus-own decisions and determinants of vertical integration as, e.g., in Monteverde and Teece (1982).

Closest to our work are Chemla, Habib and Ljungqvist (2004) and Bhattacharyya and Lafontaine (1995). The former analyze typical provisions in joint-venture and private-equity agreements aimed at achieving efficient ownership and distribution of control rights. The latter focus on the incentive properties of equity and find that linear sharing rules such as those implied by all-equity joint ventures can overcome the consequences of two-sided moral hazard and induce optimal investments. Allen and Phillips (2000) empirically verify the importance of such equity-based incentives by showing that corporate share block purchases create significantly higher abnormal returns in the presence of strategic alliances including JVs.

In the case of joint ventures, Belleflamme and Bloch (2000) argue that asymmetries in parent attributes and contributions imply asymmetric ownership arrangements while Darrough and Stoughton (1989) study the *ex post* effects of asymmetric sharing rules in a bargaining model but do not address issues of ownership and control. Similarly, Habib and Mella-Barral (2005) whose focus on buyout or termination decisions in joint ventures is complementary to our analysis of initial ownership also predict asymmetric share allocations. While these papers study important aspects of JV design, they do not explain observed ownership patterns and the role of joint or 50-plus-one-share control that are central to our analysis.

The question of joint control has also come to the forefront in the analysis of property rights. Cai (2003) characterizes ownership allocations under endogenous asset specificity and finds that joint control is optimal when investments are substitutes rather than complements. By contrast, we show that costly control can make joint ownership optimal regardless of asset type. Van Den Steen (2002) interprets bilateral equity participations that can internalize hold-up problems in corporate cooperations as 50-50 joint ventures in certain cases but does not investigate the optimality of two the clusterpoints around equal shareholdings. Wang and Zhu (2005) also find that joint control arises as a safeguard against the extraction of control rents in corporate cooperation unless efficient equity incentives of the dominant party are high enough to prevent rent-seeking. While their focus on the separation of income and control rights is complementary to ours they analyze the choice of joint vs. unilateral control and do not address the clustering of ownership at 50-plus-one share.

The paper is also related to the literature on the organizational form and design of corporate alliances. Baker, Gibbons and Murphy (2004) consider the optimality of various modes of inter-firm cooperation in the presence of spillovers and costly rent seeking by partners while Rey and Tirole (2001) show that the alignment or divergence of partner objectives and governance issues determine such choices, too. Fulghieri and Sevilir (2003) investigate the role of ownership in R&D alliances but focus on intellectual property rights when effort is noncontractible. These issues are very different from private partnerships in which Morrison and Wilhelm (2004) identify reputational rather than ownership mechanisms as a solution to suboptimal effort provision.[4]

[4]Corporate partnerships significantly differ from private ones in which tradeoffs between risk sharing and incentives are central (Lang and Gordon, 1995); Johnson and Houston (2000) reject the former as a motive for joint ventures.

The paper proceeds as follows. Section **??** discusses joint-venture ownership and the ambient legal environment. Section **??** presents a simple model of ownership and control in joint ventures that we characterize in Section **??** to motivate our subsequent empirical analysis. In Section **??**, we describe our data and methodology while Section **??** reports our empirical findings. The last section discusses our results and concludes. All proofs and tables are relegated to the Appendix.

2 Ownership and Contracting in Joint Ventures

Our data show that the clustering of ownership around equal stakes is not limited to the US and robust to different sample-selection criteria: roughly 75% of JVs exhibit 50-50 or 50-plus equity allocations with the remaining 25% showing widely differing majority stakes (Table **??**). However, corporate announcements and the management literature (Hennart, 1988 or Bleeke and Ernst, 1991) emphasize the importance of complementarities between the parties' resources that are typically heterogeneous. Hence, standard theory suggests that complementarity in resources and, more generally, differences in parent attributes such as resource costs, incentive requirements or information distribution would imply asymmetric shareholdings. But Table **??** illustrates that even parent firms differing in their attributes (size, industry, national origin, etc.) still prefer 50-50 ownership and joint control by far over asymmetric equity stakes. Studying 668 alliances worldwide, Veugelers and Kesteloot (1996) also find that about half of the joint ventures between two asymmetric parents exhibit 50-50 share allocations.

Similarly, US legal provisions would seem to favor a clear allocation of control to a majority shareholder. In 49 of the states, joint ventures fall under the *Uniform Partnership Act* and the *Revised Uniform Partnership Act*. "Disagreement among the partners" is resolved in all jurisdictions by majority vote, strict in most. In such cases, the court will let the parties vote their shares and decide according to the respective equity weights.[5] Hence, disagreement in 50-50 joint ventures often becomes intractable because it might lead to permanent deadlock. However, such an implicit veto right is precisely the legal device that allows the parties to share residual control rights (Grossman and Hart, 1986 and Hart and Moore, 1990), especially in unforeseen contingencies.

To avoid the adverse consequences of deadlock or lengthy court battles, the parties typically resort to governance provisions to resolve disagreement on key decisions (see Hewitt, 2001 for

[5] UPA §18(h); see also the decision in National Biscuit v. Stroud, 106 S.E.2d 692 (1959) which articulates the strict majority rule in corporate partnerships such as joint ventures.

details). However, it is often impossible to specify a clear, complete and enforceable mechanism to break an impasse in all contingencies.[6] As Campbell and Reuer (2001) point out, it might even be in the partners' best interest to leave contracts incomplete. Too detailed an enumeration of the partners' obligations might limit the joint venture's operational flexibility and could be construed as exhaustive by a court, further complicating management and conflict resolution. Instead, the venturers will often refer to general, less precise duties to maintain flexibility and simplicity.

Given the considerable scope for contractual incompleteness and subsequent disagreement between partners, the legal environment seems to favor a clear allocation of control rights, not 50-50 shareholdings. But majority control, while avoiding potentially costly deadlock, might give rise to abuses by the dominant partner that are often hard to verify for an outside party such as a court or arbitration panel.[7] As fiduciary duty provisions extend only limited protection to the minority partner,[8] equal ownership allocations with their threat of value-destroying deadlock can serve as a commitment device not to extract private benefits. Indeed, Hewitt *et al.* (2001) observe that "a joint venture with the potential for deadlock deliberately built into the structure [such as 50-50 share allocations] is, in fact, itself, the best way of encouraging the parties to reach agreement ... The dire consequences of an insoluble deadlock on the ongoing business (to the detriment of both parties) will generally ensure that a sensible compromise is reached."

3 Model Description

Two risk-neutral firms A and B form a joint venture by contributing costly investments $I_i, i = A, B$ to a jointly owned corporate entity. These contributions might take the form of tangible assets such as funds, plant or machinery ("investments"), or intangible ones such as human, technology or marketing resources ("effort"). For simplicity, the cost of using the assets for joint-venture activity rather than the next-best alternative including other forms of inter-firm cooperation is quadratic with parameter c_i , i.e., $\frac{c_i}{2}I_i^2$. In keeping with standard property-rights models, we take parent investments to be complementary, all the more that an often cited rationale for joint ventures are complementarities in assets and expertise (synergies).[9] Hence, we adopt the familiar Leontief

[6]See, among many other examples, the decision in NBN Broadcasting, Inc. v. Sheridan Broadcasting Networks, 105 F.3d 72 (1997). Elfenbein and Lerner (2003) and Robinson and Stuart (2001) provide empirical evidence consistent with significant contractual incompleteness including effort provision in strategic alliances and joint ventures.

[7]See Campbell and Reuer (2001) and the decision in Saudi Basic Industries v. Exxonmobil, 94 F. Supp. 2d 378 (2002) for an example.

[8]See the decision in Meinhard v. Salmon, 154 N.E. 545 (1928).

[9]JV agreements often stress the complementary nature of the parents' contributions and the resulting synergies.

production function $V(I_A, I_B) = \min\{I_A, I_B\}$ for the wealth-creation process. Section **??** contrasts our results with the case of perfect input substitutability corresponding to a linear value-creation process, the CES function's other polar case. Synergy effects also presuppose that the partners' inputs I_A and I_B be nonhomogeneous and, generically, of different size. Without loss of generality, we let A contribute the more valuable resource and, hence, $c_A \geq c_B$.

We take the parties' contributions to be noncontractible in the sense that contractual provisions in their regard are difficult to verify or enforce. This assumption captures the often very specialized or intangible nature of the investments, whose quality or value might be hard to assess by the partner, let alone an outside party such as a court of law. Hence, contracts can only be written on verifiable output, not individual contributions I_i so that the parties need to receive appropriate investment incentives through their ownership rights. Following Holmström (1982), we further assume that the partners fully split the JV's surplus so that budgets always balance. By the results in Bhattacharyya and Lafontaine (1995), the optimal contract now becomes a linear one so that we can limit our analysis to linear sharing rules, i.e., equity contracts.

Following established (American) legal practice, we assume that 50% ownership plus one share suffices for effective control which is particularly valuable because it confers private benefits. The controlling parent is able to appropriate a fraction δ of the joint venture's gross value V which we think of as residual-control benefits. They come at the expense of diminishing the JV's terminal value by a fraction $d > \delta$ through, e.g., the erosion of synergy gains, so that the remainder of the company has only a value of $(1-d)V$.[10] In the case of 50-50 ownership, neither control costs nor benefits accrue because parents share residual control rights in the sense of Hart and Moore (1990). Under US law, each venturer now has effective veto power over the use of common assets so that the threat of deadlock and ensuing legal action suffices to deter private-benefits extraction.

Letting parent A's equity stake be γ so that B's is $1-\gamma$, the joint venture's net value W_A to firm A as a function of ownership becomes

$$W_A = \begin{cases} [\delta + \gamma(1-d)]\, V(I_A, I_B) - \frac{c_A}{2} I_A^2 & \text{for } \gamma > \frac{1}{2} \\ \frac{1}{2} V(I_A, I_B) - \frac{c_A}{2} I_A^2 & \text{for } \gamma = \frac{1}{2} \\ \gamma(1-d) V(I_A, I_B) - \frac{c_A}{2} I_A^2 & \text{for } \gamma < \frac{1}{2} \end{cases}, \tag{1}$$

and similarly for parent B's net value W_B. Since the controlling party appropriates $\delta + \gamma(1-d)$

[10] Taking control benefits and costs to be linear in joint-venture value V is for ease of exposition only. Our results hold as long as control benefits and joint-venture value net of control costs are both non-decreasing in JV-value V.

of the joint venture's value including private benefits, control is valuable as long as its net value $\delta - \gamma d$ is positive, i.e., $\delta > \gamma d$ which we henceforth assume. Otherwise, the majority owner would not extract control rents because her loss as a shareholder γd would exceed her private benefit δ.

In theory, nothing precludes the parties from allocating specific control rights through governance provisions that, among others, require unanimity including supermajorities or the minority partner's consent on key decisions. In practice, such arrangements could not possibly foresee all future contingencies so that decision-specific allocations of control are unlikely to work in all possible states of nature, i.e., are incomplete.[11] Since we focus on the overall allocation of ownership our specification is consistent with the notion that parents cannot effectively separate the allocation of cash-flow and voting rights in all contingencies. Indeed, given their complementary nature (Hart, 1995, pp. 63ff.) the contractual separation of ownership and control might not be feasible or even desirable (see also Campbell and Reuer, 2001) so that typical default provisions (e.g., under the *Uniform Partnership Acts* in US law) come into play and align cash-flow and voting rights.

4 Ownership and Control

Before characterizing optimal ownership allocations, we first establish the desirability of joint ventures as an organizational form for corporate cooperation in the presence of strong synergy effects.

4.1 Optimality of All-Equity Joint Ventures

In the absence of private control costs and benefits, i.e., $\delta = d = 0$, the parents maximize the JV's net value $W(I_A, I_B) = \min\{I_A, I_B\} - \frac{c_A}{2} I_A^2 - \frac{c_B}{2} I_B^2$ by choice of equity stakes γ_i subject to the following contribution-incentives conditions derived from $\max_{I_i} W_i, i = A, B$

$$I_A = \frac{\gamma}{c_A} \text{ and } I_B = \frac{1-\gamma}{c_B} \tag{2}$$

and the efficiency condition $I_A = I_B$ to insure that none of the two inputs is wasted.

[11] For empirical evidence that minority protection clauses are considered as not fully effective, Kaplan and Strömberg's (2003) document the presence of decision-specific control rights in VC contracts, but mainly emphasize the importance of contingent control allocation to overcome contractual incompleteness. Similarly, Bai *et al.* (2003) show in the context of Chinese joint ventures that specific provisions on decision right are frequent, but conclude that control considerations rather than profit sharing motivate ownership arrangements in JVs.

The optimal ownership stakes are simply each parent's relative opportunity cost

$$\gamma^* = \frac{c_A}{c_A + c_B} \quad \text{and} \quad 1 - \gamma^* = \frac{c_B}{c_A + c_B} \tag{3}$$

that are asymmetric except for the case of identical parent costs, i.e., $c_A = c_B$. We will see that the first-best equity stakes γ^* play a crucial role in the allocation of ownership because they measure the relative difference in the parents' opportunity cost and, hence, the respective need for incentives. Note that we can also think of the ownership allocations γ^* as an intuitive proxy for parent similarity in terms of their outside options.

In principle, there is no reason to expect that the equity stakes in Equation (**??**) lead to the first-best value of the joint venture. Joint production typically suffers from an externality problem between the partners that attempt to free-ride on each other's contribution, first analyzed by Holmström (1982). However, the strong complementarities in parent resources as embodied by the Leontief specification eliminates such free-riding. Directly maximizing joint-venture value $W(I_A, I_B)$ with respect to investments I_i shows that optimal ownership γ^* yields first-best contributions $I_i(\gamma^*) = I_i^*$ and joint-venture value $W(\gamma^*) = \frac{1}{2}\frac{c_A}{c_A+c_B} = W^*$.

