Divergence of Objectives and the Governance of Joint Ventures*

Patrick Rey†
and Jean Tirole‡

March 4, 1999

*The authors are grateful to Leonardo Felli for helpful comments.
†IDEI and GREMAQ (CNRS UMR 5604), Toulouse.
‡IDEI and GREMAQ (CNRS UMR 5604), Toulouse, CERAS (CNRS URA 2036), Paris, and MIT.

Abstract

The paper analyzes optimal governance structures for the provision of a common input. Monitoring by the future users of managerial decisions concerning the input may improve its quality. Monitoring has a public good component in that it benefits all users, as well as a conflict of interest component in that a monitor may use her proprietary information to bias input choice to her benefit and to the detriment of the other users. The paper compares three familiar governance structures, outside (investor) ownership, vertical integration (undivided control by a user), and joint venture, with the optimal mechanism.

Vertical integration generates efficient monitoring of the input supply process as well as biased decision making. In contrast, a joint venture, by requiring Pareto-improving decisions, yields unbiased decision making, but generates foot-dragging and deadlocks, especially when the users' objectives are quite divergent.

Often, the size of the conflict of interest among users can be reduced, at a cost, through contractual provisions. Our comparative statics exercises unveil a stark contrast between vertically integrated governance and the joint venture in this respect. Under vertical integration, negative externalities imposed by biased decision making reduce efficiency and do not affect incentives to monitor. In a joint venture, they do not affect decision making but increase the incentive to monitor. In a joint venture, parties are already protected by their control rights and further protection turns out to be counterproductive. We therefore argue that joint venture contracts should be less detailed and offer fewer exit opportunities than contracts protecting non controlling stakeholders.

JEL Classification: D23, G32, L3
Keywords: Governance, joint venture, integration, monitoring, control rights.

1 Introduction

This paper is concerned with the provision of a common input through a specific-purpose institution: joint venture, alliance, consortium or association (*joint venture* for short). To avoid duplicative activities, to enjoy synergies, to promote a standard, or to solve an appropriability problem, firms often join forces and create producer- or customer-owned enterprises. The latter perform basic research (Bellcore, Electric Power Research Institute, Microelectronics and Computer Technology Corporation), develop new products (General Motors-Toyota's joint venture, Partnership for a New Generation of Vehicles, telecommunications or biotechnology alliances), share expensive equipment or services (hospitals' joint ventures involving expensive health care services, oil companies sharing airport facilities to supply airlines with kerosene, Associated Press), assemble parts produced by the members and market the final product (Airbus), implement network externalities (standardization committees, Visa and MasterCard credit card associations, FTD), or provide joint marketing facilities, advertising, lobbying, and public relations (long-distance moving joint ventures such as Allied Van Lines, physician speciality networks, farm cooperatives such as Land O' Lakes or Ocean Spray).

Often, though, common inputs used by multiple firms are not produced cooperatively. Rather, they are supplied by a single, vertically integrated user of the input selling or licensing the input to other potential users (the case of *vertical integration* or *proprietary shared technology*) or by an entirely separate entity (the case of *structural separation*). One may therefore wonder why the apparently natural ownership structure, namely the cooperative one, is not pervasive. Or, as Hansmann (1996) puts it, why isn't everyone an owner?

While business is much concerned with the costs and benefits of cooperative undertakings, vertical integration, structural separation and other governance mechanisms, so are antitrust authorities, who must trade off the efficiency and competitive effects of alternative ownership structures.[1] What was the cost of the US government's decision to break up AT&T in 1984? Should Visa and MasterCard be separated from their users (the banks) and turned into for

[1]See Chang-Evans-Schmalensee (1998) for an interesting analysis of the courts' treatment of joint ventures.

profit separate entities? Should transmission grids be owned by power distribution companies, and railroad infrastructures by railroad operators? Should membership be granted to applicants who knock at a joint venture's door? Are ancillary restraints such as agreements among members not to compete with the joint venture legitimate?[2] In such instances competition policy officials need to complement their analysis of competitive effects with an understanding of the functioning of alternative ownership and governance structures. Economists have sometimes argued that the efficiency cost of compelled association may outweigh the potential pro-competitive benefits of opening joint ventures to competitors.[3]

Hansmann (1996)'s fascinating book and much anecdotal and empirical evidence[4] stress the role of homogeneity of membership in the success of cooperative ventures. Factors of divergence of objectives are many: differences in the users' competitive environments (contested vs safe industry segments, entrants vs incumbents), differences in installed technologies (research on operational improvements in the technologies used by the established firms vs research on new technologies used by entrants), differences in competencies, differences in time horizons (old vs young entrepreneurs, liquidity strapped vs rich firms), in adequation between allocated capacity and needs,[5] in personal opportunities of profiting from the venture's costly side activities (large vs small farmers in Banerjee et al. (1997)), or simply in the choice of technology or the location of investments (differences in standards, differences in stakeholders' locations with respect to decisions of power grid reinforcement). Hansmann argues that homogeneity is actually one of the key motivations for the existence of "capital cooperatives", i.e., business corporations. Investors by and large have a common goal (the return on their investments), and divergences in their objectives, as in the case of debtholders and shareholders, are mainly by design. Hansmann

[2]As early as 1898, in *Addyston Pipe* (US vs Addyston Pipe & Steel Co, 83F.271, 6th Circuit), Judge Taft argued that restricting competition by the members with the joint venture may be necessary for forming a successful joint venture.

[3]E.g. Baker (1993).

[4]E.g., Baker (1993), Banerjee et al (1997), Brodley (1982), Chang et al. (1998), Emmons-Mueller (1997), Gomes-Casseres (1994), Hart-Moore (1996), Kremer (1998), Schwartz (1997), and Wilson (1973).

[5]For example, it has been argued that AT&T blocked plans to expand the capacity of transcontinental cables between Northern and Southern America as AT&T had a substantial share of the existing joint venture capacity and was not eager to see its rivals expand.

further shows that members of joint ventures or associations try hard to create unity of goals.[6]

A major task of this paper is to relate the divergence of interests to the efficacy of joint ventures and to institutional choice. On the one hand, under heterogeneous goals, most decision processes will give rise to inefficiencies if the ensuing decisions are not renegotiated. For example, the preferred outcome of a dictator or of the median voter need not coincide with the outcome that maximizes total surplus, unless preferences of all members are congruent.[7] The Coase theorem on the other hand implies that if the joint venture's members are symmetrically informed and if they can negotiate the outcome, then heterogeneity has no effect on the efficiency of final outcomes.

This suggests considering situations in which the Coase theorem is unlikely to hold and institutions matter. However, such departures from the Coase theorem do not necessarily explain Hansmann's and others' observations about the covariation of the joint venture choice and homogeneity: While joint ventures intuitively should perform better under homogeneity, so do alternative institutions. Indeed, one might well have formulated the opposite conjecture: In a situation with divergent objectives, the joint venture, by making everyone an owner, should provide all members with some degree of protection against biased technological choices and therefore might be preferred to alternative institutions despite its inefficiency. A theory of joint ventures must address this "heterogeneity puzzle".

The premise of our analysis that joint ventures' managers may be monitored by the users of the commonly produced input. Different governance structures give rise to different moni-

[6]For example, cooperatives issue little or no capital stock even among their members in order not to create classes of shareholders with interests quite distinct from the nonshareholding members'. There is also a scarcity of cooperatives handling more than one product (and the few multi-product cooperatives are usually organized in profits centers); similarly joint ventures in the computer or automobile industries usually have a limited scope. Law firms use sharing rules that promote congruence among partners to the detriment of individual incentives.
Other examples of policies that try to achieve convergence of goals include mutual stakeholddings (equity swaps, mutual board service) and the development of close relationships at multiple organizational levels in an attempt to build trust.

[7]The median voter chooses the outcome in Hart-Moore's (1998) and Kremer's (1998) analyses of associations. Banerjee et al (1997) provide evidence that large growers have disproportionate power in the case of sugar cooperative factories in the Indian state of Maharashtra and, in their model, assume that decisions maximize a weighted social welfare function in which the large growers have disproportionate weights.

toring intensities and to different qualities of decision making.[8] In our two-user model, users' monitoring choices and their use of the resulting information are both strategic. In particular, monitoring allows a user to propose to alter the course of action (if control is shared) or to directly implement this change (if he has control), in a way that may make the input more valuable to both users but also may bias input design to his advantage and to the detriment of the other user. This ambiguity as to the implications of user intervention is central to our analysis.

We study whether familiar governance structures are optimal and how heterogeneity impacts the choice of governance structure. We also derive policies that make the standard institutions more effective. The paper is organized as follows. Section 2 introduces three familiar institutions (structural separation, vertical integration, joint venture) and provides further motivation for the analysis. Section 3 describes the model. Section 4 provides conditions under which one of the familiar institutions is optimal. Section 5 shows that policies that benefit a vertically integrated environment in general hurt joint ventures. Following the lines of Maskin-Moore (1999) and Segal-Whinston (1998), section 6 analyzes optimal mechanism design with renegotiation (an exercise of interest only if the conditions obtained in section 4 are not satisfied) and generalizes the analysis of sections 4 and 5. Section 7 concludes with a summary of the main insights and policy recommendations and lists a few desirable extensions.

Our analysis can be related to several recent papers which analyze specific aspects of the possible divergence of interest among users, or between users and suppliers. Glaeser-Shleifer (1998), Kremer (1998) and Hart-Moore (1998) emphasize different channels through which the divergence of interest among members of a cooperative impacts the efficacy of decision-making. Kremer's paper stages two dimensions of employee moral hazard: investment in firm specific human capital and current effort. Workers are ex ante identical but have different productivities ex post. It assumes that the relationship between a worker's (verifiable) performance and wage cannot be contracted upon ex ante and so there is a risk of expropriation of the workers' investments. The paper compares two institutions: worker cooperative (the workers ex post vote on

[8] As in Aghion-Tirole (1997).

a linear incentive scheme) and capitalist firm (shareholders ex post choose this scheme). The benefit of a worker cooperative is that the workers have no incentive to expropriate themselves and so invest more in firm- specific human capital. But if the median voter has less than average ability, incentives for contemporaneous effort are dulled. In a similar spirit, Glaeser and Shleifer develop a hold up model in which a firm's customers or employees are somewhat protected by the non-profit status. Indeed the cost-reducing effort of the non-profit firm is lower than that of the for-profit firm. To the extent that cost reductions affect non-contractable quality, then the non-profit status may bring about an improvement.

Hart and Moore (1998) compare input supply by an independent producer and by a not-for-profit cooperative. The independent producer charges a monopoly price to users and so induces underconsumption of the input; in contrast, a not-for-profit cooperative leads to overconsumption of the input by members of the cooperative relative to outsiders because the members cannot pay themselves dividends in cash and therefore opt for "dividends in kind". Hart and Moore also analyze the impact of median voter choices on the quality of the input.

