

Hierarchies and Bureaucracies: On the Role of Collusion in Organizations

JEAN TIROLE

Massachusetts Institute of Technology

1. INTRODUCTION

This research derives its motivation (and borrows unrestrainedly) from sociological studies of collusive behavior in organizations. Like the sociology literature, it emphasizes that behavior is often best predicted by the analysis of group as well as individual incentives; and it gropes toward a precise definition of concepts such as “power,” “cliques,” “corporate politics,” and “bureaucracy” (Crozier, 1963; Cyert and March; Dalton; Scott). It differs from this literature in that it tries to incorporate the acquired knowledge of modern information economics into the analysis.

The research also borrows a considerable amount from the principal/agent paradigm of information economics. This paradigm, mainly developed for two-tier organizations, emphasizes the productive inefficiency associated with asymmetric information and insurance motives (or limited liability constraints).¹ Formally, organizations can be seen as networks of overlapping or nested principal/agent relationships. A theme of the paper, however, is that the analysis of hierarchical structures does not boil down to a compounding of the basic inefficiency, due to the fact that going from the simple two-tier principal/agent structure to more complex ones introduces the possibility of

1. See, e.g., Ross; Mirrlees, 1975; Shavell; Holmström, 1979; and Grossman and Hart.

The author is very grateful to Kenneth Arrow, Patrick Bolton, Eric Maskin, Oliver Williamson, various colleagues and students at MIT, and participants at the LEO workshop at Yale Law School for helpful comments and suggestions, and to two anonymous referees for carefully executed reports. The research was supported by the French Planning Board (Commissariat Général au Plan), the National Science Foundation, and the Sloan Foundation.

Journal of Law, Economics, and Organization vol. 2, no. 2 Fall 1986
© 1986 by Yale University. All rights reserved. ISSN 8756-6222

collusion. This research departs from the existing information economics literature in that it views an organization as a network of contracts that interplay rather than as a single contract.

The consideration of coalitions in incentive theory certainly deserves some motivation. It raises the questions of how coalitions can form and whether they, in fact, do form. Part 2 reviews and classifies some evidence on the existence of coalitions and on their enforcement mechanism. The examples given there bring direct evidence that coalitions do matter. Since the emergence of coalitions ought to be anticipated at the organization design stage, the mere observation of real-world collusive behavior understates their significance.

Part 3 develops a simple three-tier principal/supervisor/agent model. The agent is the productive unit. He makes an unobservable decision, called "effort," which, together with an exogenous productivity shock, affects the principal's profit. Productivity can be low or high. Neither the level of productivity nor the level of effort is observed by the principal. The supervisor's role is to obtain more information about the agent's activity than is available to the principal. He is a mere conduit; his supervisory effort is assumed exogenous in order to focus on the transmission of information. He observes either the true level of productivity (and then has verifiable evidence about it) or nothing. His degree of freedom is whether to report to the principal when he observes the productivity (given that he can claim to have observed nothing).

The effect of coalitions on the optimal incentive scheme is then examined with reference to the supervisor/agent coalition. In addition to the usual incentive compatibility and individual rationality constraints, new constraints must be introduced. The supervisor here acts naturally as an advocate for the agent. More generally, however, all types of coalitions need to be considered. The relevant coalition occurs at a "nexus of informed parties," that is, within a group of parties that can manipulate the information received by the rest of the organization.

Part 4 suggests some implications of coalitions for organizational behavior. Concluding remarks are offered in part 5.

2. COALITIONS AND COVERT TRANSFERS

HIERARCHIES

Vertical structures in this paper are represented by three-layer hierarchies: principal/supervisor/agent. The roles of the three parties will be described in detail; for the moment, it suffices to think of the principal as the owner of the structure or as the buyer of the agent's product, of the agent as a party picking a productive action affecting the principal, and of the supervisor as a party

collecting information to help the principal control the agent. Like the two-tier representation of the classic principal/agent model, this three-tier description is a convenient abstraction. Most organizations are more complex than the idealization considered here. First, one can easily think of higher-order vertical structures. Second, horizontal elements can be superimposed on the vertical frame. For example, the supervisor may monitor several agents (see part 4), or the agent may be monitored by several supervisors.

The evidence supplied in the next section focuses on collusion within a firm. A prototypical example concerns the hierarchy manager/foreman/worker. It is clear, however, that these internal organization examples have much in common with collusive behaviors in other structures (even though these structures may differ in other respects: nature and flows of rewards, selection process for the agent, interplay with other horizontal and vertical elements, and so forth). Thus, I expect most conclusions will apply to hierarchies such as voter/government agency/defense contractor (or regulated firm),² brass/colonel/regiment, or economics profession/Ph.D. adviser/Ph.D. student.³ These examples motivate the following axioms, which underly the model presented in part 3.

- Axiom 1:* The principal, who is the owner of the vertical structure or the buyer of the good produced by the agent, or, more generally, the person who is affected by the agent's activity, lacks either the time or the knowledge required to supervise the agent.
- Axiom 2:* It is not efficient to divide the supervisory job among several supervisors.
- Axiom 3:* The supervisor lacks either the time or the resources required to run the vertical structure.

Axiom 3 is posited only to motivate at the current stage the presence of a principal (so that the vertical structure does not boil down to a two-tier one). In the model I will actually dispense with Axiom 3 by allowing the principal to sell to the supervisor. Axiom 2 rules out the use of a team of supervisors. It can be justified either by a cost of duplication of the supervisory function or by a collusive behavior between supervisors. Some circumstances under which several supervisors can efficiently be used by the principal are described in part 4.3. Axiom 1 vindicates the supervisory function. It can be motivated by the possibilities that the principal overlooks and coordinates many agents or that he is technically unable to supervise the agent (in some of the examples

2. For example of collusion in procurement, see Scherer (1964: 100) and Williamson (1967a: 233); for the theory of regulatory capture, see Stigler and Posner; see also Rose-Ackerman and Caillaud et al.

3. To give a few other examples: shareholder/manager/worker; firm/auditor/manger; investor/broker/firm; restaurant owner/maitre d'/waiter; Department of Defense/contractor/subcontractor; train company/ticket inspector/passenger.

above, the introduction of a supervisor also helps solve the free rider problem associated with the supervision by several principals).

The model set up in part 3 will focus on the supervisory function by assuming that the supervisor has no management or production activity. This assumption is restrictive. In general, the supervisor creates a joint output: supervision of the agent and contribution to production. The productive part may involve the selection of the agent (for example, a contractor selects a subcontractor), the organization and coordination of production and the supply of tools, and the advisory function. Focusing on the supervisory function enables me to make my main points without undue complexity. I do, however, feel that the interplay between the supervisory and production functions is an important question, which I shall tackle in part 5.

2.2. COALITIONS AND COVERT TRANSFERS

The starting point and the tangible effect of the coalition is the manipulation of the information received by the principal. There are several ways in which information may be manipulated: the existing evidence may be concealed or distorted, or the evidence may not be created. Several examples below will illustrate these three possibilities.

Second, the object of the coalition is to benefit one or several members of the coalition. We can distinguish between one-sided favors—one member manipulates the information to the benefit of another member—and shared favors—the manipulation benefits both members. One-sided favors usually go with an explicit or implicit promise of a counterbalancing favor from the beneficiary of the original favor to the other member. The delivery of this promise can be simultaneous or delayed.