Proposition 1 *If parent resources are strong complements, optimal ownership stakes* $\gamma^* = \frac{c_A}{c_A+c_B}$ *in all-equity joint ventures realize first-best value creation in the absence of control costs and benefits.*

This result is a special case of Legros and Matthews (1993) that we are able to obtain in closed form. The proposition implies that we can abstract from moral hazard in joint production and focus on control benefits in the allocation of ownership. It highlights the advantages of all-equity joint ventures as an organizational choice in the presence of significant synergy effects because only this form of inter-firm cooperation allows the partners to use equity allocations - ownership - to decentralize efficient value creation. Proposition **??** also develops the argument in Hart and Moore (1990) that common asset ownership might be optimal in the presence of strict complementarities by attributing specific ownership stakes to the parties (see also Cai, 2003).

We would expect the requisite strong synergy effects to primarily arise in vertical joint ventures. The finding of Johnson and Houston (2000) that such joint ventures create significantly more value for their parents than comparable contractual arrangements or horizontal joint ventures provides empirical evidence in favor of Proposition **??**. They also report that firms choose joint ventures over simple contracts when noncontractibilities measured in terms of R&D expenditure (effort) are more severe which is again consistent with the preceding proposition and our specification.

4.2 Optimal Ownership Allocations

Let superscripts $k = A, J, P$ denote asymmetric, joint, and 50-plus control, respectively. Under our cost convention $c_A > c_B$, the first-best ownership allocation in Equation (**??**) seems to suggest that parent A should have outright majority control ($k = A$) for optimal investment incentives. Maximizing the parents' net total return in Equation (**??**) by choice of contribution I_i, i.e., $\max_{I_i} W_i^A$, $i = A, B$, yields the parties' incentive compatible resource contributions for $\gamma > \frac{1}{2}$:

$$I_A = \frac{\delta + \gamma\,(1-d)}{c_A} \;\; \text{and} \;\; I_B = \frac{(1-\gamma)(1-d)}{c_B}. \tag{4}$$

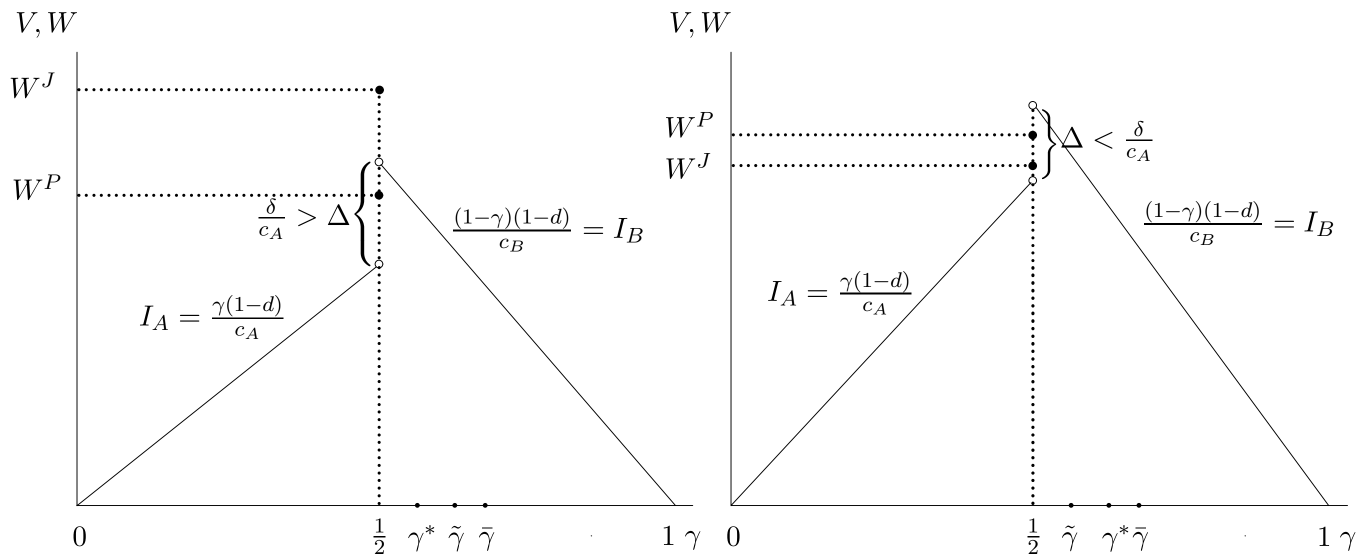
The preceding expressions reveal that granting control to one party (A) hurts the investment incentives of the other (B). The optimal distribution of ownership now depends on the partner whose contribution determines, at the margin, the output of the joint venture.

Hence, we consider each parent in turn, starting with firm A. In this case, A's contribution constrains the JV's value for first-best equity stakes γ^*. It is then in both parties' interest to adjust equity stakes so that the investment incentives in Equation (**??**) are equalized yielding the following second-best shareholdings:

$$\gamma^A = \gamma^* - \frac{\delta}{(1-d)}(1-\gamma^*) \text{ and } 1-\gamma^A = \frac{1-d+\delta}{1-d}(1-\gamma^*). \tag{5}$$

We see that the presence of control inefficiencies distorts the allocation of ownership and, hence, investment incentives. The parties gross up B's stake and decrease A's by the relative value of control to provide second-best efficient contribution incentives. However, the incentive gains from granting control to firm A more than compensate partner B for its costs. Under control by A, the net value of parent i's stake is $W_i^A = (1-d+\delta)^2\, W_i^*$ which is simply its first-best value adjusted for the net social cost of control $d - \delta$.

In the other case, control by firm A hurts B's incentives to a point where the latter's contribution becomes the constraining factor in value creation. It is now impossible to equalize investment incentives when γ^* lies in a critical region $\left(\frac{1}{2}, \bar{\gamma}\right)$ around 50-50 ownership (see Figure **??**) because granting control to B is never optimal by our cost convention $c_A > c_B$. The incentive effect of control by A ($\frac{\delta}{c_A}$ in Equation (**??**)) alone is larger than the difference in contribution incentives (Δ



(a) 50-50: Joint Control

(b) 50-plus: One-sided Control

Figure 2: Ownership Allocations with Symmetric Income Rights: 50-50 vs. 50-plus

in Figure ??). Three thresholds for relative resource costs γ^* together with the net social cost of control $d - \delta$ now determine the optimal choice of 50-50 ($k = J$) or 50-plus ownership ($k = P$).

Proposition 2 *For small net social costs of control $d - \delta$ there exists a 50-plus threshold $\tilde{\gamma}$ so that joint control is optimal for $\gamma^* \in \left[\frac{1}{2}, \tilde{\gamma}\right)$, 50-plus control for $\gamma^* \in [\tilde{\gamma}, \bar{\gamma})$, and outright majority control by A for $\gamma^* \geq \bar{\gamma}$.*

If control is socially very costly, 50-plus ownership is never optimal and a new threshold $\hat{\gamma}$ determines the choice between joint control ($\gamma^* \leq \hat{\gamma}$) and outright-majority control by A ($\gamma^* > \hat{\gamma}$).

Proof. See the Appendix. ■

Figure ?? illustrates the intuition behind 50-50 equity allocations that not only avoid the net social cost of control $d-\delta$, but also the discontinuity in contribution incentives. Even small control inefficiencies suffice to make 50-50 ownership optimal for a wide range of relative-opportunity costs γ^* if control-related frictions are significant relative to the difference in contribution incentives. If relative costs γ^* are close to the threshold $\bar{\gamma}$ and net social control costs $d - \delta$ not too important, the need for incentives for the party contributing the more valuable resource (firm A) outweighs any efficiency loss from one-sided control. In this case, 50-plus ownership that combines equal return rights with control by parent A becomes optimal (see Figure ??). One-sided control serves to optimally re-equilibrate investment incentives when the venturers are mildly heterogeneous, i.e., when relative costs are above a second threshold $\tilde{\gamma}$ separating 50-50 and 50-plus allocations. Hence, we find the two observed cluster points around 50-50 shareholdings in function of the relative size of efficiency losses from one-sided control or suboptimal investment by the dominant parent when the parties cannot equalize contribution investments.

For large net control costs, efficiency losses from one-sided control outweigh any benefits from combining equal cash-flow rights with unequal voting rights so that the 50-plus regime disappears. The partners will only deviate from 50-50 ownership if the value of their contributions are so dissimilar (high γ^*) that majority control by firm A through shareholding γ^A can equalizes incentives. In this case, a third threshold $\hat{\gamma}$ separates joint from outright-majority control by A.

It is worthwhile to point out that nothing in our specification precludes control benefits δ to outweigh costs d, i.e., $\delta > d$, so that one-sided control becomes socially desirable. This specification also captures the existence of potential operating inefficiencies arising from joint control such as protracted decision making, duplication of effort, lack of management oversight and inefficient governance, etc. that one-sided control avoids. A simple extension of our analysis then shows that joint control is never optimal so that, as $\delta - d$ increases and eventually becomes positive, 50-plus ownership displaces the 50-50 regime.

Figure **??** summarizes our model's testable implications that follow from the fact that optimal ownership arrangements vary with relative opportunity costs γ^* and net control inefficiencies $d - \delta$. As parents become more heterogeneous (γ^* increases), optimal ownership changes from 50-50 with equal cash-flow and control rights over one-sided control (50-plus) to outright majority control. At the same time, the higher the net social cost of control $d - \delta$, the more dissimilar the parents can be in terms of cost parameters under 50-50 and joint control.

From a cross-sectional perspective, a wide set of parameters can generate the observed ownership patterns. In particular, very different, possibly industry-specific combinations of parent attributes and net social costs of control can give rise to the same optimal share allocation around 50-50. The key insight is that residual control associated with majority ownership may lead to efficiency losses that veto rights implicit in equal shareholdings can avoid.

4.3 Spillovers

Joint ventures often give rise to parent-specific positive externalities through learning and transfer of expertise or technology in addition to direct gains from synergies (see, e.g., Cassiman and Veugelers,

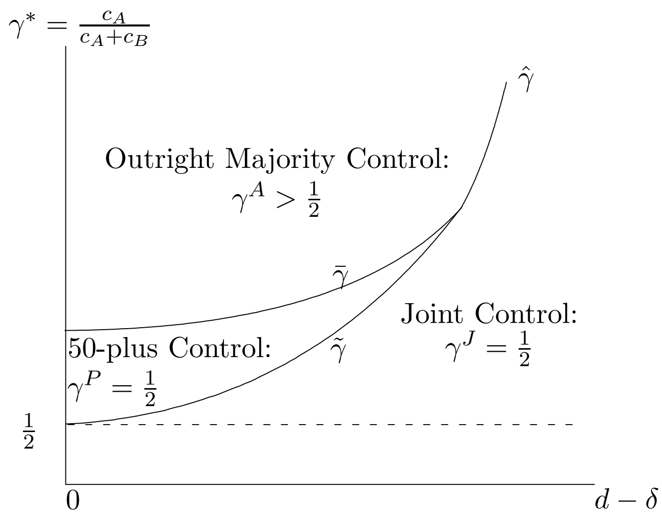


Figure 3: Ownership and Control

2002). To incorporate such spillovers into our model, suppose that their size is a function of the joint venture's success so that an additional fraction $s_i \geq 0, i = A, B$ of its gross value V accrues directly to each partner. Hence, investments can have return components that are not specific to the JV relationship. For simplicity, we assume that spillovers do not incur any additional costs.[12]

It is straightforward to show that optimal ownership now depends on the relative size of spillovers and control benefits. Replicating the preceding analysis, we find that spillovers shift the regions of optimal control in terms of the parent-cost parameter γ^*.

Proposition 3 *If the dominant parent's spillovers s_A are large relative to the partner's s_B, the region of optimal 50-50 control in terms of relative costs γ^* increases; otherwise, it decreases.*

Proof. See the Appendix. ■

The preceding proposition establishes that spillovers increase the likelihood of 50-50 to the detriment of majority ownership if relative spillover gains $\frac{s_A}{s_A+s_B}$ fall outside the critical region $\left(\frac{1}{2}, \bar{\gamma}\right)$. The more additional incentives parent A receives through spillovers s_A the less need there is for the parties to resort to one-sided control to equalize contributions. Similarly, if spillovers and control are complementary in the sense that a majority owner is able to unilaterally increase her specific gains s_A, the likelihood of 50-50 ownership rises with the potential for such spillover gains. Conversely, for $\frac{s_A}{s_A+s_B} \in \left(\frac{1}{2}, \bar{\gamma}\right)$, the existence of spillovers partially compensates the minority partner, who enjoys high spillovers s_B relative to s_A, for control-related losses. Hence, 50-50

[12] As for control costs and benefits, we only require spillover gains to be monotonic in joint-venture value V.

shareholdings become less likely. Regardless of their respective sizes, however, the existence of parent-specific spillovers increases the likelihood of 50-50 ownership relative to the 50-plus regime.

4.4 Cash-Flow and Control Rights

In the preceding analysis, we abstract from the separation of residual income and control rights beyond 50-plus shareholdings for several reasons. Although joint-venture agreements often allocate issue-specific decision rights to override legal default provisions ("Matters Requiring Consent") frequent lawsuits between partners disputing the precise nature of such rights attest to the difficulty of unambiguously separating ownership and control.[13] Similarly, dual class shares that do not seem widespread in the US offer little protection even in the UK where they do exist (Campbell and Reuer, 2001) so that Hewitt *et al.* (2001) recommend veto clauses and put options as better devices to protect the interests of a minority partner.[14] Studying US dual-class companies, Gompers *et al.* (2004) report that control rights are detrimental to firm value when they significantly exceed cash-flow rights due to the extraction of private benefits. Their findings suggest that the divergence of such rights leads to too little investment and lower valuations.