2 Examples of governance structures

2.1 Typology

Consider the following situation: An agent or management team A develops an input or a technology that later will be used by two users U_1 and U_2. The focus of this paper is on whom the agent should report to and obey. Control rights on A's activity may be allocated to one of the two users, to nonstakeholding investors (that is, investors having no direct benefit as users), or be shared among two of or the three potential right holders. Figure 1 describes the resulting governance structures; bold lines indicate a right holder. [In Figure 1, "investors" stand for "nonstakeholding investors". Also our model does not distinguish between the users' management teams and their shareholders, and so we ignore this potential distinction in Figure 1.]

Under *structural separation*, all control rights over A's activity are given to (nonstakeholding) investors. Users have no control rights over the design of the input and its price. In contrast, under *vertical integration*, all control rights are allocated to a single user, whereas under (horizontal) *joint ventures*, these control rights are shared by both users. Alternative ownership structures include vertical joint ventures, where the investors and one or the two users share the control rights over A's activity. Lastly, and although this paper focuses on governance structures in which both users have access to the *same* input, an alternative is to duplicate input production and limit access to the input owner.

To keep the terminology straight, it is worth stressing that our typology is based on the allocation of *control rights*. In particular, "structural separation" does not preclude cooperation between the independent owner and the users. This cooperation may take the form of joint financing, long-term contracts, and/or pre-decision-making communication. For example, Microsoft licenses its operating system to computer manufacturers (the OEMs), and does not make computers itself. Thus, if we restrict attention to OEM users of Windows, the structural separation paradigm applies in that a non user has control over the input design; this does not prevent Microsoft from communicating substantially with OEMs regarding their needs. Similarly, a nonstakeholding input supplier can ask noncontrolling potential users to participate in the financing; for example, Mips, a Silicon Valley startup, organized in the 1980s a coalition including NEC, DEC, Bull, software companies, and later on Microsoft and Compaq, to manufacture RISC (reduced information-set computing) chips. Unlike the other competing groups (organized around Sun, IBM, and HP), the Mips RISC group did not involve a joint management governing body. Mips, the lead company, remained in control. Thus, even though Mips might resemble a joint venture, the allocation of control rights links it more closely to the structural separation paradigm.

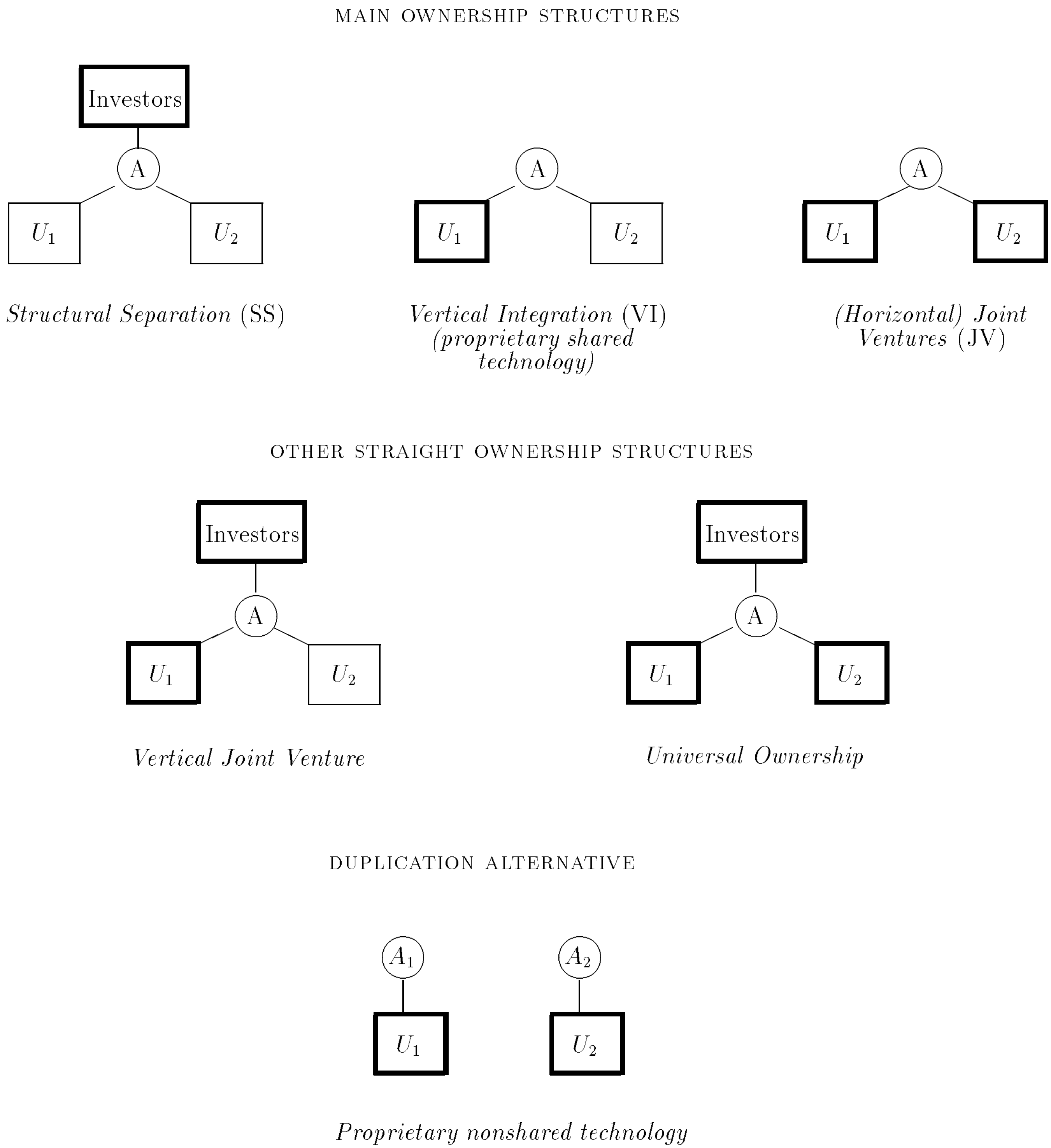
MAIN OWNERSHIP STRUCTURES
Investors
A
U_1
U_2
Structural Separation (SS)
A
U_1
U_2
Vertical Integration (VI)
(proprietary shared technology)
A
U_1
U_2
(Horizontal) Joint Ventures (JV)
OTHER STRAIGHT OWNERSHIP STRUCTURES
Investors
A
U_1
U_2
Vertical Joint Venture
Investors
A
U_1
U_2
Universal Ownership
DUPLICATION ALTERNATIVE
A_1
A_2
U_1
U_2
Proprietary nonshared technology

Figure 1

2.2 Illustrations

As the following illustrations show, a variety of governance structures are indeed observed, sometimes even within the same industry.

a) *Credit cards and ATMs*

Master Card and Visa, which accounted for 85 percent of all charges on payment cards in 1997, are non-profit joint ventures of financial institutions.[9] The initial industry structure, though, belonged to the vertical integration paradigm. For example, in the 1950s, Bank of America developed a proprietary card, which it licensed to other banks in the 1960s. Bank of America retained the control rights until it turned its card system into an independent joint venture (called NBI and then Visa) with joint management of the card issuing members. Similarly, the Master Card joint venture originated in a prior proprietary system. Note that the industry exhibits some duplication of input production, with the duplication of joint ventures as well as the existence of proprietary credit card systems such as American Express and Discover.

The evolution of the ATM (automatic teller machines) industry bears some resemblance with that of the credit card industry. It is interesting to note that ATM joint ventures have often competed with proprietary shared systems, i.e., systems in which a retail bank licenses its program to other banks, but keeps control of operating rules, fees, and conditions for participation.[10]

b) *News services*

In the US, the news services industry for several decades exhibited an interesting competition between a newspapers joint venture, Associated Press, and two proprietary systems (UP and INS) owned by independent investors. There was thus coexistence of the joint venture and

[9] See Evans-Schmalensee (1998) for a thorough analysis of the credit card industry.

[10] In both Texas and New England, the proprietary network sought favorable acccess to its non-profit joint venture competitor, which reluctanly gave in. See Baker (1993) for more details.

structural separation ownership structures.[11]

c) *Computer industry*

Alternative governance structures also coexist in the computer industry, as examplified by the competition between Intel (structural separation), Mips and the three RISC joint ventures. Microsoft's design of Windows roughly fits with the structural separation paradigm for features of interest to OEMs, and with the vertical integration paradigm for features of interest to some applications software.

d) *Electricity, railroads, telecommunications*

The restructuring of these industries is inspired by two main paradigms: structural separation of the infrastructure (AT&T breakup, independent transmission grid in the US, UK and several other countries, railroads in Europe) versus vertical integration with access policies (telecommunications in most countries, electricity in Europe, railroads in the US). There have also been examples of joint ventures such as the Pennsylvania-New Jersey-Maryland electricity pool (which was recently replaced by an independent system operator), "global services" telecommunications providers such as Global One (an alliance involving Deutsche Telekom, France Telecom, and Sprint), or transcontinental cable or satellite joint ventures. Lastly, facilities-based competition in the local loop segment provides an illustration of input duplication. To be certain, regulation affects the impact of control rights in these industries, but the efficiency effects studied in the paper ought to be relevant nevertheless.

3 The model

- *Users and supplier*: There are two ex ante symmetric, risk neutral users (or groups of users), U_1 and U_2. To produce, they need an essential input. Because of the presence of returns to scale, say, this input is produced by a single agent, A. A design or quality decision is made at

[11]In a well-known antitrust case in 1945 (Associated Press v. United States, 326 U.S.1), Associated Press was forced to abandon its system of partial local exclusivity (which was also used by the two proprietary networks). Non-member newspapers joined massively Associated Press and over the years stopped subscribing to the proprietary networks.

the interim stage, that impacts the users' final surpluses from producing from the input. The users may have conflicting interests regarding this interim design choice. Besides, the agent cannot be trusted to always choose the design that maximizes the users' aggregate surplus. The users may therefore want to have some control over the decision process.

In this paper, we will not be preoccupied with the agent's incentive to acquire information and will simply assume that she learns for free and announces her preferred choice (which may or may not be optimal for the users). Thus, there is nothing interesting about the agent's behavior in this model.[12]

- *Timing*: There are three dates, $t = 0, 1, 2$. The users choose a governance structure (a contract) at date 0 so as to maximize their expected joint surplus .