The evidence on coalitions and covert transfers I now present is based on sociological studies of the internal organization of firms. In particular, I rely heavily on the very insightful work of Crozier and Dalton,⁴ to whom I refer for more details. The general observation is that it is usually hard to obtain information from the intermediate levels of a hierarchy. Both Crozier and Dalton insist that very often common sense directs the controller to falsify his information to allow the monitored group to obtain better results;⁵ that is, the controller is not in a position that allows him to give trustworthy information. Both sociologists strongly emphasize the existence of coalitions (Crozier talks about “clans and groups of members of different categories” and Dalton about “cliques.”)⁶

As mentioned earlier, one way of manipulating the information is to ignore

4. I am grateful to Woody Powell for the Dalton reference.

5. See, e.g., Crozier, 1963: 51, 52, 56, and 280.

6. See also Selznick's idea that expertise tends to create a caste spirit and temptations of collusion with groups that depend on that expertise.

As mentioned earlier, one way of manipulating the information is to ignore it. This is the case when minor “thefts” and perquisites are not reported. Such private benefits include the use of material and services for personal ends (tools, clerical supplies, long-distance phone calls, use of the firm’s employees to redecorate a home, and so forth), days off, plush offices, expense accounting.⁷ Sometimes information may be hard to dispose of; it may then be useful not to obtain it: “Inside [the firm] nominal surprise was also a preventive of conflict. For example, safety and health inspectors usually telephoned in advance of visits so that they would not see unsafe practices or conditions they would feel obliged to report” (Dalton, 1959: 48).

Another way to manipulate the information is to distort it. The effect of collusion on auditing is now well documented.⁸ Examples of ingenious distortions of records abound, from the creation of fictitious personnel on payroll to changes of job titles, reports of nonexistent pieces, and so forth. Note also that accounting distortions are not the only type of auditing distortions; for example, quality tests can be manipulated.⁹

Manipulation of information is also very common when a shop or a group of employees decides not to implement changes it did not originate. For instance, the supervisor does not enforce the official procedures and the subordinates act cooperatively: the subordinates “keep key persons among interlocking departments informed of change in unofficial methods, and, at the proper time, they teach new members the distinctions between their practices and *official misleading instructions*” (Dalton p. 56; emphasis in text). It is also common not to apply safety rules. Accidents are then kept off the record.¹⁰

I would like to stress the importance of reciprocity in these examples. This aspect is emphasized in the contributions quoted above, and it is more generally developed in Gouldner (1961), who insists on the universality of the norm of reciprocity. Thus, one-sided favors call for reciprocated ones. For instance, a foreman manipulates the information relevant to the appraisal of his workers’ performance. In return, workers can do a number of favors for their foreman. These can include refraining from activities such as unrest, going on strike, leapfrogging for complaints. Also, when facing difficulties, employees place the responsibility not on their supervisors, but on higher

7. See Dalton, chap. 7.

8. See, e.g., Dalton (1959: 32), Williamson (1975: 146), and Antle (1984). In other contexts, see also Williamson (1967a) and Schmalensee.

9. Dalton (1959: 85–86) has observed that chemists manipulate the sample experiments to “prove” that the standards of quality are met. In this example, line foremen in return “notify the chemists, rather than their superior, of anything ‘going wrong’ that would reflect on them, and cooperate to reduce the number of analyses the chemists have to make.”

10. See Dalton (pp. 80–85) for a discussion of how and why workers may cooperate in such a deception.

levels of the hierarchy (Crozier, 1963: 52). Other nonmonetary transfers include mutual affection and respect, as emphasized by the Human Relations School (for example, see Etzioni, 1964: 34). The foreman, by defending his workers, obtains a better climate within his shop and he is thus more likely to avoid trouble (Crozier, p. 56).

Covert transfers are diverse in nature. First, many of the transfers described earlier are linked to the manipulation by one party of the information possessed about another party (for example, the supervisor conceals information that is detrimental to the agent, and conversely). Some transfers come from direct actions that benefit the other party.¹¹ A widespread enforcement mechanism for the coalition under such transfers has to do with the repetition of the relationship between the colluding parties. I will emphasize this aspect in part 4.

Second, there is another type of transfer, one which is somewhat out of the (current) realm of economics but which is very important in practice. It has to do with face-to-face relationships, and includes mutual affection and respect. It applies even to relationships that are not repeated.¹² It is just very unpleasant to hurt someone one is facing.

The model developed in part 3 chooses to formalize yet another type of covert transfer: monetary ones. Although such transfers do exist—monetary bribes in contracting; private discounts in business (for example, frequent flyer bonuses received by executives rather than by their firms);¹³ auditors obtaining management advisory service contracts from or (now illegally) holding shares of their clients—they are usually fairly limited. The reason why this is so is easily understood. A monetary transfer may be observed by parties that do not belong to the coalition and may be used as evidence of its existence. Nonmonetary transfers are not as conspicuous; or at least, they are harder to use as evidence of a coalition.¹⁴

Thus, most covert transfers are nonmonetary. The purpose of positing monetary transfers in the theoretical model of part 3 is expositional convenience. This will enable me to make a number of my points using standard economic analysis. I do believe, however, that considering only monetary transfers is restrictive. Although my results are strongly suggestive of what

11. Note that, at a formal level, the two types of transfers are very similar. The delegation of actions to parties mainly stems from informational problems. This lack of distinction is well illustrated by a promotion example: what is the difference between the supervisor's concealing information detrimental to the agent and his promoting the agent directly?

12. Think of the very strict rules that can be imposed on employees checking on people they will never see again (e.g., conductors on trains).

13. Note that firms could force their employees to return their bonuses. Thus, the outcome may well be interpreted as a coalition against the taxpayer.

14. Note that in some cases the covert transfers can actually be observed by the principal but the latter can hardly use this observation, as there is some probability that the transfer is justified. In other words, the principal is unable to show that the transfer is the outcome of a coalition against him. For example, the defense contractor can always argue that he hires the civil servant because of the latter's great talent.

occurs under nonmonetary transfers, the latter should originate new features.¹⁵

Observed collusive behaviors are only the tip of the iceberg. Anticipating that their members have incentives to collude, organizations can and do set up incentive schemes that restrict the formation and thus the effect of coalitions. In some cases, in equilibrium, no coalition forms that can be observed by outsiders (see the equivalence principle in part 3). However, coalitions are latent and do influence organizational behavior. Thus, the mere observation of collusive behavior understates the influence of coalitions on an organization.

Later I shall emphasize the restrictions on communication in organizations. Nonverifiable reports will hardly be requested. Even verifiable reports will have a somewhat limited effect on rewards (see part 3). This limited communication, which is consistent with both detailed and casual evidence, is a piece of the submerged part of the iceberg.¹⁶ I will analyze other pieces in part 4.

3. THE THEORY

3.1. THE MODEL

Consider the following simple principal/supervisor/agent hierarchy.

The parties. The *agent* is the productive unit. The profit π created by the agent's activity depends on a productivity parameter θ and on the effort $e > 0$ he exerts:

$$\pi = \theta + e.$$

The agent's disutility of effort is equal, in monetary terms, to $g(e)$, where g is increasing, strictly convex, and $g(0) = g'(0) = 0$. The principal receives profit π , and gives wage W to the agent. The latter has an increasing, differentiable, and strictly concave Von Neumann–Morgenstern utility function U . We will assume that there exists ω such that

$$\lim_{W \rightarrow \omega} U(W) = -\infty.$$

15. For instance, they may not add up to zero within a coalition; some may be inefficient, even from the point of view of the coalition (sexual harassment); others may be desirable, even from a social point of view (acts of cooperation).

16. As Katz and Kahn observe: "The typical upward communication loop is small and terminates with the immediate supervisor. He or she may transmit some of the information to the next higher level, but generally in a modified form."

The agent's expected utility is $EU[W - g(e)]$ (the uncertainty will be described later).