Divergence in cash-flow and voting rights can also lead to opportunistic behavior if the controlling firm does not sufficiently internalize the consequences of its actions. The property-rights literature has long recognized this complementarity between income and control rights (see, for instance the discussion in Hart, 1995, pp. 63ff.), and the empirical evidence is consistent with the notion that their separation creates new costs (see Claessens *et al.*, 2002 or Johnson *et al.*, 2000), especially in the face of contractual incompleteness. The less cash-flow rights a controling shareholder has, the stronger are the incentives to expropriate minority owners by diverting value (see, e.g., Bennedsen and Wolfenzon, 2000). In fact, Bebchuk *et al.* (2000) argue that the agency costs of separating income and control rights are an order of magnitude larger than those associated with controlling shareholders that also hold a majority of cash-flow rights.

Since a controlling shareholder can always attempt to hold up a partner with the higher cash-flow share to force a reallocation of returns, the optimal separation of income and control rights requires a 50-50 allocation of *voting* rights effectively giving each partner veto powers (Hewitt *et*

[13]See, for instance, the decision in NBN Broadcasting, Inc. v. Sheridan Broadcasting Networks, 105 F.3d 72 (1997). Law suits to resolve disagreement are widespread because many jurisdictions allow referral of contractual disputes to courts despite explicit privately specified mechanisms for the resolution of conflict (Campbell and Reuer, 2001).

[14]Our data does not suggest that parents separate income and control rights through dual-class shares or similar devices although we observe ancillary cash-flow arrangements in the form of royalty and licensing agreements in about 5.13% of observations.

al., 2001).[15] As a result, we are back in the setting of Section **??** so that parents would simply allocate *cash-flow* rights according to the first-best equity allocations γ^* in Equation (**??**) that equalize contribution incentives in the absence of control costs and benefits. Under this scenario, however, all joint ventures should adopt 50-50 voting-rights allocations which cannot be optimal in all circumstances and is clearly at odds with the data (see Table **??**).

Instead, joint-venture agreements seem to resort to contingent-ownership arrangements to provide incentives and resolve conflicts *ex-post* (Hewitt *et al.*, 2001). Rights of first refusal, buyout, sell-out and other option-like provisions[16] can serve to overcome contractual incompleteness (Chemla, Habib and Ljungqvist, 2004) and permit the partners to reallocate control while preserving the complementarity of cash-flow and voting rights. Table **??** highlights the importance of such provisions. Buyouts or sellouts (34.35% of JVs) are much more common in JVs with one-sided control suggesting that parents prefer to change the distribution of ownership and control concurrently (see also Habib and Mella-Barral, 2005). Explicitly announced options seem also to be concentrated in joint ventures with one-sided control as predicted by theory (Nöldeke and Schmidt, 1998).

5 Data Description and Methodology

A fundamental problem in testing empirical predictions of property-rights models such as ours is the estimation of key cost or investment variables that, by hypothesis, are noncontractible and, hence, unobservable (see Whinston, 2003 on this point). However, by analyzing joint ventures between publicly traded firms we can recover estimates of relative opportunity costs γ^* from parent wealth gains and observed ownership structure under our model assumptions. Hence, our focus on inter-firm cooperation through joint ventures allows us to sidestep the usual unobservability problems arising in structural models of property rights while, at the same time, generating a richer set of predictions for testing the determinants of ownership.

[15] Wang and Zhu (2005) confirm this observation by showing that unilateral control can only be optimal if the efficient equity incentives of at least one party are so large that it would voluntarily refrain from any benefit taking, i.e., $\gamma_i^* d > \delta$ in our case.

[16] Other common mechanisms to resolve conflicts between partners are "shoot out" (buy or sell) or "Russian Roulette" (one party names a price, the other one the transaction type: buy or sell at this price) provisions.

5.1 Sample Selection and Data Description

We start with all US joint ventures[17] announced between January 1985 and 2000 in the Joint Ventures and Strategic Alliances database of Thomson Financial Securities Data (TFSD, old SDC) with complete ownership information (around 3,069) from which we select all two-parent ones (about 80% of all JVs) excluding JVs with state-owned entities, leaving 2,718 data points (see Table **??**). For joint ventures with at least one publicly traded parent we verify and correct the records with information obtained by searching news wires around announcement dates, Lexis/Nexis, and Edgar (SEC) to improve the data quality. In case of conflict, we delete the questionable observation.

If parents announce other joint ventures during the event window, we only include the first one. Matching venturers with stock price and other financial information from the FactSet database family, whenever available, leaves a total of 1,248 joint venture announcements with 1,545 publicly traded parent companies. From these observations we extract our main sample of joint ventures whose parents are both publicly traded companies (297 joint ventures with 594 parent observations). Whenever necessary, we exclude 22 contaminated observations for which at least one parent had other significant corporate news reported around the joint venture announcement (M&A, regulatory action, CEO turnover, etc.).

From Table **??** we see that the sample comprises a broad cross-section of industries and, by comparison with the larger sample of 1,248 JVs with at least one publicly traded parent, is fully representative of US joint-venture activity. Most joint ventures involve parents in Transportation, Communications, Gas, Electricity, Manufacturing, Wholesale Trade, and Services. Table **??** indicates that 67.85% of parents are American firms and 32.15% foreign ones (17.85% Japanese, 3.03% German, 2.36% British, etc.) so that our sample offers sufficient heterogeneity in parent firms' national origin for testing model predictions.

Parent-firm characteristics vary quite substantially (see Table **??**). On average, parent firms tend to be large in terms of market value ($7.18b), assets ($13b), sales ($11.7b) and number of employees (96,189) which, in light of our focus on publicly traded companies, is hardly surprising. However, a wide range of firms is represented: the largest parent counts 813,000 employees (GM in 1988), the smallest one 34 (Cyanotech in 1994). At the same time, Table **??** does not suggest any obvious size effects since the parents' economic attributes do not seem to systematically vary with

[17] TFSD define a joint venture as "... a cooperative business activity, formed by two or more separate organizations for strategic purpose(s), which creates an *independent business entity*, and allocates *ownership*, operational responsibilities, and financial risks and rewards to each member, while preserving each member's separate identity/autonomy."

ownership.

5.2 Wealth Gains and Relative-Cost Estimation

Joint-venture partners trade off gains from resource complementarities with investment incentives and control effects. From their shareholders' perspective, parent firms should only participate if the joint venture creates value net of resource and agency costs. If so, we would expect their share prices to reflect expected wealth gains from JV activity. Hence, we compute daily abnormal returns to JV announcements using a linear market model that we estimate with a correction for non-synchronous trading effects. For comparability across parents, we take the S&P 500 and equally representative foreign stock-market indices as the relevant market portfolios. Our estimation window ranges from 280 to 50 days prior to the joint venture announcement while the event window stretches from 20 days before to 20 days after the announcement date.

Under the assumption of informationally efficient capital markets, the cumulative abnormal wealth created by joint venture announcements $w_i, i = A, B$ should reflect parent i's expected payoff W_i. Hence, we can estimate parent wealth gains as

$$w_i\left(\tau_1, \tau_2\right) = \widehat{CAR}_i\left(\tau_1, \tau_2\right) \cdot K_{i-21} \tag{6}$$

where K_{i-21} and $\widehat{CAR}_i\left(\tau_1, \tau_2\right)$ are firm i's market capitalization on the eve of the event window and its estimated cumulative abnormal return over the announcement window τ_1 to τ_2, respectively.

The first panel in Table **??** summarizes our event study results in terms of cumulative abnormal returns whose means range from 0.860% for a two-day event window to 1.141% for a five day one and are highly significant (P values of 0.0000).[18] These abnormal returns translate into wealth gains for shareholders of parent firms that average between \$45 to \$60 million (Table **??**, second panel). Normalizing wealth gains by ownership stakes and averaging them according to shareholdings, our results suggest that 50-50 joint ventures create among the most wealth for their parents' shareholders over a two-day window (Table **??**: third panel). Furthermore, normalized wealth gains tend to be, on average, larger for the majority than the minority parent. This observation is consistent with our assumption that majority owners derive additional benefits from control.[19]

[18] Our findings are broadly in line with the results of earlier studies of joint-venture announcement effects such as McConnell and Nantell (1985) or Johnson and Houston (2001), and non-equity strategic alliances excluding joint ventures (see Chan *et al.,* 1996).

[19] For the six joint ventures with majority stakes between 51% and 60%, one outlier causes the large negative average-wealth realization.

Parent-wealth gains allow us to establish a direct link between our model, its predictions, and the empirical evidence. Recall that optimal ownership arrangements depend on relative opportunity costs γ^* that are unobservable (see Figure **??**). However, the net value of optimal equity stakes is a function of γ^* under the model assumptions (Leontief value-creation process and quadratic investment costs). Hence, the corresponding expression and the observed ownership distribution (regime k) allow us to recover estimates of the unobservable relative-cost parameters γ^* from parent wealth gains.

Proposition 4 *The respective size of observed wealth gains and ownership stakes identify parents as A or B in each joint venture. Hence, the relative-cost parameter γ^* can be estimated in terms of observed cumulative wealth gains $w_i(\tau_1, \tau_2)$ for ownership regimes $k = A, J, P$ as $\widehat{\gamma}^*(k)$ where*

$$
\begin{aligned}
k = A: \ \widehat{\gamma}^*(A) &= \frac{w_A(\tau_1,\tau_2)}{w_A(\tau_1,\tau_2) + w_B(\tau_1,\tau_2)} \\
k = J: \ \widehat{\gamma}^*(J) &= \frac{w_A(\tau_1,\tau_2)}{3w_A(\tau_1,\tau_2) - w_B(\tau_1,\tau_2)} \\
k = P: \ \widehat{\gamma}^*(P;z) &= \frac{(2+z)\,w_B(\tau_1,\tau_2) - w_A(\tau_1,\tau_2)}{(3+z)\,w_B(\tau_1,\tau_2) - w_A(\tau_1,\tau_2)}, \ z = \frac{4\delta}{1-d} > 0
\end{aligned}
\tag{7}
$$

Proof. See the Appendix. ■

In the presence of spillovers, the proposition carries over without change for one-sided control (50-plus P and outright majority A). For 50-50 ownership, we can estimate relative costs $\widehat{\gamma}^*(J)$ only if parent spillovers are not too dissimilar. But Proposition **??** implies that 50-50 ownership allocations are only optimal if this is indeed the case. Note that $\hat{\gamma}^*(k)$ is an estimate of the exogenous cost parameter that drives regime choice but not *vice versa.* We merely use the observed ownership regime to identify the appropriate functional form for its estimation. As a consequence, we can include $\hat{\gamma}^*(k)$ (summarized in Table **??**) as an explanatory variable in our cross-sectional analysis without inducing any endogeneity bias.

Proposition **??** and Figure **??** suggest a simple univariate test of our model: the opportunity-cost measure $\widehat{\gamma}^*(k)$ in Equation (**??**) should be larger for joint ventures with outright-majority control than for 50-50 ones regardless of control inefficiencies. Table **??** (first panel) reports the results of a one-sided t-test of this prediction. Since the P value of the relevant test statistic is close to 0 for all subsamples, we decisively reject the null hypothesis that γ^* is invariant and conclude that cost attributes in majority-controlled joint ventures are more heterogeneous than in 50-50 ones. We also find that we cannot reject the hypothesis $\gamma^* (J) = \frac{1}{2}$, which is again consistent with our model (see Table **??**, second panel). We take these test results as evidence in favor of both our model specification and its predictions.

5.3 Measuring Asset Complementarity and Spillover Potential

Both our formal analysis and estimation of the crucial relative-cost parameter γ^* in Proposition **??** rely on strong complementarities in resource contributions. Hence, we first verify that our data exhibits a sufficiently low degree of input substitutability as required by our Leontief specification that we measure in terms of the *overlap* in production technology and expertise between parents.[20] Following Fan and Lang (2000), we define and calculate overlap as the correlation of intermediate inputs and outputs of parents from the commodity flows of their respective industries that we derive from Leontief-type Input-Output tables (see Table **??** for details). The lower the correlations, the less alike are the parents in their input and output dimension so that their technologies, expertise, and production factors are more likely to be complements with correspondingly higher scope for JV-level synergies.

Table **??** shows that the sample mean of the *average* input and output correlations between parents is 0.20. A one-sided t-test shows that we cannot reject the hypothesis that the average correlation is zero (P value of 0.2614). Since absence of overlap in parent technologies and expertise in either production dimension is sufficient for strong synergy effects, the *minimum* of the input and output correlations is an even better indicator of complementarity. In this case, we find a sample mean of only 0.14 identifying over 80% of JVs as complementary (overlap smaller than mean).

We also employ an alternative method to examine the degree of complementarity in our sample that builds on definitions of joint-venture type by TFSD. We sort our sample into JVs requiring resource complementarities (manufacturing with or without one-sided technology contributions, marketing or distribution, exclusive supply or Original Equipment Manufacturing, exploration, etc.) on the basis of announced business model and JV objectives (see Table **??** for details) and those that do not. To further refine this classification, five persons independently assess the nature of the parent contributions and expertise from descriptions of the intent, business model, and focus of the joint venture, and the parent resources and investments contained in news wire announcements (Dow Jones Interactive, Business and PR Wires), Lexis/Nexis, and TFSD. Table **??** indicates that

[20] The Leontief production function's elasticity of substitution between inputs (parent contributions) is zero.

parent contributions overwhelmingly appear to be complements (82.18%) rather than substitutes (10.18%) and that, once again, the pattern is consistent across ownership allocations.

The TFSD definitions and our announcement-based classification also allow us to construct proxies for JV-level synergy effects (resource complementarities: $COMP$) and positive spillovers (parent-specific externalities: $SPILL$) that accrue directly to parents, i.e., $s_i V(I_A, I_B)$. We first record whether joint ventures engage in R&D, licensing or cross-licensing, technology or cross-technology transfers, and exclusive licensing (*spillover* potential), or in manufacturing, sales and marketing, exploration, exclusive supply or OEM-value added reselling, etc. (indicative of *complementarities* in resources). Each activity classification gets a 0 or 1 score (except for R&D, cross-licensing and cross-technology transfer with scores of 0 or 2 because of the potential for two-sided spillovers) that we then simply add up across the spillover and complementarities categories to obtain the corresponding scope indices $COMP$ and $SPILL$ ranging from 0 to 9.[21] Consistent with our theoretical results, Table **??** shows that 50-50 joint ventures offer, on average, less scope for complementarities but more spillover potential.