At date 1 the agent learns and recommends her preferred action. The users may then acquire information about the payoff consequences of alternative technological choices. A decision is made, that affects the three parties' payoffs. At date 2, the users consume the input. Their surpluses are not verifiable.[13]

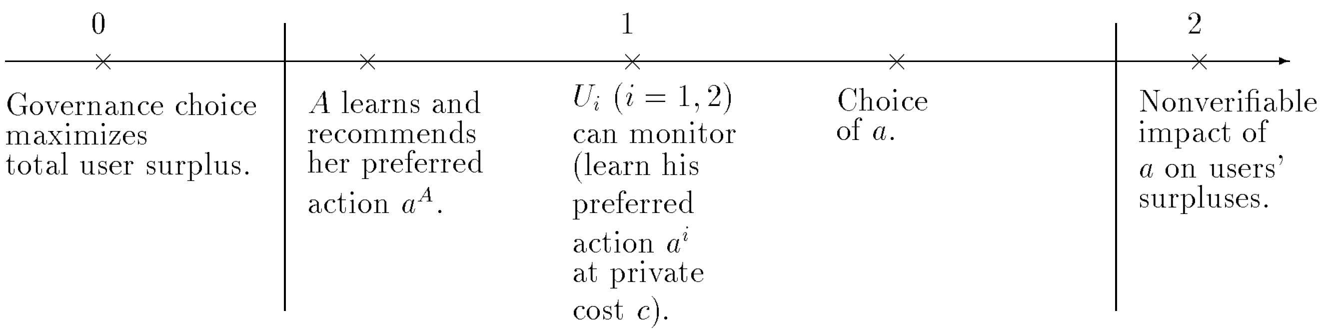

Figure 2: Timing

- *Decisions and payoffs*: At date 1, an action a in the feasible set $\mathcal{A}$ will need to be chosen. We assume that feasible actions are indescribable at date 0.[14] As already discussed, at date 1 the agent learns (and can describe) her preferred action $a^A \in \mathcal{A}$ and recommends this action

[12]Were the agent's information acquisition costly, we could further study how the ownership structure impacts the agent's incentives.

[13]This assumption rules out the benefits from equity participations identified in Dasgupta-Tao (1998a,b).

[14]Alternatively, the set $\mathcal{A}$ could be describable at date 0, but the actions in that set would be ex ante identical in the sense that all permutations of payoffs attached to these actions are equally likely.

to the users. We normalize each user's expected surplus associated with the agent's preferred action at zero; that is, we are interested in the increments/decrements to the users' surpluses brought about by altering the course of action proposed by the agent.

- *Altering the agent's proposed course of action*: Before the decision is made, each user can monitor at private cost c (by assumption, non-users are unable to monitor the adequacy of the agent's design with the users' needs). When monitoring, user U_i learns (and can describe) which action a^i in $\mathcal{A}$ is best for him. To simplify the analysis, we assume that there are only two payoff configurations: dissonance between users and congruence.

Congruence: the users' preferred actions coincide: $a^1 = a^2$. Overruling the agent's preferred action a^A then yields an extra surplus $V > 0$ to each user.

Dissonance: User U_i's preferred action a^i still yields an extra surplus V to U_i relative to a^A, but imposes a loss $L > 0$ relative to a^A on the other user.

We denote by α the probability of dissonance. An important feature of our model is that a user who does not invest in information may not know whether the other user's preferred action is good or bad for him, that is whether there is congruence or dissonance. A verifiable signal accrues that either tells the users that their preferences are congruent for sure or leaves them in the doubt. In the former case, which has probability $1 - \beta$, not only do the users' preferred actions coincide, but also an uninformed user knows that the proposal made by the other informed user is good for him.[15] Because it is then common knowledge that users' preferences coincide, monitoring by at least one user will allow users to modify the agent's action and increase each user's surplus by V.

With probability $\beta > \alpha$, there is *potential dissonance*, in that an uninformed user does not know whether the other user's preferred action is good for him. He just knows that preferences coincide with conditional probability $1 - \hat{\alpha} = 1 - \alpha/\beta$, and are dissonant with conditional probability $\hat{\alpha} = \alpha/\beta$. Only by getting informed will this user know which configuration obtains.[16]

[15]Alternatively, the informed user could come up with hard (convincing) evidence of congruence.

[16]An alternative interpretation for our model has two states of nature (congruence, dissonance) and two decisions rather than three states of nature (known congruence, potentially unknown congruence, potentially unknown dissonance) and a single decision. The first decision concerns the choice of action $a \in \mathcal{A}$ over which

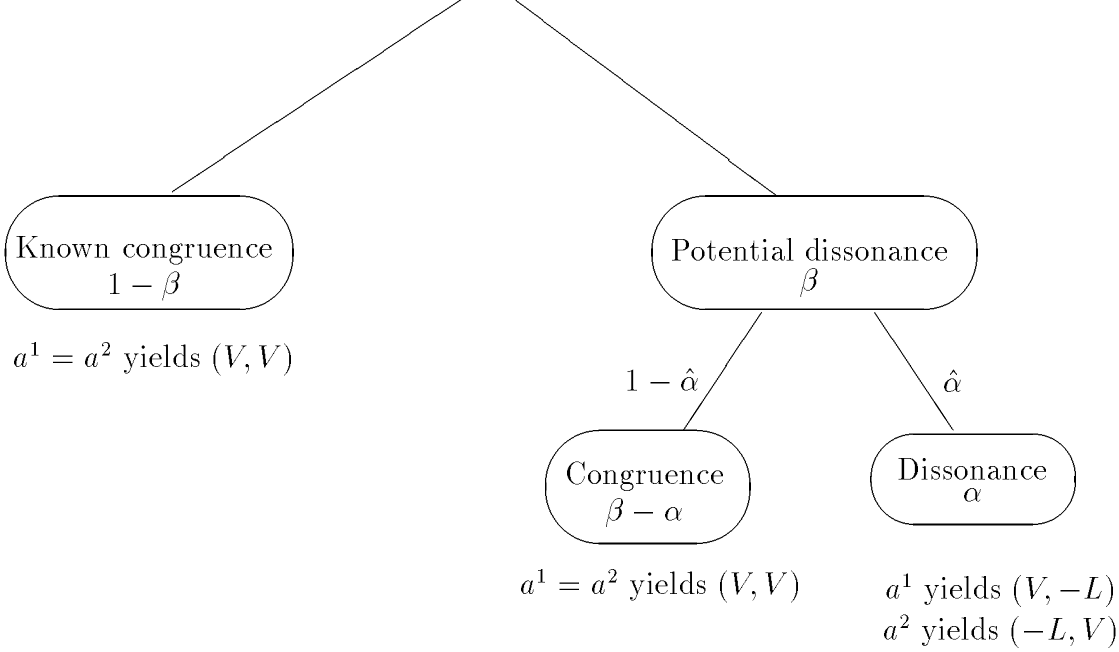

Figure 3: Information and payoff structures

Assumption 3.1 *: $L > V$.*

Assumption 3.1 implies that implementing a user's preferred action in the dissonant state is inefficient, in that the users *collectively* would be better off not interfering with the agent's proposal.

The following distinction[17] will play a crucial role both in the analysis of the unconstrained optimum and that of the optimal contract:

Definition 3.1 *A design modification corresponding to a user's preferred action is interim efficient (interim inefficient) if it increases (decreases) the users' total surplus when it is unknown whether the state is congruent or dissonant:*[18]

Interim efficiency: $(1-\hat{\alpha})(2V) - \hat{\alpha}(L-V) > 0.$

Interim inefficiency: $(1-\hat{\alpha})(2V) - \hat{\alpha}(L-V) < 0$.

there is potential dissonance: With probability $1-\hat{\alpha}$, there is congruence and common gain $\hat{V} \equiv \beta V$, and with probability $\hat{\alpha}$ dissonance and gain $\hat{V}$ and loss $\hat{L} \equiv \beta L$. The second decision is one over which the preferences are necessarily congruent, and the gain from intervention is $\Delta \equiv (1-\beta)V$ per user.

[17]The terminology follows that of Holmström-Myerson (1983). Note that a modification is always *ex post* efficient in the congruent state and *ex post* inefficient in the dissonant state (from Assumption 3.1).

[18]For the sake of presentation, we assume that L is not so high as to make trade undesirable.

As is customary in the institutional design literature, we assume that the date-0 contract is chosen so as to maximize the ex ante expected total surplus of the users (or, equivalently, of the users cum nonstakeholding investors). The justification for this assumption is that if the resulting contract favors one of the users (as is the case for instance under vertical integration), the users can always operate a date-0 compensating transfer.

Remark: Although this paper will not derive the antitrust implications of our analysis, it should be borne in mind that the privately optimal institution may not be socially optimal if it impacts consumer welfare. In this respect, note that our general payoff specification accommodates both situations in which the users are in different markets (as in the case of Bellcore or EPRI before the advent of competition between Regional Bell Operating Companies or power companies) or compete mildly with each other, and other situations in which they compete fiercely for market share. An antitrust perspective must however take into account the externality exerted by the choice of governance structure on consumers.[19]

- *Benchmark: Optimal number of monitors in the absence of problems with monitoring incentives*

In this benchmark analysis, we imagine that the users' monitoring behavior can be costlessly specified in the initial contract and that the information derived from monitoring is used as effectively as possible. "As effectively as possible" refers to the fact that, in the case of a single monitor, the monitor can manipulate his acquired information as he wishes. In this "verifiable monitoring optimum" or "unconstrained optimum", we are not concerned with the users' incentives to monitor. We also assume that the monitoring decision maximizes the sum of the users' expected payoffs.

i) *Interim efficient modification.*

Let $m \in \{0, 1, 2\}$ denote the number of designated monitors. The users' joint surplus (relative to the policy of not monitoring and systematically rubberstamping the agent's design choice)

[19] For instance, an institution fostering foreclosure of one of the users (think of a biased design choice that makes the input compatible with only one of the users) may raise total profit by softening competition (negating assumption 3.1) but reduce overall welfare.

is

$$\begin{cases} 0 & \text{if } m = 0 \\ -c + (1-\alpha)(2V) - \alpha(L-V) & \text{if } m = 1 \\ -2c + (1-\alpha)(2V) & \text{if } m = 2. \end{cases}$$

To see this, let us analyze the optimal decision for each of the three monitoring structures. When no user monitors ($m = 0$), the best for the users is to go along with the agent's recommendation. With one or two monitors, a net gain V per user is available when there is known congruence. The question is then whether the agent's preferred action should be overruled when there is a single monitor ($m = 1$) and potential dissonance. If the monitor does not know whether there is congruence or dissonance, his recommendation is followed, since it is interim efficient to overrule the agent. Nothing is changed if the monitor further learns whether the state is congruent or dissonant: According to standard mechanism design theory, there is no way to induce the monitor to reveal whether the state is congruent or dissonant since in the two states he receives the same payoff, V, from overruling the agent's recommendation. Hence the informed user's preferred action is always implemented, yielding surplus $-c + V$ to this user and $(1-\alpha)V - \alpha L$ is the other. [20]

Last, with two monitors ($m = 2$), and unlike in the single monitor case, the ex post optimal decision rule, namely overruling the agent in the congruent state and rubberstamping her proposal in the dissonant state, can be implemented. [There are various institutions yielding this outcome. For example, one can let one user make a proposal and give the other user a veto right. Alternatively, one can let the two users bargain over the choice of the decision.] Ex post, the per user surplus is then $-c + V$ in case of congruence and $-c$ in case of dissonance.

ii) *Interim inefficient modification.*

Interim efficiency is irrelevant in the absence of monitor (no modification is then suggested) or with two monitors (since both are informed). With a single monitor and interim inefficiency, it is by definition optimal not to overrule the agent when there is potential dissonance. The

[20] The monitor's recommendation could also be randomly followed, yielding a convex combination of the two payoff vectors. But it is optimal either to follow or not to follow the recommendation.

only benefit of centralized monitoring is then the increase in surplus obtained in the state of known congruence. The users' joint surplus is now $(1-\beta)(2V)-c$ under centralized monitoring.