There exists an *ex-ante* competitive supply of agents, with reservation wage W_0 , and reservation utility $\bar{U} \equiv U(W_0)$. The agent's participation (individual rationality) constraint is

$$EU[W - g(e)] \geq \bar{U}.$$

The *supervisor's* role will be described along with the uncertainty and the informational assumptions. For the moment, let us just assume that the supervisor exerts no effort, receives a wage S from the principal, and has an increasing, differentiable, and strictly concave Von Neumann–Morgenstern utility function V . The supervisor's expected utility is $EV(S)$.

There exists *ex-ante* a competitive supply of supervisors, with reservation wage S_0 , and reservation utility $\bar{V} \equiv V(S_0)$. The supervisor's participation (individual rationality) constraint is

$$EV(S) \geq \bar{V}.$$

In the discussion below, I will assume that $S_0 = 0$. This assumption corresponds to the case in which the principal must hire a supervisor for other purposes than supervision (organization, advising, coordination, and so forth). The opportunity cost of the supervisory function is then zero because of the supervisor's dual role. More generally, one can admit $S_0 \geq 0$. The decision of whether to hire a supervisor is then endogenous. The results obtained below remain valid on the condition that a supervisor is hired.

Finally, the *principal* is the owner of the technology used by the agent (or else is the buyer of the good produced by the agent). He designs the main contract and offers it to the supervisor and the agent. He is risk-neutral. His expected utility is $E(x - S - W)$. (I assume that the principal is risk-neutral so that the supervisor plays no role in insuring the principal.)

Uncertainty and Information. The productivity parameter can take two values: $\underline{\theta}$ and $\bar{\theta}$, such that $0 < \underline{\theta} < \bar{\theta}$. $\underline{\theta}$ and $\bar{\theta}$ will later be called the bad (low) and good (high) states of *productivity*. Let $\Delta\theta \equiv \bar{\theta} - \underline{\theta}$.

There are four states of *nature*, indexed by i . State of nature i has probability p_i ($\sum_{i=1}^4 p_i = 1$). The agent always observes θ before choosing his effort. The supervisor may or may not observe θ . In the following description of the four states of nature, S and A stand for supervisor and agent:

State 1: A and S observe $\underline{\theta}$.

State 2: A observes $\underline{\theta}$, S observes "nothing."

State 3: A observes $\bar{\theta}$, S observes "nothing."

State 4: A and B observe $\bar{\theta}$.

For a given θ , the supervisor's signal s can thus take two values: $\{\theta, \emptyset\}$, where \emptyset denotes observation "nothing."

The agent's information structure is finer than the supervisor's, which is finer than the principal's. For simplicity, I assume the agent knows whether the supervisor learns the true state of productivity; that is, the agent knows the state of nature.

Lastly, I assume the agent's effort e is not observable by the other two parties.

Timing. The principal first offers a contract. For the moment I do not distinguish between the main contract and side contracts. The latter will be introduced shortly. The contract specifies the transfers S and W to the supervisor and the agent, as functions of the commonly observed variables. These observables are the profit x and the supervisor's report r to the principal.

I shall assume that the supervisor's information is "hard." By this I mean that his report is *verifiable* in the following sense: when he observes the state of productivity, he can convey this information to the principal in a credible way (the principal can look at the evidence and convince himself that the supervisor has announced the true state of productivity). However, the supervisor can lie and announce he has observed nothing, that is, conceal the evidence. (He can also announce the wrong state of nature, but this claim, which cannot be substantiated, is assumed to be interpreted as the absence of observation). Thus,

$$\text{if } s = \theta, r \in \{\theta, \emptyset\}$$

and

$$\text{if } s = \emptyset, r = \emptyset.$$

Let us briefly examine the notion of verifiability. The report can be thought of as the communication of the outcome of a quality test on the agent's product, or as a report on other shops, divisions, or firms facing a state of productivity correlated with that of the agent, or else as a credible statement by the supervisor on the agent's activity (the supervisor makes a "convincing case"). This leads us to three questions. First, are there circumstances in which the agent cannot supply a verifiable report himself? Second, if the agent can supply a verifiable report himself, is there still room for the supervisory function? Third, are nonverifiable reports of any interest? The first two questions will be analyzed in sections 4.1 and 3.2 respectively. I will not attempt to address the third question in detail. In section 4.5 I give an example in which nonverifiable reports can be useful. In general, however, nonverifiable reports create hazards. Indeed, in the accounting literature, Ijiri, Gjesdal, and Antle (1982, 1984) have warned us against the use of "soft" (that is, nonveri-

The three-tier structure boils down to the two-tier principal/agent one, in which the principal pays a lump sum S_0 and inherits the supervisor's information structure.

Thus consider program (CF) (where CF stands for "coalition free"):

$$\begin{aligned} & \text{Max}_{\{W_i, e_i\}} \sum_i p_i(\theta_i + e_i - W_i) \\ (CF) \text{ s.t.} & \\ & (AIR) \sum_i p_i U[W_i - g(e_i)] \geq \bar{U} \\ & (AIC) W_3 - g(e_3) \geq W_2 - g(e_2 - \Delta\theta). \end{aligned}$$

The agent's individual rationality constraint (AIR) states that the agent must obtain at least his reservation utility. The agent's incentive compatibility constraint (AIC) comes from the fact that the principal has incomplete information about the state of nature in state 3. The agent can always exert effort $(e_2 - \Delta\theta)$ in state 3 to claim the state is actually 2 and obtain wage W_2 . (A similar incentive compatibility constraint also exists in state 2 [$W_2 - g(e_2) \geq W_3 - g(e_3 + \Delta\theta)$]; but, as is usual, this constraint is not binding at the optimum. The issue is to induce the agent to reveal that the state of productivity is good, not that it is bad.)

Program (CF) leads to

Proposition 1: In the absence of coalitions, the optimal contract is equivalent to the optimal contract between the principal and the agent when the principal has the supervisor's information structure. The supervisor's wage is equal to S_0 in all states of nature. Furthermore:

$$W_3 > W_1 = W_4 > W_2$$

and

$$e_1 = e_3 = e_4 = e^* > e_2.$$

The proof of proposition 1, which is a straightforward extension of familiar proofs in contract theory, is supplied in the appendix. The supervisor's honesty implies that the principal has full information in states of nature 1 and 4 (when the supervisor observes the true state). The first best level of effort can then be required from the agent. Optimal insurance implies that the agent's wage is the same in these two states. In states of nature 2 and 3, the principal has incomplete information about the state of productivity. The agent's wage must be higher in state 3 than in state 2, in order to provide the

agent with sufficient incentives not to shirk in state 3 (that is, not to claim that the productivity is low). Under asymmetric information, the principal must reward a high performance and punish a low one. The optimum also involves a suboptimal effort in the low state of productivity (this makes it less attractive to shirk in the good state of productivity, once the corresponding reduction in W_2 is taken into account).

3.2. SUPERVISOR/AGENT COALITION

Let us now introduce the possibility of a coalition between the supervisor and the agent. Suppose that after (or simultaneously with) having signed the main contract offered by the principal, and before the uncertainty is resolved, the supervisor and the agent sign a side (covert) contract. This side contract specifies transfer $t(x, r)$ from the agent to the supervisor as a function of the realized profit and the supervisor's report. (Making t depend also on the supervisor's signal would not affect the analysis, because as is easily seen, the signal can in equilibrium be recovered from the profit and the report.) The supervisor's and the agent's gross incomes become $\{S(x, r) + t(x, r)\}$ and $\{W(x, r) - t(x, r)\}$. Note that I formalize the side transfer t as being monetary.

I assume that either the side transfer t is not observable by the principal or the main contract does not contain a clause forbidding further bilateral contracts (the same outcome arises if the principal signs a main contract with the supervisor only, and lets the supervisor "subcontract" with an agent any way the supervisor wants).