5.4 Discrete-Choice Specification

In light of our three distinct control regimes, it seems natural to specify a discrete-choice model of joint-venture ownership. Such specifications arise from latent variables, in our case the JV value under optimal ownership given the attributes of the parents (relative costs, spillover effects, control costs and benefits) and joint venture (scope for complementarity). Hence, we let the probability that joint venture j adopts a particular ownership regime $k = A, J, P$ be governed by

$$\Pr\{REGIME_j = k\} = \Lambda\left(\beta_{1k}\widehat{\gamma}^*(k;z)_j + \beta_{2k}LEV_j + \sum_{l=3}^{6}\beta_{lk}RELpvp_j^l + \sum_m \beta_{mk}x_j^m\right) \quad (8)$$

where Λ is the logistic distribution function, $\widehat{\gamma}^*(k;z)$ the estimate of our relative-cost parameter defined in Equation (**??**), and LEV a binary variable indicating leverage of the JV. We report the means of our explanatory variables by parent stake in Table **??**.

$RELpvp^l$ represent two sets of binary variables that classify parents and joint ventures in terms of their relatedness by two-digit Standard Industry Classification codes ($SICpvp^l$: related if they

[21] Our binary classification coincides with the most commonly cited motives for joint ventures (McConnell and Nantell, 1985) that are (in decreasing order from the top) "To Acquire Skills and Technical Know How" (*spillovers*), "To Acquire Distribution Facilities" for own production (*complementarities*), and "To Acquire Production Facilities" for own distribution (*complementarities*); "R&D" and "Licensing" (*spillovers*) are 6 and 10, respectively.

share the same two-digit code) and national origin ($NATpvp^l$: headquarters in the same country) to control for industry and country effects. In the construction of $RELpvp^l_j$, the outer letters refer to the two-digit SIC code or national origin of the parents (same code/location = same letter) whereas the middle letter indicates JV j's SIC code or (invariant) US location a. For example, $SICaaa$ denotes an observation with both parents in the same industry as the JV whereas $SICacb$ refers to a joint venture with all three entities in different industries (completely unrelated). Our focus is on $SICaab$ and $NATaab$ as proxies for value diversion because one parent is from the same industry (country) as the JV while the other is not.

The last set of variables, x^m, represents joint-venture and parent attributes. To capture JV-level synergy effects we use the variable $COMP$; similarly, the $SPILL$ index is a proxy for positive externalities accruing to parents from JV activity (see Table **??** for details). To measure the scope for control benefits and costs as a function of parents' production technology and expertise, we construct the variable $DOVER$ that gauges the degree to which parents, relative to each other, share technology attributes with the JV. Proceeding as in the construction of production overlap (Table **??**), we first calculate the average of the intermediate input and output correlations between the industries of parent i and joint venture j ($OVER_{ij}$) and of both parents ($OVER_{AB}$). We next sort parents into A or B according to Proposition **??** and normalize their respective overlap with the joint venture j by their own production overlap as $OVER_i = \frac{OVER_{ij}}{OVER_{AB}}, i = A, B$. Our proxy for potential control benefits is then simply the difference in normalized firm-JV production overlap: $DOVER = \frac{OVER_{Aj} - OVER_{Bj}}{OVER_{AB}}$. We also use $OVER_i, i = A, B$ to study parent-specific control effects.

The intuition behind $DOVER$ as a measure of control benefits and costs is straightforward. The more firm A shares technology and expertise with the joint venture relative to firm B (high differential production-function overlap $OVER_{Aj} - OVER_{Bj}$), the more opportunity for value diversion the dominant parent has. However, if both firms themselves significantly overlap (high $OVER_{AB}$) the scope of such activities (e.g., through easier monitoring and threat of legal action) or their cost to the joint venture and the partner (e.g., through spillover gains) might decrease.

We estimate the multinomial discrete choice model in Equation (**??**) by Full-Information Maximum Likelihood. Since the likelihood of observing the 50-plus regime ($k = P$) also depends on the parameter z, we conduct a grid search over z to maximize the log-likelihood function in the subsequent estimation. We use our noncontaminated two-parent sample (275 observations) but exclude 8 outliers whose wealth effects are so close to 0 that our estimate of relative costs $\widehat{\gamma}^*(k; z)$

falls outside the interval $(-5, 5)$.

6 Empirical Evidence

6.1 Ownership Choice and Opportunity Costs

Our analysis (see Figure **??**) implies that less similar parents (high relative costs γ^*) should be less likely to adopt 50-50 ownership and joint control, but more likely to opt for one-sided control $(k = P, A)$. Both specifications reported in Table **??** show that the marginal effects of the opportunity-cost measure $\widehat{\gamma}^*(k; z)$ correspond exactly to this prediction. The highly significant negative marginal effect of $\widehat{\gamma}^*(k; z)$ in the joint control-equation means that the likelihood of observing 50-50 ownership decreases in γ^*, i.e., the more parents differ in opportunity costs the less likely are they to choose joint control. At the same time, the equally significant positive marginal effects of $\widehat{\gamma}^*(k; z)$ in the 50-plus and outright-majority equations indicate that more dissimilar parents are more likely to adopt one-sided control. These results are also consistent with the view of the property-rights literature that, for incentive reasons, the parent contributing the more important resource is more likely to have control (see, e.g., Hart and Moore, 1990).

Industry and nationality effects confirm these findings. When parents are from the same industries as measured by two-digit SIC-code relatedness ($SICaaa$: all three entities in the same industry; $SICaca$: parents from the same industry, JV in a different one) or national origin ($NATaaa$: all US entities), the likelihood of adopting 50-50 ownership increases, while the likelihood of choosing 50-plus or outright-majority control decreases.

Figure **??** also shows that joint ventures with larger potential for value diversion should be more likely to opt for 50-50 ownership and less frequently for one-sided control. As a first pass at this issue, we look for evidence in the industry and nationality effects. In particular, the relatedness variables $SICaab$ and $NATaab$ (unrelated parents, one parent related to the JV) identify joint ventures with higher potential for value diversion because a parent in the same sector as the JV (or located in the US) might have an advantage as an industry insider in appropriating noncontractible benefits. Hence, we would expect $SICaab$ or $NATaab$ to exhibit positive marginal effects for 50-50 joint ventures and negative ones for those with 50-plus or outright-majority control.

We find that a parent in the same industry as the JV raises the likelihood of 50-50 shareholdings and joint control and lowers it for 50-plus and outright majority control. Not only does $SICaab$

exhibit the predicted marginal effects on ownership choice, the variable is also highly significant across all three ownership regimes. At the same time, the results could not possibly be due to complementarity effects because those would require the opposite sign pattern: negative for 50-50 and positive for one-sided control. Specification 2 confirms these findings in terms of nationality-relatedness variables. It is worthwhile to point out that our results also provide empirical support for the predictions in Wang and Zhu (2005) and, in particular, the implication that 50-50 JVs offer protection against unilateral benefit extraction.

Our analysis also predicts that the larger the potential for value extraction, the more dissimilar the parent costs can be under 50-50 ownership. Using again industry effects as a proxy, we add the interactive variable $\widehat{\gamma}^{*}(k;z)\cdot SICaab$ to the specification in Equation (**??**). Table **??** reports marginal effects that are consistent with this prediction. For joint ventures with only one parent in the same industry ($SICaab=1$), cost heterogeneity $\widehat{\gamma}^{*}(k;z)$ reduces much less the likelihood of adopting 50-50 ownership so that parents tend to be more dissimilar under joint control. Conversely, the likelihood of observing 50-plus increases much less in parent heterogeneity for such joint ventures, which is again in line with the implications depicted in Figure **??**. Other parent attributes related to resources (sales, employment) or size (total assets, market capitalization, operating cash flows) are not statistically significant and, therefore, not reported. This result holds regardless of the inclusion of relative costs $\widehat{\gamma}^{*}(k;z)$ in the specification.

Our estimations reveal a further interesting effect related to the leverage of joint ventures. While 65% of our JVs are all-equity, about 35% of our observations carry a significant amount of debt. We find that the presence of debt increases the likelihood of adopting 50-50 ownership but decreases it for 50-plus and majority controlled joint ventures (Tables **??** and **??**). US GAAP might offer an explanation for this finding. Parents holding majority stakes have to fully consolidate the joint venture and recognize its liability on their balance sheets in case they guarantee the debt. Unfortunately, our data does not distinguish between guaranteed and nonguaranteed debt so that we cannot further analyze such debt-related effects.

6.2 Specification Tests: Complements or Substitutes?

Since relative-cost estimates $\widehat{\gamma}^{*}(k;z)$ establish a direct link between our theoretical and empirical specifications, the multivariate results provide further support for our model and the Leontief value-creation process at the heart of Proposition **??**. In particular, we take the high significance levels of $\widehat{\gamma}^*(k;z)$ together with the exact predicted marginal effects for ownership choice as corroboration of our earlier univariate tests of the model. To further explore our modeling assumptions and the role of resource complementarity in JV design we next carry out direct tests of our framework.

We first replicate our analysis for perfectly substitutable parent contributions represented by a linear value-creation process $V(I_A, I_B) = a_A I_A + a_B I_B$, the polar opposite to our Leontief specification.[22] It is easy to show that, regardless of control costs and benefits, ownership cannot implement first-best parent investments: venturers attempt to free-ride on each other. Setting $\tilde{c}_i := \frac{a_i^2}{c_i}$, we find that regime choice is determined by a parameter $\gamma_{lin}^* = \frac{\tilde{c}_A}{\tilde{c}_A + \tilde{c}_B}$ that measures parent similarity in terms of contribution characteristics with parent A still contributing the more valuable resource. In complete analogy to the Leontief case, there exist the same three optimal regimes that parents choose in function of relative resource value γ_{lin}^* and net control costs $d - \delta$.

Having characterized optimal ownership allocations under perfect resource substitutability, we next recover estimates of γ_{lin}^* in terms of observed parent wealth gains by proceeding as in Proposition **??** for all three control regimes k, e.g., $\hat{\gamma}_{lin}^*(J) = \frac{2w_B(\tau_1,\tau_2) - w_A(\tau_1,\tau_2)}{w_A(\tau_1,\tau_2) + w_B(\tau_1,\tau_2)}$. We then re-estimate our specifications by replacing $\hat{\gamma}^*(k;z)$ in Equation (**??**) with its linear analog $\hat{\gamma}_{lin}^*(k;z)$. We find that the marginal effects of $\hat{\gamma}_{lin}^*(k;z)$ have the exact opposite signs across regimes to the pattern predicted by the linear value-creation model so that our data rejects resource substitutability as an appropriate specification value creation in JVs.

Finally, we conduct various nonnested Davidson-MacKinnon P and Vuong tests of the two models based on linear and Leontief value-creation processes, respectively. Both test procedures also reject the linear case in favor of our Leontief specification.

6.3 Synergies and Spillovers

We next investigate the respective roles of JV-level synergies (complementarities in contributions) and parent-level spillovers (transfer of expertise) in the choice of ownership. Recall our model prediction that higher relative spillover potential increases the likelihood of joint control (50-50) and decreases the occurrence of outright majority control (see Proposition **??**). Similarly, we argued earlier that parents trade off gains from JV-level complementarities with the net social costs of control in allocating ownership. Hence, one-sided control arrangements should become more likely

[22] Within the family of CES production functions, the linear production function's elasticity of substitution between the inputs is infinity whereas the Leontief function's is 0. For intermediate elasticities of substitution the absence of closed-form solutions prevents us from estimating the underlying regime-choice parameters.

the greater the scope for complementarities. To study these effects, we include the variables $SPILL$ and $COMP$ described above in our discrete-choice model of ownership in Equation (**??**).

The results in Table **??** exhibit the exact marginal effects for resource complementarity predicted by our model. Greater synergy potential ($COMP$) tends to decrease the likelihood of joint control but increases the likelihood of outright majority control ($k = A$): incentive gains outweigh the loss of implicit veto rights because the presence of significant resource complementarities compensates the minority party for control inefficiencies. This finding is also in line with the prediction of standard property-rights models that an increase in the complementarity of assets increases the likelihood of one-sided control (Hart and Moore, 1990).

Conversely, both specifications in Table **??** suggest that the higher the scope for spillovers ($SPILL$), the more likely are the parties to adopt 50-50 ownership and the less likely to opt for outright-majority control. The lack of statistical significance of the spillover and complementarity variables in the 50-plus regime is probably due to the smaller number of observations and insufficient variation in the indices relative to the other two regimes.

Proposition **??** establishes that the presence of spillovers shifts the optimal choice of ownership between 50-50 and outright majority control: if the likelihood of one regime decreases, the other one has to increase. The opposite signs but similar magnitude of $SPILL$'s marginal effects across regimes (see Table **??**) conform to this prediction. Although our proxy for spillovers only measures their total scope and does not allow us to identify their parent-specific magnitudes, the observed sign pattern and Proposition **??** suggest that the dominant party, i.e., firm A, benefits relatively more from such JV-related transfers.

Comparing Specification 1 in Tables **??** and **??**, respectively, we see that the inclusion of the spillover and complementarities variables markedly affects the size of industry effects. Since the spillover variable attempts to measure intangible and, most likely, noncontractible benefits at the parent level, it might also proxy for control benefits. However, when we interact the spillover variable with the relatedness dummy for a parent in the same industry as the joint venture, the resulting variable $SPILL \cdot SICaab$ is insignificant in any specification across all three regimes (results not reported).

6.4 Control Benefits and Parent Technology

Recall that $DOVER$ measures the parents' difference in production-technology overlap with the joint venture normalized by their own technological overlap. As a proxy for potential control benefits in terms of technology and expertise, we would expect the likelihood of 50-50 ownership to rise in $DOVER$ while one-sided control should become less frequent.