Proposition 3.1 *(Verifiable monitoring optimum). Could the users' monitoring behavior be specified in a contract, the optimal number, m^*, of monitors would be:*

i) Interim efficient modification:

$$\text{zero if } c > \max\{(1-\alpha)(2V) - \alpha(L-V), (1-\alpha)V\}$$

$$\text{one if } \alpha(L-V) < c < (1-\alpha)(2V) - \alpha(L-V)$$

$$\text{two if } \ c < \min\{(1-\alpha)V\ , \alpha(L-V)\}.$$

ii) *Interim inefficient modification*:

$$\text{zero if } \ c > \max\{(1-\beta)(2V), (1-\alpha)V\}$$

$$\text{one if } \ (\beta-\alpha)(2V) < c < (1-\beta)(2V)$$

$$\text{two if } \ c < \min\{(1-\alpha)V, (\beta-\alpha)(2V).\}.$$

When the modification is interim efficient, monitoring (by one or two users) is more appealing, the larger the potential gain (V) and the smaller the monitoring cost (c), the probability of dissonance (α) or its cost (L). Assuming monitoring is desirable, duplicated monitoring ($m=2$) is more likely to be preferred to centralized monitoring ($m=1$), the larger the loss or externality (L) imposed on the victim of a biased decision, and the larger the probability of dissonance (α).

When the modification is interim inefficient, monitoring is again more appealing, the larger its potential gain (V) and the smaller its cost (L) or the probability of dissonance (α).[21] In contrast with the case of an interim efficient modification, however, duplicated monitoring is now more desirable than centralized monitoring when there is a high probability of *unknown congruence* ($\beta-\alpha$) rather than a high probability of dissonance.

Proposition 3.1 in particular shows that *the ex post heterogeneity of preferences, as measured by L, favors duplicated monitoring over centralized monitoring.* Duplicated monitoring gives

[21]Although the loss (L) no longer appears to be relevant, a smaller loss may make the modification interim efficient and thus raise the desirability of (duplicated) monitoring.

both users a protection against biased decision making, that is not available under centralized monitoring (if use is to be made of the information collected by the single monitor), which is the case if the modification is interim efficient.

The probability of dissonance, α, has a different impact, depending on the interim efficiency of overruling the agent's decision. When overruling the agent is interim efficient, under centralized monitoring the monitor's decision is always implemented; an increase in the probability of dissonance (α) thus makes centralized monitoring less appealing since it increases the risk of a loss (L). When instead overruling the agent is interim inefficient, then, under centralized monitoring, the monitor's preferred action is implemented only when there is known congruence; and so an increase in the probability of dissonance (α) reduces the cost of rubberstamping the agent's action and thus makes centralized monitoring more appealing.

4 Analyses of familiar governance structures

We now assume realistically that the users' monitoring behavior is subject to moral hazard. First, and in the tradition of Grossman-Hart (1986) and Hart-Moore (1990), we analyze the performance of familiar institutions and provide a comparison with the upper bound on welfare obtained in Proposition 3.1 by ignoring moral hazard in monitoring. The governance structures studied in this section are those described in section 2, namely:

Structural Separation: The supplier is investor owned. The shareholders, who cannot know the needs of the users, are unable to monitor the agent's choice and therefore rubberstamp her recommendation. The supplier sells the input to U_1 and U_2 at a price (or at prices) of his choice at date 2.

Vertical Integration: One of the users, U_1 say, has the control right over the decision. The decision process is internal to U_1 and unobserved by U_2. U_1 sets a price and sells the input to U_2 at date 2. [22]

[22]The non-owner thus cannot take part in the decision process (even by bribing the owner). A less extreme form of vertical integration (e.g., where U_1 would have a majority stake in a 51-49 joint venture, but U_2 would

Joint Venture: Any decision requires the consent of each user.[23] That is, the two users bargain at date 2 concerning the use of the jointly produced input, and (more importantly) at date 1 concerning the action to be selected. We assume that the Nash bargaining solution prevails at each stage, that is, the two users have equal bargaining power.

These three institutions are meant to be illustrative of the broader classes that encompass many variants. For example, in the case of structural separation, the users might haggle over the price. Similarly, in the case of vertical integration, the nonintegrated user could be allowed to observe the decision process (learn whether the integrated user overruled the agent's decision or not) and also try to haggle over the price of the input. The particular cases we focus on exacerbate the main characteristics of each type of institution: the users' lack of control under structural separation, the asymmetry between integrated and independent users and the bias in decision making under vertical integration, and the need to reach an agreement in the case of a joint venture. Introducing the variants would not affect the qualitative properties of the institutions studied below.

As we will see, in some situations, one of these three institutions implements the unconstrained optimum derived in Proposition 3.1. In other situations, none of them does and we must then study whether a more efficient institution exists that is consistent with the moral hazard constraint that monitoring behavior is not observable. We analyze optimal contracting in section 6.

a) *Structural separation*

Because the owner is unable to monitor what the users need, structural separation deprives the organization of its natural monitors of input design (the users). To be certain, a user could monitor the agent and try to be involved in decision making. However, the investor-owned supplier would then raise the final price to that user by the extent, V, of the increase in surplus, and so the monitoring user would lose the monitoring cost. More generally, a user

have a minority stake) would grant the control rights to one user but, by making the non-owner part of the internal decision process, would still leave some room for joint negotiation in the decision process. See Killing (1983) for a discussion of "dominant parent joint ventures", as well as section 6.

[23] Our joint venture thus corresponds to the case of "joint ownership" in Hart-Moore (1990).

without control right is unwilling to monitor as long as he does not have substantial bargaining power. Thus, structural separation implements the optimum if the optimal number of monitors in Proposition 3.1 is equal to 0.

b) *Vertical integration*

Because incentives to monitor covary with the extent of rights-holding,[24] vertical integration would seem to designate the vertically integrated user as the monitor. [For the same reason as under structural separation, the non-owner user has no incentives to monitor at the interim stage]. The owner monitors if and only if his gain of doing so exceeds his cost, or

$$V \geq c. \tag{1}$$

If (1) is satisfied and the modification is interim efficient, then vertical integration implements the unconstrained optimum when the latter corresponds to centralized monitoring.[25] Otherwise, vertical integration does not generate any monitoring (neither does the joint venture in this case, as we will see). Also, vertical integration cannot implement the unconstrained optimum if monitoring is desirable and the modification is interim inefficient.[26]

Remark: In this model, the "vertical joint venture", in which control is shared among user U_1, say, and investors (see section 2), is dominated by vertical integration: Suppose that in such a venture U_1 monitors and bargains with investors to alter the agent's course of action and over a final price (U_2 unknowing, say). The outcome is the same as under vertical integration (U_2 is not protected), but under Nash bargaining, half of U_1's surplus from monitoring is captured

[24] As in Aghion-Tirole (1997).

[25] We have not allowed secret monitoring, that is monitoring by the non-user with the aim at assessing the input's value to him. This was clearly of no consequence in the case of structural separation, where this value was known by both users. Here, the non-owner does not know whether the modifications brought about by the user reflect the congruent or dissonant state. Suppose that, at cost c, the non-owner can secretely monitor his surplus from the input before purchasing. The owner, anticipating that the non-owner does not monitor, sets a price based on the average value, $(1-\hat{\alpha})V - \hat{\alpha}L$, of the modification for the non-owner. By monitoring and purchasing only in the case of congruence, the non-owner gains $-c + (\beta - \alpha)\left[V - ((1-\hat{\alpha})V - \hat{\alpha}L)\right]$. So, if $(\beta - \alpha)\hat{\alpha}(L+V) < c$, the non-owner indeed has no incentive to monitor. Note also that the non-owner would have even less incentive to secretly monitor if the final price were the object of bargaining (and therefore would be lower) rather than set by the owner.

[26] Either (1) is satisfied, in which case the integrated user monitors and the independent one, who does not observe the decision process, cannot prevent the inefficient modification, or (1) is not satisfied, and no monitoring occurs.

by investors, leading to reduced incentives to monitor relative to vertical integration. This observation is but the transposition to our model of Hart and Moore's 1990 result according to which joint ownership (here between U_1 and investors) underprotects specific investments and is therefore suboptimal. [A similar remark applies to the comparison of universal ownership, i.e., ownership by investors and the two users, and the joint venture.]

c) *Joint venture*

By reestablishing the symmetry between the users, the joint venture institution would seem to promote duplicated monitoring. Does there indeed exist an equilibrium of the monitoring game in which they both monitor? From Assumption 3.1, the agent's proposal is overruled only when the principals have congruent preferences. Thus, the per-user increase in surplus relative to the absence of monitoring (structural separation) is

$$-c + (1 - \alpha)V.$$

Does U_2, say, have an incentive to monitor when U_1 already monitors? To answer this question, we must consider the outcome of the bargaining between the two users when there is potential dissonance and only U_1 is informed. When U_1 proposes to overrule the agent, the bargaining game involves *symmetric* information about payoffs: U_2 knows that U_1 has value V for the modification, and himself values it at $(1 - \hat{\alpha})V - \hat{\alpha}L$. Whether U_1 knows that the state is congruent or dissonant is irrelevant, because U_1 cares only about his own payoff.

i) *Interim inefficient modification.*

In a joint venture, U_1 must convince U_2 to go along with his proposal to overrule the agent. In the interim inefficiency case this is clearly impossible if U_2 is uninformed and so deadlock prevails when there is potential dissonance. Thus by deviating and not monitoring, U_2 obtains $(1 - \beta)V$. Duplicated monitoring is consistent with incentives in the interim inefficiency case if and only if

$$(1 - \beta)V \leq -c + (1 - \alpha)V$$

or

$$c \leq (\beta - \alpha)V. \tag{2}$$

The probability of congruence, which here is equal to the probability of coming to an interim agreement when both users are informed, must be sufficiently high for users to bother monitoring.[27]

Note that condition (2) is not guaranteed by the unconstrained optimality of duplicated monitoring. Recall that under interim inefficiency duplicated monitoring is preferred to centralized monitoring if $c < (\beta - \alpha)(2V)$. When deciding whether to monitor, a user does not internalize the positive externality on the other user, who will benefit if the users come to an agreement. This result is reminiscent of other results in the literature. In Anderlini-Felli (1997), two potential trading partners must sink some fixed investment cost before they are able to start bargaining over the division of a pie. Anderlini and Felli show that the Coasian efficient outcome does not come about if one of the potential partners does not derive enough surplus in bargaining to offset this upfront cost. Our analysis of the joint venture institution is also closely related to a large body of literature on "cooperative" and "selfish" investments in bilateral relationships,[28] although that literature does not consider investments in information acquisition and bargaining breakdowns.