Under a supervisor/agent coalition, the allocation given by proposition 1 is no longer sustainable. In state of nature 4, the supervisor is indifferent between reporting he has observed the good state of productivity and "remaining silent" (claiming he has observed nothing); but the agent prefers the supervisor to remain silent. Thus, the agent has an incentive to bribe the supervisor to prevent him from revealing that the technology is favorable to the agent.

More generally, the supervisor and the agent ought to sign a side contract that induces the supervisor to report r in the feasible set of reports so as to maximize the total wage bill $\{W(x, r) + S(x, r)\}$ for any state of nature and profit x .¹⁸

The issue of how the supervisor and the agent split the surplus generated by their side contract is a matter of bargaining power and is not germane to the points made here. Therefore, I will make only the following assumptions on the bargaining process.

18. Note that this point and the subsequent analysis would not be affected if the principal asked the agent to send a "message" as well. The agent and the supervisor can always coordinate on what message to send. Thus, the wage bill can only depend on hard information (verifiable report and profit).

- A1. The supervisor and the agent choose a side contract that is Pareto optimal for these two parties.
- A2. Each of the two parties can guarantee itself the no-side-contract outcome.

Given that the supervisor and the agent bargain under symmetric information, these two assumptions are indeed quite weak.

I use the following methodology: in a first step I derive a set of constraints that the *final* (post side contract) allocation must satisfy; to the usual individual rationality and individual incentive compatibility constraints, I add a set of “coalition incentive compatibility constraints.” In the second step I maximize the principal’s expected payoff subject to this enlarged set of constraints, assuming that no coalition is formed. The third (and trivial) step consists in showing that the optimal contract does not generate a side contract between the supervisor and the agent (that is, is coalition-proof).

Let us start by deriving a set of constraints that must be satisfied by the final allocation. This allocation will be represented by $\{S_i, W_i, e_i\}$ for all i (S_i and W_i now include the side transfer).

i) The participation—or individual rationality (*IR*)—constraints for the supervisor and the agent must be satisfied. Otherwise, under rational expectations, the main contract would not be signed. Thus, we can impose

$$(SIR) \quad \sum_i p_i V(S_i) \geq \bar{V}$$

and

$$(AIR) \quad \sum_i p_i U[W_i - g(e_i)] \geq \bar{U}.$$

ii) The agent in state of nature 3 should not claim that the state of nature is 2 (remember he is the only party who can distinguish between those two states). To claim so, he would have to exert effort ($e_2 - \Delta\theta$). Thus, the incentive compatibility constraint for the agent is

$$(AIC) \quad W_3 - g(e_3) \geq W_2 - g(e_2 - \Delta\theta).$$

Similarly, in state of nature 2, the agent should not behave as in state of nature 3. But, as usual, this second incentive constraint will not be binding and can be ignored for the moment. We will later check to see that it indeed is satisfied.

iii) Let us now derive the coalition incentive constraints (*CIC*). In states of nature 1 and 4, the supervisor can conceal his information. Hence, if the supervisor and the agent choose a Pareto-optimal side contract, the total wage bill net of the disutility of effort in states 1 and 4 cannot be lower than that in states 2 and 3 respectively. Thus, we get

$$(CIC\ 1) \quad S_1 + W_1 - g(e_1) \geq S_2 + W_2 - g(e_2)$$

$$(CIC\ 2) \quad S_4 + W_4 - g(e_4) \geq S_3 + W_3 - g(e_3).$$

It must also be the case that the supervisor cannot bribe the agent to behave in state 3 as in state 2. This constraint can be written:

$$(CIC\ 3) \quad S_3 + W_3 - g(e_3) \geq S_2 + W_2 - g(e_2 - \Delta\theta).^{19}$$

Note that, if (AIC) is binding, (CIC 3) reduces to (CIC 3') $S_3 \geq S_2$.

There are two constraints that we ignore for the moment: the agent IC constraint in state 2 ($W_2 - g(e_2) \geq W_3 - g(e_3 + \Delta\theta)$) and the coalition IC constraint in state 2 ($S_2 + W_2 - g(e_2) \geq S_3 + W_3 - g(e_3 + \Delta\theta)$). These constraints will indeed be automatically satisfied by the solution to our problem.

Next, let us compute the optimal contract for the principal when the latter anticipates that no coalition forms but must respect the previous constraints. That is, we look for the solution to program (C):

$$(C) \quad \begin{aligned} & \text{Max}_{\{S_i, W_i, e_i\}} \sum_i p_i(\theta_i + e_i - S_i - W_i) \\ & \text{s.t.} \quad (SIR), (AIR), (AIC), (CIC\ 1), (CIC\ 2), \text{ and } (CIC\ 3). \end{aligned}$$

Note that the coalition necessarily hurts the principal, because (C) involves more constraints than (CF). The solution to (C) is derived in the appendix and is described in the following lemma.

19. Imagine that (CIC 3) is not satisfied. Let us show that the supervisor and the agent can sign a side contract that leads to a Pareto-superior allocation for them. The supervisor is willing to accept a "certainty equivalent" wage S_e in states 2 and 3, such that

$$S_e \leq p'_2 S_2 + p'_3 S_3$$

where $p'_i = p_i/(p_2 + p_3)$. Furthermore, from (AIC) and the fact that (CIC 3) is not satisfied, $S_2 > S_3$ and $S_2 > S_e$.

The agent claims that the state is 2 in both states 2 and 3, and obtains expected utility, conditional on the state being one of these two states:

$$p'_2 U[W_2 + S_2 - S_e - g(e_2)] + p'_3 [W_2 + S_2 - S_e - g(e_2 - \Delta\theta)].$$

instead of

$$p'_2 U[W_2 - g(e_2)] + p'_3 U[W_3 - g(e_3)].$$

The latter expected utility is strictly lower than

$$p'_2 U[W_2 - g(e_2)] + p'_3 U[W_2 + S_2 - S_3 - g(e_2 - \Delta\theta)].$$

The agent's net income with the new contract dominates the income $[W_2 - g(e_2); W_2 + S_2 - S_3 - g(e_2 - \Delta\theta)]$. Thus, one can construct a Pareto-improving side contract that perturbs the assumed final allocation.

Lemma 1: The solution to (C) has the following features:

- a) $S_4 > S_1 > S_2 = S_3$
- b) $W_3 - g(e_3) > W_4 - g(e_4) > W_1 - g(e_1) > W_2 - g(e_2)$
- c) $S_4 + W_4 = S_3 + W_3$
- d) $e_1 = e_3 = e_4 = e^* > e_2$
- e) All the constraints in (C), except (CIC 1), are binding (have strictly positive shadow prices).²⁰

Note that the principal cannot hope to do better than the solution to (C), as the constraints in (C) must be satisfied by the final allocation. But if the principal offers the contract defined by the solution to (C), there is no state of nature in which the total wage bill net of the disutility of effort can be increased by changing the report or the effort level. Furthermore, by construction, (C) embodies the optimal insurance scheme (subject to the AIC constraint) between the supervisor and the agent. Thus, no side contract between the supervisor and the agent forms, and the principal can indeed guarantee himself the solution to (C). We call this fact the *equivalence principle*: the principal can restrict himself to contracts that do not induce the agent and the supervisor to collude, once the relevant coalition incentive constraints are introduced.²¹

We have thus obtained

Proposition 2: When the supervisor and the agent can collude, the final allocation satisfies conditions (a) through (e) of lemma 1.