The statistically significant marginal effects in Table **??** (Specification 1) exhibit the exact postulated sign pattern. Our technology measure for control benefits and costs has a positive effect on the probability of observing joint control and a negative effect of similar magnitude on the likelihood of outright majority control. $DOVER$ has a much smaller negative impact on the 50-plus regime (albeit statistically significant) which might reflect the fact that complementarity gains ($COMP$) just compensate for one-sided control in this regime. We also see that key explanatory variables such as relative costs $\widehat{\gamma}^*(k;z)$, parent-level spillovers ($SPILL$) and JV-specific complementarities ($COMP$) exhibit little change in terms of sign, magnitude and statistical significance in comparison with Specification 1 in Table **??**. We interpret this invariance of marginal effects as evidence that $DOVER$ indeed captures control rather than spillover or complementarity effects.

Since $DOVER$ measures the three-way overlap in production technology between parents and their joint venture, we interact this control proxy with relatedness measures such as $SICaab$ that might capture the scope for benefits extraction through industry effects. Specification 2 in Table **??** reports the marginal effects when we include $DOVER \cdot SICaab$ in our discrete choice model. We see that $DOVER$ becomes insignificant in comparison to Specification 1 while the new interactive variable is highly significant except for the 50-plus regime and exhibits precisely the predicted sign pattern. At the same time, the marginal effects of spillovers ($SPILL$) and JV-level synergies ($COMP$) remain virtually the same in magnitude and significance. We take these findings as additional evidence that, in fact, both $DOVER$ through parent production-technology effects and $SICaab$ through industry effects are good proxies for the consequences of one-sided control.

We next split $DOVER$ into the relative technology overlap of the each parent with their JV, i.e., $OVER_A$ and $OVER_B$. Once again, the marginal effects (Table **??**, Specification 1) are exactly as predicted and significant: the more the dominant parent A shares technological attributes with the JV, the higher becomes the likelihood of 50-50 ownership. Conversely, the greater the overlap between the JV and the other firm B, the lower the probability of observing 50-50 ownership because benefits extraction is more easily detectable. In the 50-plus and outright-majority regimes, the marginal effect of minority partner's overlap is both positive and significant whereas the dominant firm's is negative and insignificant. While the negative marginal effects suggest that firms are reluctant to opt for one-sided control in the presence of greater potential for benefits extraction, their statistical insignificance is consistent with the notion that the value of A's resource contribution more than compensates the minority partner for the costs of such activities. We also interact the overlap variables with our $SPILL$ variable to verify that the former do not inadvertently capture spillover effects but the marginal effects are all statistically insignificant (results not reported).

Recall that Figure **??** also implies that relative costs γ^* can be more dissimilar under 50-50 ownership the greater the potential for (and cost of) control benefits. Hence, we finally interact $\widehat{\gamma}^*(k;z)$ with firm A's overlap $OVER_A$. The sign pattern of the statistically significant marginal effects (Specification 2 in Table **??**) confirm this prediction: as the potential for value diversion grows, the more dissimilar can parent costs be under 50-50 ownership. Conversely, the likelihood of observing outright-majority control decreases as parents become more dissimilar in cost and the dominant parent A shares more technology characteristics with the joint venture.

7 Conclusion

In this paper, we develop and test a simple theory of ownership in joint ventures that reconciles the property-rights view of inter-firm cooperation with empirical facts by taking into account distortions arising from one-sided control. We argue that the tension between the need for incentives and the protection of minority interests determines ownership allocations. The more important concerns about inefficient control become, the more frequently will parents adopt 50-50 ownership to share residual control through implicit veto rights. The underlying rationale is that control-dependent benefits can lead to distortions in parent incentives that joint control avoid, leading to the observed clustering of ownership around equal shareholdings. Although firms define their boundaries by the need to assert property rights over assets (Hart and Moore, 1990 or Baker, Gibbons and Murphy, 2002), exclusive ownership of and control over resources proves elusive when more than just one firm requires incentives.

By focusing on the determinants of ownership in joint ventures by publicly traded parents, we show how to estimate otherwise unobservable investment parameters and to directly test model predictions in a structural framework. We find strong empirical support for our contention that small control-induced frictions suffice to generate the observed ownership patterns. In particular, our findings are consistent with the notion that the threat of unilateral value extraction by a dominant partner and the resulting adverse incentives induce firms to share residual control over common assets, thus explaining an empirical puzzle in the property-rights literature first pointed out by Holmström (1999). Although ownership has important incentive benefits, the resulting control rights might be detrimental to joint value creation so that partners use equity allocations to optimally balance these two forces.

While our analysis focuses on the initial allocation of ownership, joint-venture agreements often contain contingent-ownership provisions such as options and sellout, buyout, or termination provisions. Their purpose is to overcome contractual incompleteness (Nöldeke and Schmidt, 1998), provide incentives (Chemla, Habib and Ljungqvist, 2004 and Habib and Mella-Barral, 2003), and resolve disagreement between the partners (Hewitt, 2001 or Campbell and Reuer, 2001) through subsequent changes in ownership. Over time, we observe significant buyout and termination activity in our sample that points to the complementary nature of income and control rights and highlights the importance of contingent ownership in resolving conflicts between partners. However, a full analysis of these design features would require a dynamic model of joint-venture contracting that we leave for future research.

Appendix

A Proofs

Proof of Proposition ??. We establish optimal ownership allocations and the prevalence of 50-50 and 50-plus regimes in function of parents economic attributes in a sequence of results. Let $\gamma_i^k, k = A, J, P$ denote i's ownership stake under outright majority, joint, and 50-plus control, respectively ($\gamma_A^k + \gamma_B^k = 1$), W^k the joint venture's surplus, and W_i^k i's net JV profits.

Lemma 1 *If firm A, contributing the more valuable resource, determines the joint venture's value at the margin, outright majority control by parent A is optimal with corresponding equity stakes* $\gamma^A = \gamma^* - \frac{\delta}{(1-d)}(1-\gamma^*)$ *and* $1-\gamma^A = \frac{1-d+\delta}{1-d}(1-\gamma^*)$.

Proof. By assumption, A constrains total output to $V^A(\gamma) = \min\left\{\frac{\delta+\gamma(1-d)}{c_A}, \frac{(1-\gamma)(1-d)}{c_B}\right\} = \frac{\delta+\gamma(1-d)}{c_A}$. Choosing γ to equalize investment incentives, i.e., $\frac{\delta+\gamma(1-d)}{c_A} = \frac{(1-\gamma)(1-d)}{c_B}$, yields the (second-best) optimal ownership distribution under outright control by A in Equation (**??**). ■

Lemma 2 *For* $\gamma^* \in \left(\frac{1}{2}, \bar{\gamma}\right)$ *with* $\bar{\gamma} = \frac{(1-d)/2+\delta}{1-d+\delta}$, *share allocations cannot equalize contribution incentives.*

Proof. Let γ^* be sufficiently close to $\frac{1}{2}$ so that control by A would constrain the JV output to $V^A(\gamma) = \min\left\{\frac{\delta+\gamma(1-d)}{c_A}, \frac{(1-\gamma)(1-d)}{c_B}\right\} = \frac{(1-\gamma)(1-d)}{c_B}$ for $\gamma \in \left(\frac{1}{2}, \gamma^*\right)$. Control by A under $c_A > c_B$ is optimal as long as there exists $\gamma \geq \frac{1}{2}$ such that both partners have equal investment incentives, $\frac{\delta+\gamma(1-d)}{c_A} = \frac{(1-\gamma)(1-d)}{c_B}$. But, this is only possible if

$$\frac{\delta + \frac{1}{2}(1-d)}{c_A} \leq \frac{\frac{1}{2}(1-d)}{c_B} \tag{9}$$

that, for $\gamma^* = \frac{c_A}{c_A+c_B}$, now yields the critical threshold $\bar{\gamma} = \frac{(1-d)/2+\delta}{1-d+\delta} > \frac{1}{2}$ in Equation (**??**). For $\gamma^* \geq \bar{\gamma}$, the (second-best) optimal asymmetric equity stakes γ^A in Equation (**??**) are feasible while for $\frac{1}{2} < \gamma^* < \bar{\gamma}$ Equation (**??**) is violated and B indeed contributes less. ■

Lemma 3 *There exists a threshold* $\hat{\gamma} = \frac{1+\sqrt{1-(1-d+\delta)^2}}{2(1-d+\delta)^2} > \frac{1}{2}$ *such that for all* $\gamma^* \in \left(\frac{1}{2}, \hat{\gamma}\right)$, *50-50 ownership with joint control maximizes value creation in the joint venture.*

Proof. By Lemma **??**, $W^A = W(\gamma^A)$ defines an upper bound for net JV surplus under any equity allocation different from joint ownership and control. To show that $W^J > W^A$ for all $\gamma^* < \hat{\gamma} = \frac{1+\sqrt{1-(1-d+\delta)^2}}{2(1-d+\delta)^2}$ we compute the JV's net value under joint control ($k = J$) as $W^J = \frac{1}{2c_A} - \frac{(c_A+c_B)}{2}\frac{1}{4c_A^2} = \frac{3c_A-c_B}{8c_A^2}$ and outright majority control by A as $W^A(\gamma') = (1-d+\delta)\frac{\gamma'(1-d)+\delta}{2c_A} = \frac{(1-d+\delta)^2}{2(c_A+c_B)}$ where γ' is A's income share that equalizes incentives if A held all control rights. Hence, we require $W^J - W^A(\gamma') = \frac{3c_A-c_B}{8c_A^2} - \frac{(1-d+\delta)^2}{2(c_A+c_B)} > 0$ which is equivalent to $(1-d+\delta)^2(\gamma^*)^2 - \gamma^* + \frac{1}{4} \leq 0$ by $\gamma^* = \frac{c_A}{(c_A+c_B)}$ and $\frac{c_B}{c_A} = \frac{1-\gamma^*}{\gamma^*}$. The threshold, $\hat{\gamma} = \frac{1+\sqrt{1-(1-d+\delta)^2}}{2(1-d+\delta)^2}$ is now simply the root larger than $\frac{1}{2}$ of $(1-d+\delta)^2\hat{\gamma}^2 - \hat{\gamma} + \frac{1}{4} = 0$. ■

We are now ready to establish Proposition **??**. The relative size of thresholds $\hat{\gamma}$ and $\bar{\gamma}$ determines the number of optimal ownership regimes for various combinations of relative costs γ^* and net social costs of control $d - \delta$. For $\hat{\gamma} \geq \bar{\gamma}$ (high net control costs $d - \delta$) only 50-50 and outright majority control (by A) exist as distinct control regimes by Lemma **??**. Lemma **??** implies that venturers prefer joint control for all $\gamma^* \leq \hat{\gamma}$ and outright majority control, otherwise.

In case of $\hat{\gamma} < \bar{\gamma}$, Lemma **??** implies that, for all $\gamma^* > \bar{\gamma}$, outright majority control characterized in Lemma **??** is optimal and feasible by Equation (**??**), while 50-50 ownership is optimal for $\gamma^* < \hat{\gamma}$. In the remaining interval $[\hat{\gamma}, \bar{\gamma})$, only 50-50 or 50-plus ownership are feasible by the arguments in the proof of Lemma **??**.

To find the threshold $\tilde{\gamma}$ separating 50-50 from 50-plus control, consider

$$G(\gamma^*) := \frac{W^P(\gamma^*)}{W^J(\gamma^*)} = (1-d)\,\frac{4(1-d+\delta)(1-\gamma^*)-(1-d)}{4\gamma^*-1}\,\frac{(\gamma^*)^2}{(1-\gamma^*)^2} \tag{10}$$

obtained by dividing $c_A W^J = \frac{3c_A - c_B}{8c_A}$ into $c_B W^P = (1-d+\delta)\frac{1-d}{2} - \frac{(1-d)^2}{8(1-\gamma^*)}$ and rearranging. Clearly, $G(\gamma^*)$ is continuously differentiable on $[\hat{\gamma}, \bar{\gamma}]$. Furthermore, we have $G(\hat{\gamma}) < 1$, since, by Lemma **??**, $W^J = W^A(\gamma') > W^P$ if $\gamma^* = \hat{\gamma}$ and, similarly, $G(\bar{\gamma}) > 1$ which can be verified by substituting $\gamma^* = \bar{\gamma}$ into Equation (**??**). By the Intermediate Value Theorem, there exists a value $\tilde{\gamma} \in (\hat{\gamma}, \bar{\gamma})$ so that $G(\tilde{\gamma}) = 1$ or, equivalently, $W^P(\tilde{\gamma}) = W^J(\tilde{\gamma})$. It is possible to show that $\frac{dG}{d\gamma^*} > 0$ on $[\hat{\gamma}, \bar{\gamma}]$, from which it follows that this threshold $\tilde{\gamma}$ is unique. ■

Proof of Proposition ??. With parent-level synergy gains $s_i V, i = A, B$ spillovers, the payoffs to parent A (and similarly for B) become

$$W_A = \begin{cases} [\delta + s_A + \gamma(1-d)]\, V(I_A, I_B) - c_A \frac{I_A^2}{2} & \text{for } \gamma > \frac{1}{2} \\ \left[s_A + \frac{1}{2}\right] V(I_A, I_B) - c_A \frac{I_A^2}{2} & \text{for } \gamma = \frac{1}{2} \\ [s_A + \gamma(1-d)]\, V(I_A, I_B) - c_A \frac{I_A^2}{2} & \text{for } \gamma < \frac{1}{2} \end{cases}$$

Calculating the critical region $\left(\frac{1}{2}, \bar{\gamma}_s\right)$ with spillovers, we find the corresponding threshold $\bar{\gamma}_s = \frac{(1-d)\frac{1}{2}+\delta+s_A}{1-d+\delta+s_A+s_B}$ from $\frac{\frac{1}{2}(1-d)+\delta+s_A}{c_A} \geq \frac{\frac{1}{2}(1-d)+s_B}{c_B}$. For $\bar{\gamma}_s \geq \bar{\gamma}$, we require $\frac{(1-d)\frac{1}{2}+\delta+s_A}{1-d+\delta+s_A+s_B} \geq \frac{(1-d)/2+\delta}{1-d+\delta}$ which, upon rearranging and letting $s^* = \frac{s_A}{s_A+s_B}$, yields Equation (**??**). It follows that the higher the relative fraction of spillovers, the more likely becomes joint control and the less likely outright majority control. ■

Proof of Proposition ??. Under control by A, the net value of i's equity stake is $W_i^A = (1+\delta-d)^2 W_i^*$ for first-best JV value $W_i^* = \frac{1}{2}\gamma_i^* V^*$ so that $\frac{c_A^A}{c_B^A} = \frac{\gamma_A^*}{\gamma_B^*} = \frac{W_A^A}{W_B^A}$ and, hence, $\gamma^*(A) = \frac{W_A^A}{W_A^A + W_B^A}$. If equity markets are informationally efficient we can replace W_i^A with $w_i(\tau_1, \tau_2)$ in the expression while preserving the asymptotic distributional properties.