[27]When condition (2) is violated, the basic joint venture institution is incapable of implementing the unconstrained optimum. It is interesting, though, to analyze its implications. For a given probability $x_j \in [0, 1]$ that user U_j monitors, user U_i's expected benefit from monitoring is

$$x_j[(\beta - \alpha)V] + (1 - x_j)(1 - \beta)V - c.$$

Hence, the monitoring decisions are strategic complements if the probability of unknown congruence $(\beta - \alpha)$ is larger than that of known congruence $(1 - \beta)$. If $(1 - \beta)V < c$, then it is a dominant strategy for both users not to monitor. If $(1 - \beta)V > c$, the monitoring decisions are strategic substitutes, and there are three equilibria, two in pure strategies ("only U_1 monitors", and "only U_2 monitors") and a symmetric mixed strategic equilibrium (each user monitors with probability $((1 - \beta)V - c)/[(1 - \beta)V - (1 - \alpha)V]$).

Conversely, when condition (2) is satisfied but monitoring decisions are strategic complements, so that $(\beta - \alpha)V > c > (1 - \beta)V$, there also exists a pure strategy equilibrium where no user monitors, as well as a mixed-strategy equilibrium.

[28]See, e.g., Grossman-Hart (1986), Hart-Moore (1990) and Hart (1995) for incomplete contract approaches, and Che-Hausch (1998), Hart-Moore (1999), Maskin-Tirole (1999a) and Segal (1995, 1999) for optimal complete contracts with the possibility of renegotiation.

ii) *Interim efficient modification*

Suppose, again, that only one of the users is informed. Under Nash bargaining and interim efficiency in the state of potential dissonance, the gains from trade, $(1-\hat{\alpha})(2V)-\hat{\alpha}(L-V)$, are split in halves. This provides users with an extra incentive not to monitor. Indeed, a user is willing to monitor provided the other user also monitors if and only if[29]

$$c \leq \beta\left\{(1-\hat{\alpha})V-\left[(1-\hat{\alpha})V-\frac{\hat{\alpha}}{2}(L-V)\right]\right\},$$

or

$$c \leq \frac{\alpha}{2}(L-V). \tag{3}$$

Again, an informed user gets only half of the surplus generated by his monitoring.

Proposition 4.1 *a) The verifiable monitoring optimum can be implemented through*

– structural separation if $m^*=0$*,*

– vertical integration if $m^*=1$*, a user's preferred action is interim efficient, and*

$$V \geq c,$$

– the joint venture if $m^*=1$*, a user's preferred action is interim inefficient, and*

$$(1-\beta)V > c,$$

[29] If condition (3) is violated, then the joint venture institution cannot implement the unconstrained optimum when the latter prescribes duplicated monitoring. The outcome of the monitoring subgame again hinges upon whether the monitoring efforts are strategic substitutes or complements. User U_i's net gain from monitoring when user U_j monitors with probability x_j is

$$x_j\left[\frac{\alpha(L-V)}{2}\right]+(1-x_j)\left[(1-\alpha)V-\frac{\alpha(L-V)}{2}\right]-c.$$

Thus, monitoring efforts are strategic substitutes if

$$\alpha(L-V)-(1-\alpha)V<0,$$

and strategic complements otherwise. Under strategic substitutes, there again exists three equilibria, two in pure strategies ("only U_1 monitors", and "only U_2 monitors") and one symmetric mixed strategy equilibrium, if $(1-\alpha)V-\dfrac{\alpha(L-V)}{2}>c$, and no monitoring otherwise.

– *the joint venture if* $m^* = 2$ *, and*

$$c \leq \min\left\{(\beta-\alpha)V\,,\ \frac{\alpha(L-V)}{2}\right\}.$$

It cannot be implemented by any of these three simple institutions otherwise.

b) There is always more overruling of the agent's proposal under vertical integration than under a joint venture.

Part b) of the proposition stems from i) the fact that the private gain of monitoring in a joint venture is always lower than V, and so if $V < c$ there is no monitoring in a joint venture either; and from ii) the fact that information acquisition under a joint venture does not necessarily affect decision-making. Proposition 4.1 stresses that centralized monitoring is easier to implement through vertical integration,[30] although excessive overruling (when it is interim inefficient) may make up the joint venture more appealing, provided it does generate enough incentives to monitor, which is not guaranteed. Lastly, the joint venture is the only arrangement that may generate duplicated monitoring, but it may fail to do so because of insufficient incentives: Under the joint venture arrangement, the private returns from monitoring are always smaller than the surplus it generates.[31]

5 Strategies for joint venture success

We now perform comparative statics and unveil factors that help make the joint venture optimal. We show that the impacts of variations in parameters on the efficiency of joint ventures and vertical integration are quite different.

a) *Don't overprotect*

From Proposition 4.1, the joint venture implements the unconstrained optimum if $m^* = 2$

[30]The necessary condition for the emergence of centralized monitoring under a joint venture ($c < (1-\alpha)V - \frac{\alpha}{2}(L-V)$ for an interim efficient modification and $c < (1-\beta)V$ otherwise) is stronger than the sufficient condition obtained for vertical integration ($c < V$).

[31]In contrast with the case of vertical integration, which may provide too much incentives to monitor (e.g., if $V > c > (1-\beta)(2V)$.

and

$$c \leq \min\left\{(\beta-\alpha)V\,,\ \frac{\alpha}{2}(L-V)\right\}.$$

Our analysis shows that reducing the loss or exposure L is not desirable under the joint venture arrangement. Indeed, in the case of an interim efficient modification, a reduction in the loss raises the users' benefit from free-riding, while it does not affect that from monitoring. *A smaller exposure thus reduces the incentive to monitor without altering the efficiency of the joint venture.* Since *users are already protected by their control rights*, they do not need further protection; the only impact of protection is a possible reduction in incentives. This implies that there is no point spending substantial energy at the joint venture design stage to try to limit each party's exposure.

To see this, suppose that, at some ex ante contracting cost, the loss L can be reduced to $\ell \in (V, L)$ (so we keep the assumption that overruling the agent is ex post inefficient in case of dissonance). The new incentive compatibility condition for duplicated monitoring is

$$c \leq \min\left\{(\beta-\alpha)V, \frac{\alpha}{2}(\ell-V)\right\}.$$

The incentive compatibility condition is strictly relaxed whenever overruling the agent is interim efficient under the increased protection ($(\beta-\alpha)(2V) > \alpha(\ell-V)$). The ex ante surplus (gross of the ex ante cost of protecting the parties) has not changed and is still equal to $-2c+(1-\alpha)(2V)$.

This conclusion is in sharp contrast with the case of vertical integration. *Under U_1-ownership, reducing user U_2's exposure by contractual means increases efficiency without altering user U_1's incentives to monitor.* Protection of the non-owner is therefore desirable.

The application of this latter result to a different context may help grasp the main idea. Consider the standard corporation with equity holders in control and a range of noncontrolling stakeholders (creditors, employees, communities, etc.). Because control is undivided, optimal contracting calls for limiting the noncontrolling stakeholders' exposure to biased decision making by shareholders. This can be viewed as a costly step toward reducing L. In the case of loan contracts, the protection takes the form of giving creditors a nominally fixed claim, pledging them collateral, and providing them with exit options (through short maturities and convertibility). Similarly, many countries attempt to limit externalities imposed by shareholder decision-making on employees.

b) *Foster commitment by limiting outside activities and exit options*

In what can be viewed as a special case of the previous precept, a joint venture may benefit from curtailing its members' outside opportunities (despite the obvious cost of doing so) in order to strengthen their commitment to and investment in the venture. To illustrate this point, suppose that an outside opportunity for user U_i provides a substitute for this user in case the input proves quite inadequate to its needs, namely when the design is the other user's preferred design and there is dissonance. The existence of an outside opportunity can thus be viewed as a reduction in his potential exposure, L_i. A reduction in L_i has no impact on the joint venture's efficiency but reduces the user's incentive to invest (monitor) in the joint venture. This conclusion seems consistent with a body of anecdotal evidence showing that attempts by parties to a joint venture do reduce their mutual reliance tend to undermine the effectiveness of the joint venture.[32] An implication of this point is that antitrust authorities should not object to exclusivity relationships in research or network joint ventures unless exclusivity substantially reduces competition in the input market.

It is interesting to contrast this commitment rationale for strong relationships with the existing theories linking control rights and outside opportunities. A major theme of the literature originating in the work of Grossman-Hart (1986) and Hart-Moore (1990) is that outside opportunities (the opportunity to trade with alternative buyers or sellers in their model) *encourage* specific investments in a relationship by protecting each party's investment against expropriation by the other through haggling. The explanation for the difference with our work is that in Grossman-Hart-Moore a party's level of investment and the value of his outside opportunity reinforce each other, whereas they are substitute in our model. Outside opportunities may also be undesirable in the transfer pricing model in Holmström-Tirole (1991), but for a different

[32]To be certain, we identify only one effect here. Indeed, while some joint ventures impose various forms of exclusivity (e.g. Visa, Atlas Van Lines), others (e.g., EPRI, Intelsat, Bellcore) don't, either by fear of antitrust prosecution (e.g., being accused of cartelizing the R&D market) or for efficiency reasons (for instance, to enjoy the benefit of multiple sourcing).

reason than that given here; there, the existence of outside opportunities encourage parties to invest in inefficient general-purpose technologies that raise their bargaining power vis-a-vis their trading partner.

The noncontrolling user's outside opportunities are beneficial under vertical integration in our model. They increase efficiency by reducing this user's loss in case of dissonance. Outside opportunities have no effect on incentives to monitor and do not affect the controlling user's payoff either. So, outside opportunities are beneficial under vertical integration and detrimental to a joint venture.

c) *Don't belabor agreements*

In our model, actions are all ex ante identical, and there is no reason to exclude some and single out others in the initial contract. Suppose in contrast that the action set can be subdivided into groups of actions distinguished by ex ante attributes. Intuitively, under vertical integration, the parties to the initial contract may want to prevent the controlling user from taking specific actions or groups of actions (or, more generally, forcing him to compensate the other user if he selects such actions). And indeed, under undivided control, contracts with noncontrolling parties often include extensive restrictions on the controlling party's decision set. For example, a loan contract between creditors and shareholders usually specify a large number of "positive and negative covenants", that is of dos and don'ts. In the framework of our model such restrictions on the decision set of the controlling user (U_1) can be viewed as reducing the probability of a large negative externality (L_2) on the noncontrolling user (U_2).