Let us now comment on the outcome under collusion. Lemma 1 (d) says that a distortion in effort is imposed only when the state of productivity is low and is not observed by the supervisor; (c) stems from (CIC 2) and the fact that the effort is the same in states 3 and 4. Thus, the total wage bill is the same in states 3 and 4. However, the supervisor's and the agent's wages vary between these two states, in spite of risk aversion. The point is that in state 3, the agent

²⁰ Let me check that the ignored constraints are also satisfied by the solution to (C). From (e), we know that

$$W_3 - g(e_3) = W_2 - g(e_2 - \Delta\theta).$$

Together with (d) and the convexity of g , this equality implies

$$W_3 - g(e_3 + \Delta\theta) < W_2 - g(e_2),$$

so that the agent's incentive compatibility constraint in state 2 is satisfied. Furthermore, from (a), we have

$$S_3 + W_3 - g(e_3 + \Delta\theta) < S_2 + W_2 - g(e_2),$$

so that the coalition incentive compatibility constraint in state 2 is also satisfied.

²¹ The coalition then does not form. Note that the allocation between the supervisor and the agent that results from (C) is optimal given the (conditional) wage bill and the agent's IC constraint; thus the solution to (C) could also be obtained by the principal by letting the supervisor and the agent collude. An extreme example occurs when the principal gives the supervisor the total (conditional) wage bill and lets the supervisor subcontract with an agent.

can claim that the state of productivity is low and the supervisor cannot provide evidence to the contrary. The agent must then be paid a high wage in order not to shirk. In state 4, optimal insurance calls for a lower wage for the agent than in state 3. But the supervisor must then obtain a higher wage in state 4 than in state 3, in order for the agent not to bribe the supervisor to conceal the state of productivity. This increase in the supervisor's wage represents a cost of obtaining the information.

The coalition incentive compatibility constraint in state 1—which induces the supervisor to reveal that the state of productivity is low—is not binding. This is very natural because in the low state of productivity, the agent prefers to have an excuse for generating a low profit. We interpret the result that (CIC 1) is not binding, while (CIC 2) is, as the idea that the supervisor naturally acts as an *advocate* for the agent.

To make it less costly to induce the supervisor to reveal that productivity is high (state of nature 4), the principal would want to give him a low salary (S_3) if he claims he has observed nothing and the profit is high. However, the supervisor's wage in state 3 cannot be lower than that in state 2 (from [CIC 3']). Thus $S_3 = S_2$. This constraint in turn leads to a lower S_2 . This explains why the supervisor's wage in state 1 is higher than in state 2, despite the fact that the supervisor is quite willing to reveal the low state of productivity.

The two extreme cases of risk aversion for the supervisor lead to particularly simple results (see the appendix for a derivation). The supervisor is risk-neutral if V is linear; he is infinitely risk-averse if he cares only about his lowest possible wage.

Proposition 3: If the supervisor is risk-neutral, the principal realizes the same profit as in the collusion-free case. Up to a fixed cost S_0 , everything is *as if* the principal monitored the agent directly and had the information structure $\{s_1 = \underline{\theta}, s_2 = s_3 = \emptyset, s_4 = \bar{\theta}\}$ (that is, the supervisor's information structure).

Proposition 4: If the supervisor is infinitely risk-averse, the principal pays a fixed wage S_0 to the supervisor; he then has the information structure $\{s_1 = \underline{\theta}, s_2 = s_3 = s_4 = \emptyset\}$ to monitor the agent.

The interpretation of propositions 3 and 4 is as follows.

A risk-neutral supervisor can own (be a residual claimant for) the vertical structure without any loss in terms of insurance. Thus, the principal can sell the vertical structure to the supervisor at a price equal to the expected profit minus the supervisor's reservation wage. The hierarchy then boils down to a two-tier structure between the supervisor and the agent. But we know that there is no room for collusion in a two-tier structure. Thus, the outcome is the collusion-free one.

In the examples mentioned in part 2, the supervisor is far from being made the residual claimant for the vertical structure. This suggests that proposition 3 is of limited interest in many cases.

The case of infinite risk aversion is clearly extreme. The motivation for studying it is that it very starkly illustrates the nature of the supervisor-agent coalition. The supervisor receives a constant wage like in the collusion-free case; however, he deliberately ignores the information he receives about the good state of productivity. He reveals only the information he receives about the bad state of productivity. Again, this behavior amounts to acting as an advocate for the agent.

As mentioned above, we may wonder what would happen if the agent were able to produce verifiable reports himself. Let us assume away the supervisory function, and let us endow the agent with full information in all states of nature (as earlier) and with verifiable information about the state of productivity in states 1 and 4 (thus, we transfer the supervisor's technology to the agent). Do we obtain the same outcome as with a supervisor (the outcome with a supervisor is the solution to [C], whether or not the agent can produce verifiable information in states 1 and 4)? The answer is provided in

Proposition 5: Assume the agent can produce verifiable information himself. Except in the case of supervisor's infinite risk aversion, there is still scope for a supervisory function.

The idea behind proposition 5 (the proof of which is straightforward and therefore not provided) is simple. In the absence of a supervisor, the agent will release only information that is favorable to him, that is, only evidence about the bad state of nature. In particular, we have $W_3 = W_4$ (and $e_3 = e_4$). Thus, the solution differs from (and is dominated by) the solution with a supervisor. This point is particularly clear in the case of the supervisor's risk neutrality. The supervisor, who is then the owner of the vertical structure, prefers to be informed about the good state of productivity, information he can obtain only if he collects verifiable information himself.

3.3. GENERAL COALITIONAL STRUCTURES

In the previous section, we assumed that only the supervisor and the agent can form a coalition. There is no a priori reason to impose such a restriction.

Consider first the outcome obtained in part 3.1, when no coalition is feasible, and introduce the possibility of a supervisor-principal coalition. This coalition could induce the supervisor not to release the evidence in state 1 or in state 4. Clearly, there is no point in doing so in state 4 ($W_3 > W_4$ and $e_3 = e_4$). It can also be shown that the main contract can be designed so that the supervisor reveals his signal in state 1.²² Thus, the collusion-free

22. There is a subtle point to be addressed here: What happens if the outcome is not foreseen (i.e., not one of the four outcomes specified) by the main contract? For instance, in state 1 the agent could exert effort e^* , anticipating that the supervisor reports the evidence. But the supervisor might not do so. The profit would then differ from that expected in state 2, i.e. $(\theta + e_2)$.

The main contract can be designed so as to be immune to the supervisor/principal coalition.

outcome is immune to a coalition between the supervisor and the principal. Similarly, it is easily seen that it is also immune to a coalition between the agent and the principal.

We now investigate what kind of allocation can be implemented by the principal when *all* types of bilateral coalitions are allowed. By allocation, we mean the *final* allocation that results from the parties' optimizing behavior given the main contract and the side contracts.

A *final allocation is said to be coalition-proof* if there exists no state of nature in which a coalition can increase its aggregate payoff by changing a variable (effort, report) that is controlled by a member of the coalition.

Proposition 6: The solution to (C) is coalition-proof.

Proposition 6 says that the main contract defined by program (C), in which a potential coalition between the supervisor and the agent is accounted for, is more generally coalition-proof. Thus, if the principal offers this contract, it is an equilibrium for the other parties to accept the contract and for all parties not to expect or suggest any side contract.²³

The proof of proposition 6 (supplied in the appendix) starts by describing the mechanism more completely (in particular, it defines what happens if the observed [profit, report] pair is not one of the four equilibrium ones), and shows that the solution to (C) can indeed be implemented when all coalitions are allowed.