Repeating the preceding argument for joint control, the net values of the equity stakes are $W_A^J = \frac{1}{8}\frac{1}{c_A}$ and $W_B^J = \frac{2c_A - c_B}{8c_A^2}$. Solving for the cost ratio $\frac{c_B^J}{c_A^J} = 2 - \frac{W_B^J}{W_A^J}$, we obtain $\gamma^*(J) = \frac{W_A^J}{3W_A^J - W_B^J}$ so that replacing W_i^J with $w_i(\tau_1, \tau_2)$ again yields the desired result.

For 50-plus control, we have $W_A^P = \frac{(1-d)}{2c_B}\left(\delta + \frac{1}{2}(1-d)\left(1 - \frac{c_A}{2c_B}\right)\right)$ and $W_B^P = \frac{(1-d)^2}{8c_B}$. Using $\frac{c_A}{c_B} = \frac{\gamma^*}{1-\gamma^*}$, we obtain

$$\frac{W_A^P}{W_B^P} = \frac{4\delta}{1-d} + 2 - \frac{\gamma^*}{1-\gamma^*}$$

which depends on the social cost term $\frac{4\delta}{1-d}$. Hence, we will parameterize our model to derive a closed form solution independent of the unobservable control costs and benefits. Let $\frac{4\delta}{1-d} = z$ for some parameter $z > 0$ so that $\delta = \frac{1-d}{4} z$. We then have that $\frac{W_A^P}{W_B^P} = z + 2 - \frac{\gamma^*}{1-\gamma^*}$ whence

$$\gamma^* (P) = \frac{(2+z) W_B^P - W_A^P}{(3+z) W_B^P - W_A^P}$$

which is greater than $\frac{1}{2}$ for $(1+z) W_B^P > W_A^P$. We need to verify that the parameter restrictions for δ, d and $\hat{\gamma} < \bar{\gamma}$ hold for some value of z. One condition that insures the existence of three control regimes is $d = \frac{21}{20}\delta, \delta > \frac{1}{8}$ while privately valuable control requires $\delta > \gamma d, \gamma \geq \frac{1}{2}$. However, it is easily verified that $\delta = 20\frac{z}{80+21z}, d = 21\frac{z}{80+21z}$ satisfy not only the three regimes and parameterization conditions but also the restriction for privately valuable control. Note that an estimate of z allows us to infer relative costs of control in the 50-plus regime as $\frac{\delta}{1-d} = \frac{z}{4}$.

The identification of parents as A or B is a simple consequence of the preceding expressions for wealth gains and observed stakes. For outright and 50-plus control, the observed majority stake trivially identifies the dominant parent A. For joint control, observed wealth gains identify parent A since $W_A^J = \frac{1}{8}\frac{1}{c_A} < \frac{2c_A - c_B}{8c_A^2} = W_B^J$. ■

B Tables

Table 1: **Ownership Distribution in Two-Parent Joint Ventures**

Majority Stake (in %)	**All US JVs**		**1 Public Firm: US**		**2 Public Firms: US**		**1 Public Firm: EU**	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
50-50	1,931	71.04	822	65.86	193	64.98	1,257	62.72
50+ to 51	210	7.73	106	8.49	27	9.09	245	12.23
51+ to 60	192	7.06	107	8.57	30	10.10	151	7.53
60+ to 67	60	2.21	33	5.52	8	2.69	63	3.14
67+ to 75	135	4.90	69	8.84	17	5.72	160	7.98
75+ to 80	100	3.68	55	4.40	9	3.03	56	2.79
80+ to 90	57	2.10	35	2.80	9	3.03	33	1.65
90+ to 100	33	1.21	21	1.68	4	1.35	39	1.95
Total	2,718	100.00	1,248	100.00	297	100.00	2,004	100.00

The table summarizes ownership arrangements by majority stakes for four different samples of joint ventures announced between January 1st, 1985 and 2000 (excluding those involving a state-owned entity). The "All US JVs" sample consists of all two-parent joint ventures incorporated in the US and recorded in the Thomson Financial Securities Data during this period, while "1 Public Firm" and "2 Public Firms" are two subsamples of the former with, respectively, at least one and two publicly traded parents with full financial data availability. We also report the majority stakes for a comparator sample of two-parent European joint ventures with at least one publicly traded parent ("1 Public Firm: EU").

Table 2: **Ownership Structure by Venturer Similarity**

Parent Attribute	**Two-digit SIC**		**Nat. Origin**		**Market Value**		**Total Sales**		**Employees**	
	Sim.	**Dissim.**	**Sim.**	**Dissim.**	**Sim.**	**Dissim.**	**Sim.**	**Dissim.**	**Sim.**	**Dissim.**
Joint ventures	45.1	54.9	44.4	55.6	29.2	70.8	30.0	70.0	13.9	86.1
of which:										
50-50	62.7	66.9	68.9	61.8	77.0	59.8	72.4	61.6	65.5	65.4
50-plus	7.5	11.0	6.8	11.5	5.4	11.2	5.3	11.3	3.4	10.1
Outright majority	29.9	22.1	24.2	26.7	17.6	29.1	22.4	27.1	31.0	24.6
Total	100	100	100	100	100	100	100	100	100	100

This table classifies the owners of our 297 JVs with publicly traded parents as *Similar* ("Sim.") in terms of their economic attributes if they belong to the same two-digit SIC code, are from the same country, or fall within 30% of the average of their market value, total sales or number of employees, and *Dissimilar* ("Dissim.") otherwise.

The first line records the percentage of similar and dissimilar parents for all joint ventures regardless of ownership regime so that percentages sum to 100% across each of the five attributes. The remainder of the table records the frequency of *regimes* among the similar and dissimilar parents.

Table 3: **Contingent Ownership Arrangements**

Equity (in %)	JVs Obs.	Buyouts No.	Buyouts Freq.	Terminated No.	Terminated Freq.	Sale/Merger No.	Sale/Merger Freq.	Unchanged No.	Unchanged Freq.	Options No.	Options Freq.
50-50	193	51	26.42	40	20.73	4	2.07	90	46.63	3	1.55
50-plus	28	12	42.86	2	7.14	3	10.71	11	39.29	2	7.14
Outright majority	76	31	40.79	10	13.16	1	2.63	34	44.74	10	13.16
JVs	297	102	34.34	52	17.51	8	2.69	135	45.45	15	5.05

This table summarizes buyout and termination activity for our sample of 297 US joint ventures in terms of observations ("No.") and frequencies of occurrence by control regime ("Freq."). *Buyouts* correspond to one party acquiring the entire stake of the partner or taking control through a partial buyout, *Terminated* to the dissolution of the joint venture, *Sale/Merger* to a sale to third parties or change to wholly owned subsidiary when parents merged, and *Unchanged* ownership status. *Options* indicate explicitly announced buyout or sellout provisions in addition to the usual preemption rights. Percentages sum to 100 within each control regime.

Table 4: **Industry Distribution of Joint-Venture Parents**

SIC Code 1 digit	Industry	At least One Public Parent Number	At least One Public Parent Frequency	Two Public Parents Number	Two Public Parents Frequency
4xxx	Transport., Comm., Gas, Electricity	484	31.33	232	39.06
3xxx	Manufacturing	269	17.41	122	20.54
5xxx	Wholesale Trade	198	12.82	66	11.11
8xxx	Services	173	11.20	62	10.44
7xxx	Finance, Insurance, Real Estate	119	7.70	24	4.04
2xxx	Construction	108	6.99	30	5.05
6xxx	Retail Trade	72	4.66	18	3.03
1xxx	Mining	65	4.21	22	3.70
Others		57	3.69	18	3.03
Total		1,545	100.00	594	100.00

This table shows that our sample represents a wide cross-section of sectors in terms of parents' Standard Industry Classification (SIC) codes, ordered by frequency. "At least One Public Parent" and "Two Public Parents" refer to our main sample (US joint ventures with two publicly traded parents) and its larger superset, US joint ventures with at least one publicly traded parent.

Table 5: **Country Origin of Parents by Headquarter Location**

Country	At least One Public Parent Number	At least One Public Parent Frequency	Two Public Parents Number	Two Public Parents Frequency
US	1,124	72.75	403	67.85
Japan	214	13.85	106	17.85
UK	45	2.91	14	2.36
Canada	44	2.85	11	1.85
Germany	26	1.68	18	3.03
France	19	1.23	7	1.18
Australia	12	0.78	6	1.01
Others	61	3.95	29	4.88
Total	1,545	100.00	594	100.00

This table reports the number and percentages of parents' headquarter locations (national origin) for our main sample (US joint ventures with two publicly traded parents) and, for comparability, for its larger superset of US joint ventures with at least one publicly traded parent. We define *Country Origin* in terms of actual headquarter location rather than country of incorporation.

Table 6: **Parent Attributes by Stake**

Equity (in %)	Market Value (in m)	Assets (in m)	Sales (in m)	Net Op. Cash Flow (in m)	Employees	Inside Ownership (in %)
0 to 20	6,925.82	9,325.23	11,171.03	607.17	12,0784	13.06
20+ to 40	12,034.38	20,323.68	25,112.38	1,069.50	5,2257	18.93
40+ to 49-	4,010.84	8,970.65	8,757.35	807.46	9,0717	8.07
49 to 50-	3,479.06	17,711.28	13,971.93	427.59	2,9147	30.85
50-50	7,081.46	12,452.68	10,449.81	706.42	10,3971	13.20
50+ to 51	6,111.11	14,717.78	9,480.42	543.38	9,8693	12.31
51+ to 60-	3,497.04	2,417.33	2,504.05	243.11	2,3138	2.84
60 to 80-	6,427.70	12,055.28	10,007.32	565.41	10,5201	12.52
80 to 100	6,579.89	8,859.21	10,612.49	576.79	12,0784	13.06
Mean	**7,164.91**	**13,065.11**	**11,723.26**	**695.06**	**9,6189**	**14.29**
Maximum	68,741.87	194,881.00	192,548.50	9,627.00	81,3000	82.26
Minimum	1.00	4.67	0.00	-1,303.55	34.0	0.025

This table indicates the means of parent attributes by ownership stake for the 594 parents in our main sample of US joint ventures. *Market value* is the parent's market capitalization on the eve of the joint venture announcement, and *Assets*, *Sales*, *Op. Cash Flow*, *Employees*, and *Inside Ownership* their total asset value, sales, net operating cash flows, number of employees, and the percentage of equity held by insiders in the quarter of the announcement, respectively. The last three rows indicate the mean, maximum, and minimum of the attributes for the entire two-parent sample.

Table 7: **Cumulative Abnormal Returns and Wealth Gains**

		Mean Cumulative Abnormal Returns			
	Obs.	$CAR(-1,0)$	$CAR(-1,1)$	$CAR(-2,2)$	$CAR(-5,5)$
Mean	550	0.860%***	0.941%***	1.141%***	0.671%*
(P value)		(0.0000)	(0.0000)	(0.0000)	(0.0968)
$CAR > 0$ (% of obs.)		54.36%	54.00%	52.91%	52.18%
		Non-Normalized Wealth Creation			
	Obs.	$w(-1,0)$	$w(-1,1)$	$w(-2,2)$	$w(-5,5)$
Mean	550	56.19**	45.48*	59.84*	-17.87
(P value)		(0.0126)	(0.0997)	(0.0950)	(0.7401)
		Wealth Creation Normalized by Stake			
Equity in %	Obs.	$\frac{w(-1,0)}{\gamma}$	$\frac{w(-1,1)}{\gamma}$	$\frac{w(-2,2)}{\gamma}$	$\frac{w(-5,5)}{\gamma}$
0 to 20	19	-869.25	-2545.80	-1821.72	-3870.96
20+ to 40	47	111.19	187.32	686.89**	-561.30**
40+ to 49-	6	90.69	105.27	18.83	-254.67**
49 to 50-	24	80.69	87.55*	207.10***	196.60***
50-50	358	125.22**	81.67	66.38	-45.28
50+ to 51	24	120.00	119.72	-43.50	-245.62*
51+ to 60-	6	-103.72	75.83	243.97	-62.15
60 to 80-	47	116.47**	199.11***	239.03***	131.54**
80 to 100	19	109.75*	30.26	82.89	220.18***
Mean	**550**	**94.03**	**40.12**	**99.64**	**-161.81**
(P value)		(0.2270)	(0.3973)	(0.3091)	(0.7049)

The first panel summarizes the stock market reaction to the announcement of joint-venture formation in terms of the sample means of cumulative abnormal returns $CAR(\tau_1, \tau_2)$. The second panel shows sample means of raw abnormal wealth gains w_i that we normalize by parent stakes γ_i in the third panel, i.e., $\frac{w_i}{\gamma_i}$. Three joint ventures have equity allocations of 0-100 (with the minority shareholder holding an option to acquire a stake) so that we normalize the respective parents' wealth gains by $\gamma_i \cong 0.01$.