Again, the contrast with joint ventures is striking. Joint-venture partners are already protected by their control rights. A prohibition on some actions in our model can only hurt parties (if there is no interim renegotiation) or at best not affect them (in case of interim renegotiation).

To see this, suppose for example that, when the users' preferences diverge, there are not one but two "biased" actions available to each user who has monitored, the first one (B) yielding $(V, -L)$ as before and the second one (b) yielding $(V-\varepsilon, -\ell)$, where $\varepsilon > 0$, $V < \ell < L$ and $(\beta - \alpha)(2V) > \alpha(\ell - V)$: action b is ex post inefficient but is interim efficient and generates a smaller externality or bias than action B.

If in a joint venture, only one user monitors, he will offfer to implement B rather than b (since $V > V - \varepsilon$), which the uninformed user may or may not agree to, depending on whether B is interim efficient. If instead both users monitor, they will implement neither b nor B when there is dissonance. Hence, the private incentive to duplicate monitoring is given by

$$-c + \min\left\{\frac{\alpha}{2}(L - V), (\beta - \alpha)V\right\}.$$

Now, suppose that, at some ex ante contracting cost, action B can be banned (or made verifiable, so that a fine could sanction its adoption), thereby protecting an uninformed user by reducing his exposure. Our analysis shows that such protection is not desirable. Indeed, while this protection does not affect what happens under duplicated monitoring, if only one user monitors he will now offer to implement b, which the uninformed user will agree to since b is interim efficient. Hence, the private incentive to duplicate monitoring is now given by

$$-c + \frac{\alpha}{2}(\ell - V),$$

and is thus smaller than before since $\ell < L$ and $\frac{\alpha}{2}(\ell - V) < (\beta - \alpha)V$ since b is interim efficient. Hence, protecting the uninformed user again does not enhance the efficiency of the joint venture under duplicated monitoring, but does reduce the incentive to monitor and thus is not desirable as long a duplicated monitoring is efficient.

This conclusion stands in sharp contrast with that for vertical integration. In the absence of protection, the owner gets $V - c$ (assuming he monitors, that is, $V > c$) while the non-owner gets $(1 - \alpha)V - \alpha L$. Protecting the non-owner (by banning action B) affects only slightly the owner's incentives to monitor if ε is small, since the owner now gets $V - \alpha\varepsilon - c$, but has a significant and positive impact on the non-owner, who now gets $(1 - \alpha)V - \alpha\ell$. Hence, if the reduction in the loss or exposure $(L - \ell)$ is much larger than the loss of surplus for the informed user (ε), and if the contracting cost of banning action B is small enough, protecting the non-owner increases the efficiency of vertical integration.

d) *Strive for congruence*

As discussed in the introduction, the lack of congruence is often perceived to be fateful to joint ventures. Our analysis shows that a key factor in organizational choice is the magnitude of potential dissonance when it occurs, that is, whether overruling the agent is interim efficient. Indeed, while the interim efficiency or inefficiency of the modification does not affect each user's payoff, $(1-\alpha)V - c$, in a joint venture, it crucially affects what happens in the state of potential dissonance when only one user monitors (excessive deadlock if the modification is interim inefficient, excessive overruling otherwise) and thus affects the monitoring incentive.

Consider first the case where the loss L is so large that the modification is interim inefficient. In this case, deadlock prevails when only one user monitors and there is potential dissonance, while the agent is overruled if there is known congruence. The private incentive to monitor is thus equal to $(\beta-\alpha)V - c$.

Hence, an increase in the probability $1-\beta$ of the state of known congruence does not affect the value of the joint venture but reduces the partners' willingness to monitor. This is the standard "free-riding" problem: Increasing the likelihood that preferences are unambiguously congruent reinforces the public good aspect of monitoring and thus reduces incentives to monitor.

In contrast, an increase in $1-\alpha$, the probability of actual congruence, increases the incentive to monitor, even if it is compensated by a reduction in V to keep the value of the joint venture constant.[33] The reason is that monitoring is here necessary to exploit ex post the congruence of preferences: If only one user monitors, and since the modification is interim inefficient, the other user will not trust him when there is potential dissonance and will instead insist on following the agent's recommendation, even though they may actually have congruent preferences; then, increasing the probability of congruence increases the incentive to monitor and breaks this deadlock. *There is thus a sharp contrast between the nature of "known" congruence, which generates a public-good problem and reduces monitoring, and that of "potential congruence", which instead promotes monitoring by increasing the cost of deadlocks.*

[33] Consider a reduction in α and V keeping $(1-\alpha)V$ constant. Then $(\beta-\alpha)V = (1-\alpha)V-(1-\beta)V$ decreases.

These conclusions again are in sharp contrast with the case of vertical integration, where the incentive to monitor, measured by $V - c$, does not depend on the magnitude of known or potential dissonance (it depends neither on β nor on α). Then keeping the joint surplus $(1-\alpha)(2V) - \alpha(L-V)$ constant means that an increase in congruence (i.e., a reduction of α) must be accompanied by a reduction in V. The controlling user's incentive to monitor are then reduced: Under vertical integration, there is no point sacrificing value for congruence, unlike for a joint venture.

Consider now the case where the loss L is not so large, so that the modification is interim efficient. While the payoffs remain the same in the joint venture (since the modification is not adopted when it is ex post inefficient), the private incentive to monitor is now equal to

$$\frac{\alpha}{2}(L-V) - c.$$

Hence, in that case, an increase in the probability of dissonance *raises* the incentive to monitor (that is, as long as the modification remains interim efficient), although it reduces the payoff of the joint venture. The reason is that, when only one user monitors, the risk is now one of excessive overruling rather than that of excessive deadlock. Hence, any increase in the probability of congruence reduces this risk and thus decreases the monitoring incentive. Note that the probability $1-\beta$ of known congruence becomes irrelevant: Since the modification is always implemented whenever there is indeed congruence and at least one user monitors, what happens in the case of *actual* dissonance is the only thing that matters here.

6 Optimal contract

We have provided conditions under which either a joint venture or vertical integration implements the unconstrained optimum. We now investigate whether and how institutional design can improve upon these basic institutions when these conditions are violated.

We make three assumptions:

(A1) A user always learns (and can describe) one action as well as his payoff attached to that action: This action is his preferred action if he monitors, and a clone of the agent's preferred action (yielding the same payoffs as the agent's preferred action) if he does not.

Assumption (A1) is technical. It prevents mechanisms from telling whether a user has monitored just on the basis of the number of actions he has learned. That the clone action has exactly the same payoffs as the agent's action is not important. The key assumption is that a user who has not monitored can still pretend to have learned something and make a recommendation.

(A2) The users observe who has monitored. They can renegotiate ex post, knowing who has monitored and, possibly, the state of congruence (known congruence or not if the user has monitored, and actual congruence or not if both users have monitored).

Assumption (A2) implies that interim inefficient actions cannot be implemented.[34]

(A3) The transfers between users must be balanced.

Assumption (A3) posits the absence of third parties acting as "budget breakers". The key assumption here is that transfers to a third party are impossible.[35]

The Appendix allows for completely general mechanisms and analyzes the conditions under which the unconstrained optimum can be implemented. The following proposition, which summarizes the insights obtained in the Appendix, can be seen as an extension of Proposition 4.1 to arbitrary mechanisms.

Proposition 6.1 *Under assumptions (A1) through (A3), the unconstrained optimum can be implemented in the presence of moral hazard on monitoring if and only if*

[34]The describability assumption rules out "strange" recommendations and ensures that renegotiation always starts from either the agent's or one user's preferred action. Together with A2, it implies that all relevant (expected) payoffs are common knowledge and renegotiation is efficient, given the available information.

[35]Assumptions (A2) and (A3) are discussed for example in Hart-Moore (1999), Maskin-Tirole (1999a,b) and Tirole (1999).

– $m^* = 2$ *and* $c \leq \min\left\{(\beta - \alpha)V, \dfrac{\alpha(L-V)}{2}\right\} + \dfrac{\alpha(L+V)}{4}$,

– $m^* = 1$ *and* $c \leq V + \max\left\{\dfrac{\alpha(L-V)}{2} - (\beta-\alpha)V, 0\right\}$.

– $m^* = 0$.

Propositions 6.1 and 4.1 show that, relative to the straight joint venture institution, one can relax the incentive compatibility condition for duplicated monitoring. The idea is that when the two partners disagree, the decision right can be allocated randomly between the two rather than specify a stalemate. Indeed, it is easy to find institutions that implement duplicated monitoring when $c \leq \min\left\{(\beta - \alpha)V, \dfrac{\alpha(L-V)}{2}\right\} + \dfrac{\alpha(L+V)}{4}$; e.g., an ex post first price auction for the right to decide, in which the loser receives a transfer equal to the winner's bid; or more simply, a fair random allocation of the right to decide. Because in our model the decision right is more valuable to a user when he is informed, this policy adds to incentives to monitor.

Proposition 6.1 also shows that one cannot improve on vertical integration to implement centralized monitoring when the modification is interim efficient. The reason is that vertical integration maximizes the integrated user's incentive to monitor by giving him the decision right, and concurrently minimizes the independent user's incentive to monitor by restricting his access to the decision process. When the modification is interim inefficient, it may still be possible to implement centralized monitoring and not to overrule the agent in the potentially dissonant state, an outcome which vertical integration cannot achieve. The reason is that the contract can allow the independent user to observe the agent's recommendation and to negotiate away the modification proposed by the integrated user.[36]

Proposition 6.1 extends the conclusions of Proposition 4.1 and the implications drawn in section 5 to fully general mechanisms. Note in particular that protecting users by reducing their loss L is again a bad policy for duplicated monitoring.

[36] In practice, however, giving all decision rights to one user may put him in the position to manipulate the agent's recommendation, thereby reintroducing the risk of biased decision-making when the modification is interim inefficient.

7 Summary and lines of research

To a large extent our analysis supports common sense views about cooperative undertakings. Vertical integration (undivided control) generates efficient monitoring of the input supply process as well as biased decision making. In contrast, a joint venture, by requiring Pareto-improving decisions, yields unbiased yet costly decision making. A key challenge for a joint venture is to induce the partners to invest informationally in making the joint venture work. A partner's insufficient effort may result from his not internalizing the full cost of deadlock, or else the concession he forces on the enterprising partner, by not becoming informed about the consequences of alternative actions.

Coming back to the "heterogeneity puzzle" stated in the introduction, in case of a substantial divergence of objectives, shared control is preferred to undivided control if one ignores the users' incentives to acquire information. In a nutshell, shared control rights protect players with conflicting interests. Things look different when incentives to monitor are accounted for (Proposition 4.1). Partners in a joint venture have less incentives to try to make the joint venture work precisely when their objectives are likely to be divergent (when α is large). This may explain why joint ventures do not seem to be favored over other governance structures when parties have conflicting interests.