Proposition 6 shows that the principal need not worry about the effect that his potential coalitions with the agent and the supervisor have on the optimal contract for the supervisor-agent coalition. The corresponding coalition incentive compatibility constraints are not binding. In this sense, the relevant coalition is that between the supervisor and the agent. Thus, collusion naturally arises at the organization's *nexus of informed parties*, that is, within a group that can manipulate the information obtained by the rest of the organization (here, by the principal).²⁴

I have not showed that the equivalence principle holds (while I did so when only the supervisor-agent coalition is feasible). Hence, we may wonder whether, given an extensive form for the formation of coalitions, the principal can do better when he can form coalitions than when he cannot (given, or course, that the other two parties correctly anticipate these coalitions if the main

Assume that the three parties are punished heavily in case of an "unforeseen outcome." Clearly, one equilibrium is the collusion-free one (the supervisor does not want to deviate unilaterally and conceal the evidence in state 1). To make sure that $(e = e_2, r = \emptyset)$ is not another equilibrium in state 1 (in which the agent correctly anticipates that the other two parties form a coalition not to release evidence in state 1), it suffices that the main contract requires that the report be released *after* the profit is observed. This gives the agent a Stackelberg leadership. As he prefers state 1 to state 2, he can force the supervisor to announce the truth in state 1.

23. Here I am a bit loose on the extensive form for the formation of coalitions. See below.

24. In a sense, this property is an extension to group behavior of the classic principal/agent paradigm, in which the agent manipulates the information received by the principal.

contract gives scope for them). To answer this question, one must posit an extensive form for the game of coalition formation. For instance, suppose that in the coalition formation game, the supervisor and the agent form their coalition last. Then the constraints (CIC 1) through (CIC 3) must be satisfied by the final allocation. The final allocation must also satisfy (SIR), (AIR), and (AIC) (this last property holds for any game of coalition formation). Thus, the principal *cannot* do better than the solution to (C). Together with proposition 6, this implies that the outcome of the game with general coalitions is the same as the one with only the supervisor-agent coalition.

4. COALITIONS AND ORGANIZATIONAL BEHAVIOR

4.1. WHAT DO SUPERVISORS DO?

Before deriving some implications for hierarchical organizations, it is useful to discuss the role of supervisors in the light of the previous model. I again assume away productive activities by the supervisor to focus on the supervisory function. Also, I assume that the supervisor and the agent do collude (the factors of collusion are discussed in the next two sections).

We saw that the supervisor's information is more costly to obtain under collusion. For example, in the extreme case in which the supervisor is not willing to bear any income risk, everything is *as if* the principal hired a collusion-free (honest) supervisor who could observe that the agent's environment is unfavorable, but would never observe that this environment is favorable: the supervisor acts as an *advocate* (see proposition 4). But even in this extreme case, the supervisor is useful in producing verifiable evidence in the unfavorable state of productivity.

The behavior of the supervisor as an advocate for the agent may shed some light on the well-known and intriguing fact that *positive reinforcement is more reliable than negative reinforcement*.²⁵ Rewards work better than punishments. The usual, psychological explanation for this phenomenon is the trauma associated with punishments (issue of framing). It is harder to come up with an economic interpretation. Economists are not used to distinguishing rewards and punishments (punishments are just negative rewards). The theoretical model of part 3 shows that there may be an economic explanation as well, if one views organizations as a network of groups. For instance, a supervisor who is not willing to bear any income risk intervenes only to raise the agent's wage (in state 1), never to lower it. Thus, the supervisor's degree of freedom (object of intervention) is to reward the agent.²⁶ Except in the

25. See, e.g., Katz and Kahn (1978: 310).

26. If the supervisor is not infinitely risk-averse, the idea that rewards work better than punishments can still be formalized, albeit not in such a stark way. The supervisor needs no special incentive to reveal the environment is unfavorable (state 1), in the sense that the coalition

extreme case of an infinitely risk-averse supervisor, there is still scope for the supervisory function if the agent can produce the verifiable information himself. In the absence of a supervisor, there is no way to induce the agent to reveal that the environment is favorable (while he is always willing to demonstrate that the environment is unfavorable). A supervisor who is willing to bear some income risk can be given incentives to reveal that the environment is favorable, as long as the penalty imposed on the agent by this announcement is not so high that the agent bribes the supervisor not to reveal. (An alternative and more technical way to approach this result is to notice that the presence of a supervisor increases the set of contingencies over which an insurance-incentive contract can be signed with the agent.) In some cases, the agent may not be in a position to produce verifiable information himself. He may not be able to defend his case clearly ("lawyer's syndrome") or to provide quality tests. Alternatively, he may lack the time to do so.²⁷

4.2. WHO COLLUDES WITH WHOM?

The reader might be misled by my emphasis on the supervisor-agent coalition and infer that (effective) coalitions naturally arise between the lower tiers of a vertical structure. The problem with this inference is that the conventional ordering in vertical structures is based on criteria that may not capture the issue studied here (for example, the ordering may stem from the initial distribution of authority or residual rights of control). Even though coalitions naturally form between a "supervisor" and an "agent," the notions of "supervisor" and "agent" may not fit conventional ordering.

For instance, the ordering of the hierarchies justice/police/convict and colonel/captain/conscript may not reflect their structures of information. One may think of instances in which the agent is the police or the captain, the principal the convict or conscript, and the supervisor the judicial system or the colonel. With this reordering, the agent may take an action that affects the principal, and the supervisor may check the agent's action. Thus, a coalition can form between the judicial system and the police against the convict, and between the colonel and the captain against the conscript. This means the

incentive constraint is not binding. By contrast, in state 4, the supervisor reveals that the environment is favorable only if his wage increase associated with the disclosure of information is at least equal to the corresponding reduction in the agent's wage (the coalition incentive constraint is binding).

27. The supervisor, from his dual function (planning, coordinating, advising, etc.) may devote more time to learning about outside units (shops, firms). If some other units are subject to productivity shocks that are statistically correlated with the agent's activity, the performance of these units can be used as a yardstick to infer the agent's behavior. Another possibility is that the supervisor supervises several agents. A common productivity shock affecting the agents may give rise to a free rider problem between the agents: each agent may be able to gather the evidence about the common shock and discuss it with upper tiers of the hierarchy, but he would prefer other agents to offer their time to do so.

theory is consistent with the existence of coalitions between members of what is traditionally called "upper tiers." The moral is that the identification of effective coalitions in an organization requires a careful consideration of the information structure. Similarly, a party may collude with different parties depending on the issue.²⁸

4.3. THE LENGTH OF RELATIONSHIPS

Giving parties contract incentives or forcing them to have a long-run relationship has some desirable effects. First, as Williamson (1975) has forcefully argued, long-run relationships help foster the accumulation of specific assets. Second, as emphasized in the repeated moral hazard literature, repetition alleviates incentive problems (if the agent does not have access to perfect capital markets). On the other hand, it has been recognized that contracts should leave some flexibility for mutually advantageous "breaches."²⁹ In this section, I remark that the possibility of collusion suggests an alternative explanation of short-run relationships.

Collusions require side-transfers. As discussed in part 2, some types of transfers (monetary, personal interaction) may enforce coalitions in short-run relationships. The latter can also be enforced by a mutual threat (each member of the coalition threatens to release some piece of information that would be detrimental to the other member). Often, however, transfers and threats are not simultaneous: a party does a favor for the other party, who implicitly or explicitly promises to reciprocate later. The enforcement mechanism is then associated with repetition.