The sample consists of 275 uncontaminated two-parent joint ventures (550 parent firms) that we derive from the full two-parent sample (297 US joint ventures) by excluding 22 joint ventures involving at least one parent firm with a major corporate announcement (M&A activity or rumor, earnings report, etc.) during the event window. Significance levels are as follows: *** denotes statistical significance at 1%, ** significance at 5%, and * significance at 10%.

Table 8: **Production-Technology Overlap, Complementarities, and Spillovers**

Equity (in %)	**Obs.**	**Prod. Overlap Average**	**Minimum**	**Resource Class. (%) Comp.**	**Subst.**	**Indet.**	**JV Scope Index** *COMP*	*SPILL*
0 to 20	19	0.1915	0.1626	92.31	7.69	0.00	1.4737	1.0526
20+ to 40	47	0.1979	0.1353	83.02	13.21	3.78	1.4565	0.8696
40+ to 49-	6	0.1347	0.0532	83.33	16.67	0.00	1.3333	0.1667
49 to 50-	24	0.2082	0.1497	87.50	4.17	8.33	1.3333	0.8750
50-50	358	0.2075	0.1463	80.45	10.06	9.49	1.0398	0.8466
50+ to 51	24	0.2082	0.1497	87.50	4.17	8.33	1.3333	0.8750
51+ to 60-	6	0.1347	0.0532	83.33	16.67	0.00	1.3333	0.1667
60 to 80-	47	0.2157	0.1529	82.98	12.77	4.26	1.4565	0.8696
80 to 100	19	0.1493	0.1104	89.47	10.53	0.00	1.4737	1.0526
Sample mean	**550**	**0.2033**	**0.1432**	**82.18**	**10.18**	**7.64**	**1.1734**	**0.8524**
(P value: t-test)		(0.2614)	(0.3230)					
Maximum		1	1				8	6
Minimum		0	-0.0279				0	0
Potential for Resource Complementarity: All Two-Parent JVs (297 Obs.)								
		Average JVs < Mean	Minimum	Comp.	Subst.	Indet.	*COMP* JVs > 0	*SPILL* JVs > 0
Percent		67.35	80.47	81.14	10.10	8.76	73.29	37.67

Average Production Overlap corresponds to the average of the input and output correlations while *Minimum Production Overlap* corresponds to their minimum as the absence of overlap in either the parent output or input dimension suffices for synergy effects. For parents in industries l and m, we match parent SIC codes with the Bureau of Economic Analysis' "Use Table" published in 1997 that record the intermediate commodity flows between approximately 500 industries, and compute the correlation of their output shares supplied to all other industries, as well as the correlation across their own input requirement coefficients (defined as the fraction of industry k's output required to produce industry l's output). For parents of different national origin, we set the correlations to zero (absence of Use-Table data), for parents in the same (sub)industry the correlation is trivially one. The P values refer to one-sided tests of the hypothesis that the mean and minimum of the overlap variables are, respectively, 0.

For the *Resource Classification*, the authors and three research assistants independently classified parent expertise or contributions as *complements* ("Comp."), *substitutes* ("Subst."), or *indeterminate* ("Indet.") on the basis of common set of rules and definitions from the parent and joint venture descriptions, news wire articles, and TFSD information. For each parent-stake category, the table indicates the consensus percentage of complements, substitutes, and indeterminate cases so that each line sums to 100%. The last line records the number of non-contaminated joint ventures whose contributions are complements, substitutes, or of indeterminate nature.

For the *Scope Indices* for *Complementarities* (*COMP*: JV-level synergies) and *Spillovers* (*SPILL*: parent-level positive externalities), we record whether joint ventures engage in R&D, licensing or cross-licensing, technology or cross-technology transfers, and exclusive licensing (*spillover* potential), or in manufacturing, sales and marketing, exploration, exclusive supply or OEM-value added reselling, etc. (indicative of *complementarities* in resources) on the basis of TFSD's joint-venture type definition, their description of parents and JVs, and news-wire announcements. Each activity classification gets a 0 or 1 score (except for R&D, cross-licensing and cross-technology transfer with scores of 0 or 2 because of the potential for two-sided spillovers) that we then simply add up across the spillover and complementarities categories with each scope index ranging from 0 to 9.

The first panel reports results for our usual sample of 275 non-contaminated two-parent joint ventures incorporated in the US with 550 parent firms. The second panel that is based on the full two-parent sample of 297 JVs indicates the fraction of JVs with complementary resources for each classification (with the exception of the spillover proxy *SPILL*). For the *Production Overlap* categories, the percentages refer to JVs whose parents' production-technology overlap falls below the respective means of the whole sample. The *Resource Classification* percentages reprise the sample means for all 297 joint ventures whereas for the *Scope Indices* the percentages represent the fraction of JVs whose *COMP* or *SPILL* indices are greater than 0 (i.e., at least some scope for complementarities or spillovers).

Table 9: **Model Tests Based on Relative Costs $\gamma^*(k)$**

Outright Majority Control vs. 50-50 JVs					
Sample mean		**Test statistic**	**P value**	**Number of Observations**	
$\overline{\gamma^*}(J)$	$\overline{\gamma^*}(A)$	t	$\Pr\{T \leq t \mid H_0\}$	50-50 JVs	Outright Maj. JVs
0.2575	0.6303	3.0192	0.0017	176	68
Model prediction:			**Reject H_0 in favor of H_1**		
			50-50 JVs		
$\overline{\gamma^*}(J)$		z	$\Pr\{\lvert Z\rvert \leq z \mid H_0\}$	50-50 JVs	
0.2575		-0.5233	0.6008	176	
Model prediction:			**Fail to Reject H_0**		

The first panel summarizes the one-sided Smith-Satterthwaite t-test of our model prediction (see Figure **??**) that parent costs are more dissimilar in JVs with outright majority control ($k = A$) than in 50-50 JVs ($k = J$). We wish to reject the null hypothesis $H_0 : \gamma^*(A) = \gamma^*(J)$ in favor of the alternative $H_1 : \gamma^*(A) > \gamma^*(J)$.

In the second panel, we test the model prediction that parent costs are similar in 50-50 JVs so that we do not want to reject the null $H_0 : \gamma^*_A(J) = \frac{1}{2}$. We use our non-contaminated sample of two-parent joint ventures from which we exclude 7 outliers with $\widehat{\gamma}^*(k)$ outside $(-5, 5)$.

Table 10: **Explanatory Variables by Stake**

Equity (in %)	**Obs.**	**Rel. Cost** $\widehat{\gamma}^*(k;z)$	**Leverage** LEV	**Relatedness** $SICaab$	$NATaab$	**JV Scope Index** $COMP$	$SPILL$	**Technology Overlap** $OVER_i$	$DOVER$
0 to 20	18	0.2984	0.0556	0.3333	0.5556	1.5000	1.1111	3.8423	-2.0875
20+ to 40	44	0.7161	0.1591	0.1818	0.4545	1.4884	0.8140	3.0851	-1.6380
40+ to 49-	6	0.9963	0.1667	0.1667	0.6667	1.3333	0.1667	4.1773	-2.6336
49 to 50-	23	0.9379	0.0870	0.3478	0.6522	1.3478	0.9130	9.9700	-8.2722
50-50	352	0.2575	0.4545	0.3295	0.4602	1.0460	0.8448	2.0196	-0.0685
50+ to 51	23	0.9379	0.0870	0.3478	0.6522	1.3478	0.9130	1.6978	-8.2722
51+ to 60-	6	0.9963	0.1667	0.1667	0.6667	1.3333	0.1667	1.5437	-2.6336
60 to 80-	44	0.7161	0.1591	0.1818	0.4545	1.4884	0.8140	1.4471	-1.6380
80 to 100	18	0.2984	0.0556	0.3333	0.5556	1.5000	1.1111	1.7548	-2.0875
Mean	**534**	**0.4111**	**0.3408**	**0.3034**	**0.4869**	**1.1818**	**0.8485**	**2.4602**	**-1.2276**
Maximum	534	4.3341	1.0000	1.0000	1.0000	8.0000	6.0000	180.0050	19.3146
Minimum	534	-2.1341	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0715	-169.7351

This table summarizes our explanatory variables by equity stake for our sample of non-contaminated joint ventures excluding 8 outliers with $\widehat{\gamma}^*(k;z) \in (-5, 5)$ (leaving 267 JVs with 534 parent firms) that underlies the multivariate analysis. The relative cost parameter $\widehat{\gamma}^*(k;z)$ ("Rel. Cost") is computed as in Proposition **??** and LEV indicates the fraction of joint ventures with leverage.

$SICaab$ indicates the fraction of JVs for which only one parent is from the same (sub)industry as the JV (high potential for value diversion). $NATaab$ is analogously defined for the case of national origin: one parent is a foreign firm so that the US parent might have an advantage in extracting private benefits from their US joint venture (high potential for value diversion). For a description of the scope indices $COMP$ (JV-level synergies) and $SPILL$ (parent-level spillovers) refer to Table **??**.

$OVER_i$ ("Technology Overlap") measures the production-technology overlap of firm i with its JV j relative to the parents' overlap with each other (for details on the definition of overlap, see Table **??**), i.e., $OVER_i = \frac{OVER_{ij}}{OVER_{AB}}, i = A, B$, where we sort parents into A or B in accordance with Proposition **??** except for 50-50 ownership. $DOVER$ is simply the difference in firms' overlap with their JV j relative to their own, i.e., $DOVER_j = \frac{OVER_{Aj} - OVER_{Bj}}{OVER_{AB}}$.

Table 11: **Choice of Control Regime**

Specification		**1**			**2**	
Regime	$k=J$	$k=P$	$k=A$	$k=J$	$k=P$	$k=A$
z		10.6804			10.6764	
$\widehat{\gamma}^*(k;z)$	-0.2531***	0.0705***	0.1826***	-0.2484***	0.0678***	0.1806***
(P value)	(0.0000)	(0.0016)	(0.0005)	(0.0000)	(0.0021)	(0.0004)
LEV	0.3777***	-0.0965***	-0.2812***	0.3888***	-0.1160***	-0.2729***
(P value)	(0.0000)	(0.0052)	(0.0000)	(0.0000)	(0.0006)	(0.0000)
$SICaaa$	0.2111***	-0.1455***	-0.0656			
(P value)	(0.0004)	(0.0001)	(0.2073)			
$SICaca$	0.2687***	-0.0846**	-0.1841**			
(P value)	(0.0014)	(0.0131)	(0.0178)			
$SICaab$	0.3367***	-0.1123***	-0.2244***			
(P value)	(0.0000)	(0.0007)	(0.0001)			
$SICacb$	0.2255***	-0.1053***	-0.1202**			
(P value)	(0.0005)	(0.0019)	(0.0356)			
$NATaaa$				0.2946***	-0.1403***	-0.1543***
(P value)				(0.0000)	(0.0001)	(0.0015)
$NATaab$				0.2479***	-0.0994***	-0.1485***
(P value)				(0.0000)	(0.0002)	(0.0004)
$NATbac$				0.2748*	-0.1179*	-0.1569
(P value)				(0.0552)	(0.0728)	(0.2269)
Log-likelihood		-187.80			-191.43	
Pseudo R^2		0.157			0.140	
Log-likelihood Ratio		69.89***			62.64***	
(P value)		(0.0000)			(0.0000)	
Observations		267			267	

This table reports the marginal effects that we obtain by evaluating $\frac{\partial \Pr_j}{\partial x_{jk}} = \Lambda'\left(\mathbf{x}'_{jk}\boldsymbol{\beta}_k\right)\beta_k$ at the regressors' sample means and their P values for the multinomial-logit specifications

$$\Pr\{REGIME_j = k\} = \Lambda\left(\beta_{1k}\widehat{\gamma}^*(k;z)_j + \beta_{2k}LEV_j + \sum_{l=3}^{6}\beta_{lk}RELpvp_j^l\right)$$

for JVs $j = 1,...,N$ and control regimes $k = A, J, P$ where Λ is the logistic distribution function $\Lambda\left(\mathbf{x}'_{jk}\boldsymbol{\beta}_k\right) = \frac{\exp\left\{\mathbf{x}'_{jk}\boldsymbol{\beta}_k\right\}}{\sum_k \exp\left\{\mathbf{x}'_{jk}\boldsymbol{\beta}_k\right\}}$, $\widehat{\gamma}^*(k;z)$ the estimate of our cost similarity variable γ^*, LEV a binary variable for JV leverage, and $RELpvp^l$ measures JV and parent relatedness in terms of SIC codes ($SICpvp$) or national origin ($NATpvp$).

We estimate the discrete-choice models by Full-Information Maximum Likelihood with a grid search over z for the 50-plus regime for our sample of noncontaminated JVs from which we exclude 8 outliers so that $\widehat{\gamma}^*(k;z) \in (-5,5)$. The pseudo-$R^2$ is McFadden's likelihood ratio index $1 - \frac{\log L}{\log L_0}$. In the second specification, we drop the $NATbab$ variable because of insufficient observations in the 50-plus regime ($k = P$). Since the coefficient estimates have no obvious economic interpretation we suppress them in the interest of readability. Significance levels: *** denotes significance at 1%, ** significance at 5%, * significance at 10%.