We showed that policies aimed at improving the efficiency of joint ventures are often the opposite of those benefitting vertically integrated structures. In a joint venture, there is little point writing a detailed contract that protects the partners by reducing potential externalities and specifies covenants restricting the set of possible actions. Partners are already protected by their control rights; and such contractual features, which are pervasive under undivided control, only serve to reduce incentives without improving efficiency. Joint ventures may also want to shut down the partners' otherwise desirable outside opportunities in order to foster their commitment to the joint venture. Last, firms may put substantial weight on congruence in their search for potential joint venture partners, although some amount of dissonance can help ensure that they monitor each other.

By focusing on control right aspects of governance structures, our model has ignored other considerations relevant to institutional design. A glaring omission of our analysis is the lack of impact of institutional choice on managerial incentives. In a more general model managerial initiative would depend on who has control. We conjecture that our model is thereby biased in favor of joint ventures and against structural separation. To understand why, suppose that there are dimensions of input quality that can be verified by the users before consumption (these dimensions relate to "search goods", rather than "experience goods"). Under structural separation, the price at which the input is sold to users is sensitive to the quality of the input; management can then be offered effective incentives based on supplier profit. The same is true under vertical integration, although to a lesser extent since only half of the sales are external. User-owned joint ventures in contrast are poorly suited for an efficient design of managerial profit-based incentives.[37]

Another oversimplification of our analysis is that the users have similar size and similar monitoring talents. In asymmetric joint ventures, bigger players are more likely to monitor, i.e., supply the public good, because of their higher stakes. But they may also have trouble getting themselves heard by the smaller players because they may not have the same interests. For example, in associations such as Visa or MasterCard, larger banks may favor innovation at the bank level while smaller ones would prefer association-level innovation. The partners may also have different monitoring skills; some may have R&D capabilities while others excel in marketing or manufacturing; it would be interesting to extend our analysis to multiple dimensions of monitoring.

[37]Being unable to offer bonuses and stock options to their management, non-profit associations often rely on career concern incentives coupled with benchmarking. For a start on this, see Hausman et al. (1999).

References

Aghion, P. and J. Tirole (1997) "Formal and Real Authority in Organizations," *Journal of Political Economy*, 105: 1-29.

Atwood, J. (1996) "Antitrust, Joint Ventures, and Electric Utility Restructuring: RTGs and POOLCO", *Antitrust Law Journal*, 64: 323–339.

Baker, D. (1993) "Compulsary Access to Network Joint Ventures Under the Sherman Act: Rules or Roulette?," *Utah Law Review*, 999–1133.

Banerjee, A., D. Mookherjee, K. Munshi, and D. Ray (1997) "Inequality, Control Rights and Rent Seeking," mimeo, MIT 1997.

Besen, S., Kirley, S. and S. Salop (1990) "An Economic Analysis of Copyright Collectives," mimeo, Georgetown University Law Center.

Brodley, J. (1982) "Joint Ventures and Antitrust Policy," *Harvard Law Review*, LXXXXV , 1523–1590.

Chang, H., Evans, D. and R. Schmalensee (1998) "Some Economic Principles for Guiding Antitrust Policy Toward Joint Ventures," *Columbia Business Law Review*, 223–329.

Che, Y.K. and D. Hausch (1998) "Cooperative Investments and the Value of Contracting," *American Economic Review.*

Dasgupta, S., and Z. Tao (1998a) "Bargaining, Bonding and Partial Ownership," forthcoming, *International Economic Review* .

—– (1998b) "Contractual Incompleteness and the Optimality of equity Joint Ventures," *Journal of Economic Behavior and Organization.*

Emmons, W.R., and W. Mueller (1997) "Conflict of Interest Between Borrowers and Lenders in Credit Co-operatives: The Case of German Co-operative Banks," mimeo, Federal Reserve Bank of St-Louis.

Evans, D. and R. Schmalensee (1999) *Paying with Plastic: The Digital Revolution in Paying and Borrowing* , forthcoming, Cambridge: MIT Press.

Felli, L., and L. Anderlini (1997) "Costly Coasian Contracts," mimeo, LSE.

Glaeser, E., and A. Shleifer (1998) "Not-For-Profit entrepreneurs," mimeo, Harvard University.

Gomes-Casseres, B. (1994) "Group Versus Group: How Alliance Networks Compete," *Harvard Business Review*, July-August: 62–74 .

Grossman, and O. Hart (1986) "The Costs and Benefits of Ownership: A Theory of Lateral and Vertical Integration," *Journal of Political Economy*, 94: 691-719.

Hansmann, H. (1996) *The Ownership of Enterprise*, Belknap Harvard.

Hart, O. (1995) *Firms, Contracts, and Financial Structure.* Oxford University Press.

Hart, O. and J. Moore (1990) "Property Rights and the Nature of the Firm," *Journal of Political Economy*, 98:1119–1158.

—– (1996) "The Governance of Exchanges: Members' Cooperatives Versus Outside Ownership," *Oxford Review of Economic Policy*, 12: 53–69.

—– (1998) "Cooperatives vs Outside Ownership," mimeo, Harvard University.

—– (1999) "Foundations of Incomplete Contracts," *Review of Economic Studies.*

Hausman, J., Leonard, G., and J. Tirole (1999) "The Impact of Duality on Productive Efficiency and Innovation," mimeo, MIT.

Hogan, W., Hitt, C. and J. Schmidt (1996) "Governance Structures for an Independent System Operator (ISO)," mimeo, Harvard Electricity Policy Group.

Holmström, B. and R. Myerson (1983) "Efficient and Durable Decision Rules with Incomplete Information," *Econometrica*, 51: 1799– 1819.

Holmström, B. and J. Tirole (1991) "Transfer Pricing and Organizational Form," *Journal of Law, Economics and Organization*, 7: 201-228.

Killing, P. (1983) *Strategies for Joint-Venture Success*, London, Croom Helm.

Kremer, M. (1998) "Worker Cooperatives as Economic Democracies" mimeo, MIT.

Maskin, E. and J. Moore (1999) "Implementation and Renegotiation," *Review of*

Economic Studies.

Maskin, E., and J. Tirole (1999a) "Two Remarks on Property Rights," *Review of Economic Studies.*

—– (1999b) "Unforeseen Contingencies and Incomplete Contracts," *Review of Economic Studies.*

Nöldeke, G. and K. Schmidt (1995) "Option Contracts and Renegotiation: A Solution to the Hold-Up Problem," *Rand Journal of Economics*, 26(2):163–179.

Peck, M. (1986) "Joint R&D: The Case of Microelectronics and Computer Corporation," *Research Policy*, 15: 219–231.

Plummer, J. (1990) " Implications of a Competitive Structure for the role of EPRI," chapter 27 in *Competition in Electricity: New Markets and New Structures*, J. Plummer and S. Troppman eds., Arlington, Virginia: Public Utilities Report, INC.

Segal, I. (1995) *Essays on Commitment, Renegotiation, and Incompleteness of Contracts*, PhD thesis, Harvard University.

—– (1999) "Complexity and Renegotiation: A Foundation for Incomplete Contracts," *Review of Economic Studies.*

Segal, I. and M. Whinston (1998) "The Mirrlees Approach to Implementation with Renegotiation (with applications to Hold-Up and Risk-sharing)," mimeo.

Tirole, J. (1999) "Incomplete Contracts: Where Do We Stand?" *Econometrica.*

Ward, B. (1958) "The Firm in Ilyria: Market Socialism," *American Economic Review*, 48: 566–89.

Wilson, J.Q. (1973) *Political Organization*, Princeton University Press.

Appendix: Proof of Proposition 6.1

We denote by K the state of *known congruence* (probability $1-\beta$) where it is common knowledge that users' preferences are congruent and by P the case of *potential dissonance* (probability β); in this "state", *dissonance* (state D) has probability $\hat{\alpha}$ and *congruence* (state C) has probability $1-\hat{\alpha}$. The ex ante probability of dissonance is thus $\alpha = \beta\hat{\alpha}$.

The timing of the game is as follows:

- Ex ante, each user decides whether to monitor. Each user then observes: (i) exactly one action (his preferred one if he has monitored, or a clone of the agent's preferred action if he has not) and how to describe it; (ii) whether the other has monitored; and (iii) whether there is known congruence (state K or P) and, in state P and provided he has monitored, whether there is congruence (state C or D).

- At the interim stage, and according to the mechanism designed at the initial stage, each user describes the action he has observed and sends messages, which can mention who has monitored, indicate whether there is congruence, and also include non payoff-relevant messages. Based on these messages, the (possibly random) contract specifies balanced transfers and which of the three actions observed by the agent and the users should be implemented.

- Ex post, the users renegotiate the status quo defined by the contract, through an efficient bargaining game where the gains from bargaining are equally shared.

a) *The ex post bargaining game*

It is useful to first characterize the outcome of the ex post renegotiation stage, starting from a status quo summarized by balanced transfers (t_1, t_2) and an action $\hat{a}$ which, given our describability assumption, can only be the action preferred by the agent, a^A, or the action observed by one user, $\hat{a}^1$ or $\hat{a}^2$. By construction, the expected payoffs attached by each user to each of these three actions are always common knowledge, given the information available to each user.

- When it is common knowledge that users' preferences are congruent (in state K, or in state C if both users have monitored), U_i eventually gets $t_i + V$ whatever the status quo decision $\hat{a}$, since this status quo generates an identical payoff for both users.

- In contrast, when it is common knowledge that users' preferences are dissonant (both users have monitored and know that they are in state D), a user benefits from having his preferred action be chosen as status quo. If $\hat{a} = \hat{a}^i = a^i$, after renegotiation U_i and U_j get respectively

$$\begin{aligned} t_i + V + \frac{1}{2}(L - V) &= t_i + \frac{V + L}{2} \equiv t_i + A, \\ t_j - L + \frac{1}{2}(L - V) &= t_j - A. \end{aligned}$$

  Whenever $\hat{a} = a^A$, U_i simply gets t_i after renegotiation.

- Assume that U_i is informed but U_j does not know whether preferences are congruent (only U_i has monitored and state K did not occur). It is then common knowledge that $\hat{a}^i = a^i$, the action observed by U_i, yields V for U_i and an expected surplus of $(1 - \hat{\alpha}) V - \hat{\alpha} L = V - 2\hat{\alpha} A$ for U_j. Hence, the sum of the users' expected surpluses is $W \equiv V + (1 - \hat{\alpha}) V - \hat{\alpha} L = 2(V - \hat{\alpha} A)$ and:

  - if the modification is interim efficient (i.e., $W > 0$, or $V > \hat{\alpha} A$), a^i is not renegotiated if chosen as status quo, and thus U_i gets V while U_j gets $V - \hat{\alpha} A$; any other action is replaced with a^i through renegotiation, and each user i gets

$$t_i + \frac{W}{2} = t_i + V - \hat{\alpha} A.$$

  - If the modification is interim inefficient ($V < \hat{\alpha} A$), then a^i is renegotiated away if chosen as status quo; U_i and U_j thus get respectively

$$\begin{aligned} t_i + V - \frac{W}{2} &= t_i + \hat{\alpha} A, \\ t_j + (1 - \hat{\alpha}) V - \hat{\alpha} L - \frac{W}{2} &= t_j - \hat{\alpha} A. \end{aligned}$$

If the agent's preferred action or a clone of it constitutes the status quo decision, each user U_i simply gets t_i.