Keeping relationships short has the advantage of restricting side transfers and, thus, of limiting the influence of coalitions in organizations. As Kreps et al. have shown, cooperation between two parties at any given time increases with the time horizon of their relationship. It would be desirable to develop models of reputation that explain the common observation that the extent of collusion between two parties tends to increase over time. I expect such a formalization to follow one of the following two intuitive lines. First, trust may be slow to develop and the stakes of a cooperative behavior may accordingly rise over time. Higher stakes can be offered when one becomes reasonably sure that the other party is interested in cooperation.³⁰ Second,

28. In my model, the supervisor might share with the owner of the firm some information about demand for the product, say (like in the implicit contract literature). The supervisor then becomes a supervisor for the (so-called) principal and may collude with him not to release this information to the (so-called) agent. At the same time, he may collude with the agent regarding the release of the productivity information.

29. This aspect has been particularly emphasized by Aghion and Bolton in their reconsideration of the market foreclosure doctrine. In a somewhat different vein, see also Harris and Holmström's study of the sampling problem between two parties who, over time, lose information about the value of their relationship.

30. For a promising start on this, see Sobel's introduction of a stake into the Kreps–Milgrom–Roberts–Wilson model.

and this argument is more specific to coalitions in organizations, past collusion may enforce current and future collusion. Once parties (for example, the supervisor and the agent) have started colluding, each possesses threats against the other in case of a breach. Disclosure by one party of information detrimental to the other party usually prompts immediate retaliation through release by the latter of information detrimental to the former.³¹ This mutual blackmail, which makes the breakdown of collusion costly, forces the parties into a coalition to keep on colluding.³²

There is some evidence that organizations give their members (especially at the managerial and supervisory levels) incentives to switch jobs within the organization.³³ Sometimes they even require it. In France one of the functions of the "Grands Corps" of civil servants is to provide decision makers and analysts who are mobile and fairly independent of pressures that come from inside the organizations with which they are working (because of their job and wage security as well as their mobility).

Another piece of evidence is the use of consulting firms to collect information. The latter are expensive and in many cases are limited in their access to information. However, their members have a short-run relationship with each firm for which they are working and therefore are almost (hidden) transfer-free.^{34,35}

Similarly, outside recruiting may bring new blood to an organization, even when the new employee does not have superior ability or knowledge. (New employees are less subject to coalitional pressures because they do not yet know whom to trust).³⁶

31. For instance, Dalton (1959: 77) mentions the case of a foreman colluding with operators not to "kill" a good rate. The foreman received an order to be completed at once. He decided to abide by the order, which led the engineers to investigate the operators' performance, which had unexplainably moved from a normal to a phenomenal level with no change in job or method. Enraged by the foreman's deception, the operators explained their remarkable rate by exposing the foreman's part in the deception.

32. A mitigating factor in this increase in collusion over time is the fact that at the beginning of the relationship each party can make the other party's life miserable for a longer period of time if the latter does not cooperate immediately (this effect is captured by Kreps et al.)

33. Monotony and the lack of further on-the-job learning may be motives to change jobs; but, to some extent, they are internalized by the member and do not require special incentives.

34. There is another use of consulting firms that is also related to coalitions: sometimes consultants are hired by the boss to tell him or her what he or she wants to hear (the threat in case of breakdown of collusion is the nonrenewal of the consulting contract).

35. In a similar spirit, Scherer suggested the use of an independent Program Evaluation Board to assess defense programs: "Serious problems of bias and lack of comparability are likely to arise when performance judgements are made by persons deeply involved in the programs" (1964: 329). Or the auctioning of defense contracts may break privileged relationships between contractors and Department of Defense officials. Let us also mention Niskanen's proposal to change committees after a limited time (1971: chap. 20); the frequent rotations of independent audit firms personnel among clients; and the high mobility in the diplomatic corps.

36. Greg Dow and Raaj Sah suggested to me that the desire to limit intertemporal side transfers may be a (very partial) explanation for Weber's observation that incumbents have no right to their office (in particular, cannot choose their successor). (For a model of reputation with overlapping parties, see Kreps's view of the firm as a reputation carrier.)

As a last example, let me point out that the advantage of a journal's anonymous reviewing process is that the referee-author relationship amounts to a one-shot relationship.

4.4. RULES VS. DISCRETION: THE EMERGENCE OF BUREAUCRACIES

The design of coalition-proof schemes has two facets. Should the principal rely on the supervisor's report to reward or punish the agent? Should the supervisor have discretion on the agent's reward or punishment? I take these two facets to be equivalent for the purpose of my single supervisor framework.

The main feature of a *rule* is that *it leaves no discretionary power to its enforcer*. In other words, a rule prevents the use of the enforcer's decentralized information. Rules are thus impersonal (suppress face-to-face relationships) and involve a loss of information. *Bureaucracies* are organizations mainly run by rules. The role of rules has been emphasized by, among others, Weber, Crozier, and Arrow.

The classical principal/agent paradigm in economics is already concerned, if not with rules, at least with limits on the discretionary power left to the informed party. In this model, the agent is simultaneously decision maker (because of his superior information)—and involved party. Therefore, he cannot be fully trusted and must be given an "incentive compatible" reward scheme (in some extreme cases, the principal may demand something like a profit or production target—in technical terms, may induce pooling or bunching—which is the theoretical analog of a rule). The idea that one may want to limit the discretion of a party who is simultaneously "judge and party" is well understood. By contrast, the observation that a party having relevant information to assess or affect *other* parties cannot fully be trusted to use this information to serve the goals of the organization may be more central to the reflections on rules and bureaucracies.

As we saw, collusion creates hazards to soft information, and even to a part of hard information (see, for example, proposition 4). The nonreliability of information transmitted by a supervisor naturally leads to the abandonment of this information or, equivalently, to the absence of supervisory discretion. For example, a foreman may not be entitled to allow a worker to be absent even if only he has the information relevant to this decision. More generally, foremen have almost no initiative as to personnel management and organization.³⁷

37. Crozier (1963: 51–52, 56, 176, 238). Similarly, consider the familiar pronouncement by an employee of an administration: "I know that in your case the rule ought not to apply, but I have got to abide by it." The organization does not let the employee discriminate on the basis of his or her information for fear of letting face-to-face relationships (a type of collusive behavior) systematically bias the decision. It seems one might be able to use the law of large numbers: the employee would be entitled to some proportion of exceptions to the rule. But this arrangement requires that several conditions be met. The exceptions must be recorded, and the benefits of bookkeeping

If coalitions indeed foster bureaucratic tendencies, the previous reflections on the factors that influence the formation of coalitions ought to be relevant to explain why some organizations are more bureaucratic than others (that is, more run by rules). Let me offer some conjectures on this.

First, the theory of coalitions should predict that old organizations should be more bureaucratic than younger ones. This idea is based on the analysis of part 4.3. When organizations get started, their employees are not yet tied by a network of relationships (that is, cliques are not yet fully developed). When the organization matures, there is always at any point of time a substantial fraction of employees bound by their previous personal commitments. Thus, allowing employees to exercise discretion becomes more hazardous. (An alternative explanation for the development of rules over time is the idea that experience allows for a better description of tasks and, therefore, reduces discretion. This explanation, which does not involve coalitions, is certainly relevant. Let us, however, also note that it should not lead to the perception of rules as the lesser of two evils).

Second, the theory of coalitions may well predict that large firms should be more bureaucratic than smaller ones. The direct control of the veracity of one level of supervision's transmitted information—or, equivalently, its correct use of discretion—becomes harder and harder when the (vertical and horizontal) span of control rises.