Table 12: **Parent Similarity and Industry Effects**

Specification		**1**			**2**	
Regime	$k = J$	$k = P$	$k = A$	$k = J$	$k = P$	$k = A$
z		10.6696			10.6788	
$\widehat{\gamma}^*(k;z)$	-0.4179***	0.1074***	0.3104***	-0.3998***	0.0941***	0.3057***
(P value)	(0.0000)	(0.0023)	(0.0001)	(0.0000)	(0.0025)	(0.0000)
$\widehat{\gamma}^*(k;z) \cdot SICaab$	0.3054***	-0.0635*	-0.2419**	0.2837***	-0.0412	-0.2425***
(P value)	(0.0103)	(0.0902)	(0.0208)	(0.0034)	(0.1603)	(0.0043)
LEV	0.3899***	-0.0945***	-0.2954***	0.4111***	-0.1224***	-0.2887***
(P value)	(0.0000)	(0.0075)	(0.0000)	(0.0000)	(0.0004)	(0.0000)
$SICaaa$	0.2717***	-0.1657***	-0.1061*			
(P value)	(0.0000)	(0.0001)	(0.0667)			
$SICaca$	0.3476***	-0.1047***	-0.2429***			
(P value)	(0.0002)	(0.0073)	(0.0042)			
$SICaab$	0.2701***	-0.0959***	-0.1742***			
(P value)	(0.0000)	(0.0036)	(0.0035)			
$SICacb$	0.2925***	-0.1242***	-0.1684***			
(P value)	(0.0000)	(0.0013)	(0.0073)			
$NATaaa$				0.3194***	-0.1438***	-0.1756***
(P value)				(0.0000)	(0.0001)	(0.0004)
$NATaab$				0.2669***	-0.1041***	-0.1627***
(P value)				(0.0000)	(0.0002)	(0.0002)
$NATbac$				0.3435**	-0.1305*	-0.2129
(P value)				(0.0236)	(0.0560)	(0.1171)
Log-likelihood		-184.17			-186.61	
Pseudo R^2		0.173			0.162	
Log-likelihood Ratio		77.15***			72.28***	
(P value)		(0.0000)			(0.0000)	
Observations		268			268	

This table reports the marginal effects and their P values obtained by estimating

$$\Pr\{REGIME_j = k\} = \Lambda\left(\beta_{1k}\widehat{\gamma}^*(k;z)_j + \beta_{2k}\widehat{\gamma}^*(k;z)_j \cdot SICaab_j + \beta_{3k}LEV_j + \sum_{l=4}^{7}\beta_{lk}RELpvp_j^l\right)$$

We add the interactive variable $\widehat{\gamma}^*(k;z) \cdot SICaab$ to the previous specification to test the model prediction that parents are more heterogeneous under 50-50 ownership when the potential for value extraction is larger. All other variables remain unchanged, as do the sample selection, outlier correction, and estimation procedures (see Table **??** for further details). Significance levels: *** denotes significance at 1%, ** significance at 5%, * significance at 10%.

Table 13: **Spillovers and Complementarities**

Specification		**1**			**2**	
Regime	$k=J$	$k=P$	$k=A$	$k=J$	$k=P$	$k=A$
z		10.6653			10.6727	
$\widehat{\gamma}^*(k;z)$	-0.2572***	0.0736***	0.1836***	-0.2528***	0.0708***	0.1820***
(P value)	(0.0000)	(0.0017)	(0.0004)	(0.0000)	(0.0020)	(0.0004)
$SPILL$	0.0566**	-0.0049	-0.0516**	0.0452	-0.0013	-0.0439*
(P value)	(0.0393)	(0.6782)	(0.0377)	(0.1057)	(0.9097)	(0.0878)
$COMP$	-0.0951***	0.0126	0.0825***	-0.0877**	-0.0008	0.0885***
(P value)	(0.0061)	(0.3572)	(0.0066)	(0.0139)	(0.9527)	(0.0047)
LEV	0.3764***	-0.0974***	-0.2791***	0.3896***	-0.1165***	-0.2731***
(P value)	(0.0000)	(0.0068)	(0.0000)	(0.0000)	(0.0008)	(0.0000)
$SICaaa$	0.2834***	-0.1572***	-0.1262**			
(P value)	(0.0001)	(0.0004)	(0.0461)			
$SICaca$	0.3391***	-0.0981**	-0.2411***			
(P value)	(0.0002)	(0.0136)	(0.0040)			
$SICaab$	0.4139***	-0.1272***	-0.2866***			
(P value)	(0.0000)	(0.0014)	(0.0000)			
$SICacb$	0.2959***	-0.1188***	-0.1772***			
(P value)	(0.0002)	(0.0033)	(0.0100)			
$NATaaa$				0.3419***	-0.1404***	-0.2015***
(P value)				(0.0000)	(0.0002)	(0.0003)
$NATaab$				0.3432***	-0.0968***	-0.2465***
(P value)				(0.0000)	(0.0034)	(0.0001)
$NATbac$				0.3454**	-0.1156*	-0.2298*
(P value)				(0.0210)	(0.0859)	(0.0904)
Log-likelihood		-182.05			-184.39	
Pseudo R^2		0.175			0.164	
Log-likelihood Ratio		76.98***			72.29***	
(P value)		(0.0000)			(0.0000)	
Observations		264			264	

This table reports the marginal effects and their P values for

$$\Pr\{REGIME_j = k\} = \Lambda\left(\beta_{1k}\widehat{\gamma}^*(k;z)_j + \beta_{2k}SPILL_j + \beta_{3k}COMP_j + \beta_{4k}LEV_j + \sum_{l=5}^{8}\beta_{lk}RELpvp_j^l\right)$$

where we add the scope indices for parent spillovers ($SPILL$) and resource complementarity ($COMP$) to the general specification in Equation (**??**). All other variables and estimation procedures remain unchanged and are described in the explanations of Table **??**. The sample consists of our 275 non-contaminated two parent joint ventures to which we apply the same outlier correction for $\widehat{\gamma}^*(k;z)$ as before. We lose 4 observations due to missing spillover or complementarity indices because the joint ventures do not offer sufficiently detailed information to determine their type. Significance levels: *** denotes significance at 1%, ** significance at 5%, * significance at 10%.

Table 14: **Complementarities, Spillovers and Control Benefits**

Specification		**1**			**2**	
Regime	$k = J$	$k = P$	$k = A$	$k = J$	$k = P$	$k = A$
z		10.6788			10.6762	
$\widehat{\gamma}^*(k;z)$	-0.2775***	0.0789***	0.1986***	-0.3454***	0.0946***	0.2508***
(P value)	(0.0000)	(0.0013)	(0.0002)	(0.0000)	(0.0011)	(0.0001)
$DOVER$	0.0192**	-0.0045*	-0.0147*	0.0052	-0.0001	-0.0051
(P value)	(0.0407)	(0.0592)	(0.0523)	(0.4873)	(0.9806)	(0.4236)
$DOVER \cdot SICaab$				0.0422***	-0.0105**	-0.0318**
(P value)				(0.0083)	(0.0431)	(0.0164)
$SPILL$	0.0576**	-0.0033	-0.0543**	0.0604**	-0.0038	-0.0565**
(P value)	(0.0417)	(0.7815)	(0.0347)	(0.0407)	(0.7621)	(0.0344)
$COMP$	-0.1062***	0.0154	0.0908***	-0.1174***	0.0166	0.1008***
(P value)	(0.0037)	(0.2795)	(0.0044)	(0.0026)	(0.2633)	(0.0029)
LEV	0.3668***	-0.0875**	-0.2793***	0.3891***	-0.0929**	-0.2962***
(P value)	(0.0000)	(0.0201)	(0.0001)	(0.0000)	(0.0175)	(0.0000)
$SICaaa$	0.2984***	-0.1675***	-0.1309**	0.3408***	-0.1803***	-0.1604**
(P value)	(0.0001)	(0.0003)	(0.0474)	(0.0000)	(0.0002)	(0.0206)
$SICaca$	0.3854***	-0.1129***	-0.2725***	0.4191***	-0.1179***	-0.3012***
(P value)	(0.0001)	(0.0080)	(0.0019)	(0.0000)	(0.0081)	(0.0010)
$SICaab$	0.4746***	-0.1491***	-0.3255***	0.5654***	-0.1705***	-0.3949***
(P value)	0.3451	(0.0008)	(0.0000)	(0.0000)	(0.0006)	(0.0000)
$SICacb$	(0.0000)***	-0.1363***	-0.2088***	0.3716***	-0.1393***	-0.2322***
(P value)		(0.0020)	(0.0043)	(0.0000)	(0.0022)	(0.0025)
Log-likelihood		-177.58			-173.56	
Pseudo R^2		0.195			0.213	
Log-likelihood Ratio		85.92***			93.96***	
(P value)		(0.0000)			(0.0000)	
Observations		264			264	

This table reports the marginal effects and their P values for the specification

$$\Pr\{REGIME_j = k\} = \Lambda\left(\beta_{1k}\widehat{\gamma}^*(k;z)_j + \beta_{2k}DOVER_j + \beta_{3k}SPILL_j + \beta_{4k}COMP_j + \beta_{5k}LEV_j + \sum_{l=6}^{9}\beta_{lk}SICpvp_j^l\right)$$

obtained by adding to the model in Table **??** the variable $DOVER_j = \frac{OVER_{Aj} - OVER_{Bj}}{OVER_{AB}}$ that captures the difference in parents' production-technology overlap with their joint venture relative to their own. We compute $OVER_{ij}, i = A, B$ and $OVER_{AB}$ as the averages of the correlations of input and output coefficients for intermediate-commodity flows between the respective industries (from the Bureau of Economic Analysis' "Use Table" published in 1997) for each parent and the JV, and between the parents.

All other variables and estimation procedures remain unchanged and are described in greater detail in the explanations of Tables **??** and **??**. The sample consists of our 275 non-contaminated two parent joint ventures minus 4 observations with missing spillover or complementarity indices, to which we apply the same outlier correction for $\widehat{\gamma}^*(k;z)$ as before. Significance levels: *** denotes significance at 1%, ** significance at 5%, * significance at 10%.

Table 15: **Technological Overlap and Control Benefits**

Specification		**1**			**2**	
Regime	$k = J$	$k = P$	$k = A$	$k = J$	$k = P$	$k = A$
z		10.6750			10.6754	
$\widehat{\gamma}^*(k;z)$	-0.2799***	0.0789***	0.2010***	-0.4246***	0.1128***	0.3118***
(P value)	(0.0000)	(0.0013)	(0.0002	(0.0000)	(0.0032)	(0.0001)
$\widehat{\gamma}^*(k;z) \cdot OVER_A$				0.0486**	-0.0107	-0.0379*
(P value)				(0.0450)	(0.2154)	(0.0945)
$OVER_A$	0.0331*	-0.0122	-0.0209	0.0020	-0.0015	-0.0005
(P value)	(0.0609)	(0.1417)	(0.1800)	(0.9216)	(0.9018)	(0.9758)
$OVER_B$	-0.0156*	0.0038*	0.0118	-0.0137*	0.0034*	0.0104
(P value)	(0.0742)	(0.0664)	(0.0989)	(0.0855)	(0.0870)	(0.1086)
$SPILL$	0.0574**	-0.0031	-0.0543**	0.0606**	-0.0031	-0.0576**
(P value)	(0.0399)	(0.7864)	(0.0332)	(0.0331)	(0.7958)	(0.0252)
$COMP$	-0.1051***	0.0156	0.0895***	-0.1135***	0.0167	0.0967***
(P value)	(0.0034)	(0.2429)	(0.0046)	(0.0020)	(0.2311)	(0.0025)
LEV	0.3542***	-0.0751**	-0.2791***	0.3505***	-0.0760**	-0.2745***
(P value)	(0.0000)	(0.0434)	(0.0001)	(0.0000)	(0.0450)	(0.0001)
$SICaaa$	0.2684***	-0.1523***	-0.1161*	0.3630***	-0.1837***	-0.1793**
(P value)	(0.0009)	(0.0008)	(0.0945)	(0.0001)	(0.0015)	(0.0234)
$SICaca$	0.3717***	-0.1054***	-0.2662***	0.4561***	-0.1305***	-0.3257***
(P value)	(0.0001)	(0.0100)	(0.0024)	(0.0000)	(0.0084)	(0.0006)
$SICaab$	0.4304***	-0.1283***	-0.3021***	0.4988***	-0.1520***	-0.3468***
(P value)	(0.0000)	(0.0034)	(0.0001)	(0.0000)	(0.0031)	(0.0000)
$SICacb$	0.3173***	-0.1226***	-0.1947***	0.4009***	-0.1497***	-0.2512***
(P value)	(0.0003)	(0.0043)	(0.0098)	(0.0000)	(0.0045)	(0.0023)
Log-likelihood		-176.85			-174.02	
Pseudo R^2		0.198			0.211	
Log-likelihood Ratio		87.38***			93.04***	
(P value)		(0.0000)			(0.0000)	
Observations		264			264	

This table reports the marginal effects and their P values for the specification

$$\Pr\{REGIME_j = k\} = \Lambda(\beta_{1k}\widehat{\gamma}^*(k;z)_j + \beta_{2k}OVER_{Aj} + \beta_{3k}OVER_{Bj} + \beta_{4k}SPILL_j + \beta_{5k}COMP_j + \beta_{6k}LEV_j + \sum_{l=7}^{10}\beta_{lk}SICpvp_j^l)$$

obtained by splitting the technology-overlap variable $DOVER_j$ in the previous estimation (Table **??**) into its constituent parts $OVER_{Aj} = \frac{OVER_{Aj}}{OVER_{AB}}$ and $OVER_{Bj} = \frac{OVER_{Bj}}{OVER_{AB}}$ that measure the relative sharing of technology attributes of each firm with their JV. Specification 2 also includes the interactive variable $\widehat{\gamma}^*(k;z) \cdot OVER_A$ to test the model prediction that JVs can exhibit greater resource-cost heterogeneity under 50-50 ownership the larger the potential for the extraction of control benefits by the dominant parent A (see Figure **??**).

All other variables and estimation procedures remain unchanged and are described in greater detail in the explanations of Tables **??** to **??**. The sample consists of our 275 non-contaminated two parent joint ventures minus 4 observations with missing spillover or complementarity indices, to which we apply the same outlier correction for $\widehat{\gamma}^*(k;z)$ as before. Significance levels: *** denotes significance at 1%, ** significance at 5%, * significance at 10%.

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