- Lastly, if none of the users has monitored, the users can only rubberstamp the agent's recommendation and U_i thus simply gets t_i.

We now successively consider the implementation of the three types of unconstrained optimum. Throughout the analysis, we denote by $\tau_i(\sigma_1, \sigma_2)$ the expected pre-renegotiation transfers and by $\chi_i(\sigma_1, \sigma_2)$ the probability that the pre-renegotiation decision specified by the mechanism consists of the action observed by U_i, as a function of users' interim stage strategies (σ_1, σ_2). Each user U_i's strategy σ_i is a distribution of probability over the set of messages assigned to this user.

b) *Duplicated monitoring: $m^* = 2$*

We consider here the situation where the unconstrained optimum involves duplicated monitoring.

If both users monitor, then congruence or dissonance is always common knowledge at the interim stage. Denote by

$$t_i^* \equiv (1-\beta)\, t_i^{*K} + (\beta - \alpha)\, t_i^{*C} + \alpha t_i^{*D}$$

the expected pre-renegotiation transfers in the continuation equilibrium, and by x_i^* the probability that the pre-renegotiation status quo action corresponds to U_i's preferred one in state D. From the above characterization of the renegotiation stage, along the equilibrium path U_i gets an expected utility u_i given by

$$u_i = -c + t_i^* + (1-\alpha)\, V + \left(x_i^* - x_j^*\right) \alpha A.$$

Consider now a deviation by user U_2, where he does not monitor and furthermore "pretends" U_1 has deviated: That is, U_2 does not monitor and then, denoting by $\hat{\sigma}_i$ the equilibrium continuation strategy played by user U_i when he is the unique monitor, U_2 plays $\hat{\sigma}_2(K)$ in state K and $(1-\hat{\alpha})\, \hat{\sigma}_2(C) + \hat{\alpha} \hat{\sigma}_2(D)$ in state P (U_2 plays a mixed strategy, not knowing which of

C or D prevails), while U_1, having observed that U_2 did not monitor, plays accordingly $\hat{\sigma}_1(s)$ in each state $s = K, C, D$ where $\hat{\sigma}_1$ denotes U_1's equilibrium strategy when only U_1 monitors. Denote by $\hat{t}_i$ the corresponding expected pre-renegotiation transfers, given by

$$\begin{aligned}
\hat{t}_i &= (1-\beta)\,\tau_i(\hat{\sigma}_1(K), \hat{\sigma}_2(K)) \\
&\quad + \beta(1-\hat{\alpha})\left[(1-\hat{\alpha})\,\tau_i(\hat{\sigma}_1(C), \hat{\sigma}_2(C)) + \hat{\alpha}\tau_i(\hat{\sigma}_1(C), \hat{\sigma}_2(D))\right] \\
&\quad + \beta\hat{\alpha}\left[(1-\hat{\alpha})\,\tau_i(\hat{\sigma}_1(D), \hat{\sigma}_2(C)) + \hat{\alpha}\tau_i(\hat{\sigma}_1(D), \hat{\sigma}_2(D))\right],
\end{aligned}$$

and by $\hat{x}_i$ the probability that the state is P and the pre-renegotiation status quo be the action observed by U_i:

$$\begin{aligned}
\hat{x}_i &= \beta(1-\hat{\alpha})\left[(1-\hat{\alpha})\,\chi_i(\hat{\sigma}_1(C), \hat{\sigma}_2(C)) + \hat{\alpha}\chi_i(\hat{\sigma}_1(C), \hat{\sigma}_2(D))\right] \\
&\quad + \beta\hat{\alpha}\left[(1-\hat{\alpha})\,\chi_i(\hat{\sigma}_1(D), \hat{\sigma}_2(C)) + \hat{\alpha}\chi_i(\hat{\sigma}_1(D), \hat{\sigma}_2(D))\right].
\end{aligned}$$

U_2's expected utility, v_2, is then given by

$$v_2 = \hat{t}_2 + (1-\beta)\,V + S - \hat{x}_1\alpha A,$$

where $S \equiv \beta\max\{V - \hat{\alpha}A, 0\} = \max\{\beta V - \alpha A, 0\}$ denotes the (per user) expected joint surplus in the state of potential dissonance when only one user monitors. This deviation is thus not profitable only if $u_2 \geq v_2$, that is, only if

$$-c + t_2^* + (1-\alpha)\,V + (x_2^* - x_1^*)\,\alpha A \geq \hat{t}_2 + (1-\beta)\,V + S - \hat{x}_1\alpha A.$$

The similar deviation for U_1 (no monitoring, and "acting" as if U_2 had deviated, so that each user acts again as if he were the only monitor) is not profitable either only if

$$-c + t_1^* + (1-\alpha)\,V + (x_1^* - x_2^*)\,\alpha A \geq \hat{t}_1 + (1-\beta)\,V + S - \hat{x}_2\alpha A.$$

Adding those two conditions and using the fact that transfers are balanced implies

$$\begin{aligned}
c &\leq (\beta-\alpha)\,V - S + \frac{\hat{x}_1 + \hat{x}_2}{2}\alpha A \\
&\leq (\beta-\alpha)\,V - S + \alpha\frac{A}{2} \\
&= \min\left\{\alpha\frac{L-V}{2}, (\beta-\alpha)\,V\right\} + \alpha\frac{L+V}{4}. \qquad \text{(A.1)}
\end{aligned}$$

Conversely, if inequality (A.2) holds, giving each user the decision right with probability 1/2 (and no transfer; $x_i \equiv 1/2, t_i \equiv 0$) implements duplicated monitoring: U_i gets

$$u_i = -c + (1 - \alpha) V$$

if he monitors whereas if he does not monitor he only gets

$$v_i = (1 - \beta) V + S - \frac{\alpha A}{2},$$

which is indeed lower than u_i when (A.2) is satisfied.

c) *Centralized monitoring:* $m^* = 1$

We turn to the situation where the unconstrained optimum involves centralized monitoring. To fix ideas, we consider a candidate equilibrium where only U_1 monitors and denote by $\tilde{\sigma}_1(s)$ (for $s = K, C, D$) and $\tilde{\sigma}_2(s)$ (for $s = K, P$) the two users' continuation equilibrium strategies, by

$$\tilde{t}_i = (1 - \beta) \tau_i (\tilde{\sigma}_1 (K), \tilde{\sigma}_2 (K)) + (\beta - \alpha) \tau_i (\tilde{\sigma}_1 (C), \tilde{\sigma}_2 (P)) + \alpha \tau_i (\tilde{\sigma}_1 (D), \tilde{\sigma}_2 (P)),$$

the expected pre-renegotiation transfers along the equilibrium path and by

$$\tilde{x}_1 = (1 - \hat{\alpha}) \chi_1 (\tilde{\sigma}_1 (C), \tilde{\sigma}_2 (P)) + \hat{\alpha} \chi_1 (\tilde{\sigma}_1 (D), \tilde{\sigma}_2 (P))$$

the probability that the state is P and the action observed by U_1 is the pre-renegotiation status quo. The two users' expected utilities along the equilibrium path are respectively given by

$$\begin{aligned} w_1 &= -c + \tilde{t}_1 + (1 - \beta) V + S + \tilde{x}_1 \alpha A, \\ w_2 &= \tilde{t}_2 + (1 - \beta) V + S - \tilde{x}_1 \alpha A. \end{aligned}$$

Suppose now that U_2 deviates and, while still not monitoring, plays the strategy $\bar{\sigma}_2(s)$ (for $s = K, P$) that he is supposed to follow when no user monitors. Denoting by

$$\bar{t}_i = (1 - \beta) \tau_i (\tilde{\sigma}_1 (K), \bar{\sigma}_2 (K)) + (\beta - \alpha) \tau_i (\tilde{\sigma}_1 (C), \bar{\sigma}_2 (P)) + \alpha \tau_i (\tilde{\sigma}_1 (D), \bar{\sigma}_2 (P))$$

the corresponding expected pre-renegotiation transfers along the continuation equilibrium path and by

$$\bar{x}_1 = (1-\hat{\alpha})\,\chi_1(\tilde{\sigma}_1(C), \bar{\sigma}_2(P)) + \hat{\alpha}\chi_1(\tilde{\sigma}_1(D), \bar{\sigma}_2(P))$$

the probability that the state is P pre-renegotiation action be the one recommended by U_1, this deviation is not profitable for U_2 only if

$$\tilde{t}_2 + (1-\beta)V + S - \tilde{x}_1\alpha A \geq \bar{t}_2 + (1-\beta)V + S - \bar{x}_1\alpha A.$$

Suppose now that U_1 does not monitor but acts as if he had; that is, U_1 plays $\tilde{\sigma}_1(K)$ in state K and $(1-\hat{\alpha})\,\tilde{\sigma}_1(C) + \hat{\alpha}\tilde{\sigma}_1(D)$ in state P while U_2, having observed the absence of monitoring, plays his continuation equilibrium strategy $\bar{\sigma}_2$. This deviation is not profitable only if

$$-c + \tilde{t}_1 + (1-\beta)V + S + \tilde{x}_1\alpha A \geq \bar{t}_1.$$

Adding up the two latter inequalities (since transfers are balanced)

$$\begin{aligned} c &\leq (1-\beta)V + S + \bar{x}_1\alpha A \\ &\leq (1-\beta)V + S + \alpha A \\ &= V + \max\left\{\frac{\alpha(L-V)}{2} - (\beta-\alpha)V, 0\right\}. \end{aligned} \tag{A.2}$$

Conversely, the "vertical integration" contract $(x_1 \equiv 1, t_i \equiv 0)$[38] implements centralized monitoring when condition (A.2) is satisfied.

d) *No monitoring: $m^* = 0$*

The implementation of $m^* = 0$ is straightforward: never overruling the agent $(x_i \equiv t_i \equiv 0)$ ensures in that case that users have no incentives to monitor: By allocating the decision right to the agent, this contract forces any informed user to share with the other user the gains from overruling the agent, and thus to share the benefits from monitoring. Hence monitoring cannot be an equilibrium if it is not efficient.

[38] This contract is however different from the simple structure considered in the previous sections, which rules out any involvement of the non-owner in the decision process (thus ruling out any renegotiation of the owner's decision). While this is of no consequence when the modification is interim efficient, the contract considered here allows the users to renegotiate away the modification when it is interim inefficient.