4.5. MULTIAGENT SITUATIONS

Most of our conclusions apply to the case of “discriminatory hierarchical coalitions,” in which a supervisor monitoring several agents favors some of them, not directly at the expense of the principal, but at that of other agents.³⁸

Consider the principal/supervisor/multiagent situation, and suppose individual agent performance is observed only by the supervisor and is not

must exceed its costs (this leads to a standard argument in favor of rules). Furthermore, even if the basic technology of bookkeeping is reasonably cheap, it must be the case that it is not manipulated with the employee's supervisor's tacit agreement. More generally, an employee's discretion requires fine monitoring by the supervisor to make sure it is used appropriately. In the presence of a coalition, this in turn requires a fine control by the supervisor's supervisor, etc. This accumulation of monitoring costs (when they should have stopped at the first level of supervision in the absence of collusion) makes rules relatively appealing (checks by higher tiers are much cheaper, and can often be done randomly).

38. For instance, foremen or heads give better work conditions to their protégés. Or maintenance officers favor some operations heads. Such an example is given in Dalton (p. 34), in which some operation heads had hundreds of unfinished orders while others had none. The “dominant operation chiefs threatened to block their flow of informal favors to maintenance officers. These favors included (1) cooperation to ‘cover up’ errors made by maintenance machinists, or at least to share responsibility for them; (2) defense for the need of new maintenance personnel; (3) support in meetings against changes recommended by staff groups that maintenance forces opposed; (4) consideration, and justification to top management of material needed by Maintenance for its success and survival in meeting the demands of Operation.”

Similarly, the Department of Defense may favor firms it has already dealt with (Scherer, 1964: 73); and, in business firms, managers may identify with a particular supplier (Pettigrew).

verifiable (by a court, say). In this case, all information is soft. Hence, if the supervisor colludes with the group of agents, he cannot be given any discretion over the agents' aggregate reward (like in part 3). However, he might be given authority to split a *fixed-size reward* among the agents as he likes. As long as he colludes only with the whole set of agents, he has no incentive to manipulate the announcements of individual performances.³⁹ If, however, he engages in discriminatory hierarchical coalitions, he destroys the link between individual performance and reward (that is, defeats the purpose of discretion) and, furthermore, promotes wasteful competition for the attainment of favors and privileged information among the agents.⁴⁰ Like the hierarchical coalition studied in this paper, the discriminatory hierarchical coalition fosters the abandonment of discretion (that is, the introduction of rules).

In a discriminatory hierarchical coalition, the supervisor must choose the agents with whom he wishes to collude. The previous thoughts on the availability of side transfers may shed some light on who is chosen. One factor is the length of the relationship. A transient agent may thus be at a disadvantage relative to agents with a similar but permanent position. A second factor lies in the preferences of parties. Thus, parties who are more prone to enforce collusion (or to use fear to coerce favors) will more likely be picked.

5. CONCLUSION

5.1. THEORIES OF ORGANIZATION

This section points out some of the features that identify the approach in terms of coalitions relative to complementary approaches. For ease of comparison, it focuses on features that distinguish it from other emanations of the basic principal/agent paradigm. For instance, it ignores the theory of bounded rationality,⁴¹ which takes a very different route (in order to focus on the important phenomena of rules of thumb, limited attention, and imperfect communication, the latter approach abstracts from incentive problems and, in particular, from the malicious distortion of information).

Principal/Agent and Compounding Theories. There is not much point reviewing the now well-known principal/agent theory here. Several authors (Williamson, 1967b; Mirrlees, 1976; and Calvo and Wellisz) have extended this theory to multilayer contexts by assuming that intermediate layers have a

39. A similar argument is made by Bhattacharya and Malcomson to justify rank-order tournaments, an instance of a fixed-size reward.

40. Competition between agents can also be wasteful if mutual help between them is crucial for efficiency. It is then preferable to motivate them to form a productive team by suppressing discretion and offering only "low-powered" individual incentives (in the sense of Williamson, 1985).

41. See Simon; Nelson and Winter; Geanakoplos and Milgrom; Sah and Stiglitz.

choice of supervisory effort. For example, in the simple principal/ supervisor/ agent model, the principal monitors the supervisor who, in turn, supervises the agent (for instance, the probability of discovering that the agent shirks increases with the supervisor's effort). An interesting insight of this literature is to show how slack can trickle down a hierarchy: inappropriate incentives for the principal to monitor lead to a low supervisory effort in the middle tier, which leads to a low productive effort in the bottom tier (note that by making the supervisory effort exogenous, I emphasized the manipulation of information over supervisory slack). The literature also draws some conclusions about the optimal span of control and size of the vertical structure and about wage differentials.

In the compounding theory, any information held by a party about another party (the outcome of supervision broadly defined) is transmitted honestly. There are no side transfers and coalitions do not form. In terms of organizational design, the compounding theory (1) decomposes the search for the minimal cost of inducing a given organizational strategy (efforts, reports, and so on) into n subprograms; (2) puts no emphasis on the hazards associated with long-run relationships; (3) uses all information that does not reflect on parties that transmit it (that is, all supervisory information); and (4) favors, in multiagent contexts (in which individual performance is not verifiable), the use of (delegated) discretion to reward the agents. None of these properties holds in the presence of coalitions.⁴²

Theory of Moral Hazard in Teams. Moral hazard between members of a team arises when only the aggregate performance of the team is observable and verifiable. The associated free rider problem has been discussed much in the economics literature.⁴³

Such a problem may arise in the simple principal/supervisor/agent structure. As I mentioned in part 2, the supervisor in general also has a productive function on top of the supervisory function: advising, selection, coordination, management, and so forth. Furthermore, the supervisor's productive performance is often observed only through the agent's. In other words, the supervisor and the agent form a productive team. This, of course, affects the supervisor's incentives when reporting on the agent's performance. For instance, a Ph.D. adviser may overstate the Ph.D. student's thesis quality, not because they are colluding, but because the adviser is eager to show that he or she obtains the good students and advises them well.

Thus, it would seem that the theories of moral hazard in teams and of coalitions lead to the same type of manipulation of information by the supervisor, in which the supervisor acts as an advocate for the agent. This is, however, false. To give an example, suppose, as in part 3, that the agent's performance

42. Property (1) does not hold because the cost of inducing a party to take some given action depends on the reward structure of other parties (through the coalition incentive constraints).

43. E.g., Alchian and Demsetz, 1975; Holmström, 1982.

(x) depends on his effort (e) and on some productivity parameter (θ). Suppose further that the productivity parameter depends on the supervisor's productive effort. On the one hand, if the supervisor can manipulate the observation of performance, he has an incentive to overstate this performance, regardless of the existence of a coalition.⁴⁴ On the other hand, if the supervisor reports on the agent's effort or on the productivity parameter, his behavior is much influenced by the existence of a coalition with the agent. His best interest, in the absence of collusion, is to demonstrate that the agent exerts a low level of effort or faces a favorable productivity parameter. For example, for a given poor performance, the supervisor has every incentive to pass the responsibility for this poor performance on to the agent; and similarly, he tries to take credit for good performance. Thus, *everything that reflects poorly on the agent but not on the supervisor is reported by the latter*. For instance, in the absence of collusion the foreman ought to supply any evidence that the worker's task is an easy one. Or the Department of Defense ought to insist that the contracting firm could have avoided the cost overruns. This contrasts with the findings of part 3.

5.2. CONCLUDING REMARKS

By contrast with earlier work, this paper views an organization as a network of coalitions and contracts that interplay. The model developed in part 3 shows how the introduction of the relevant coalition incentive constraints modifies the optimal incentive scheme. It also shows that a natural coalition occurs between the agent and the supervisor. The words *agent* and *supervisor* must be taken in a broad sense; they do not necessarily reflect the traditional hierarchical ordering (as argued in part 6.2). At a more applied level, the ideas developed here are inspired by the direct evidence of the existence of coalitions and side transfers collected in the sociology literature. The indirect evidence was provided by the consistency of the suggestions of the model for organizational behavior with observed practice; among them: (1) the supervisor tends to act as an advocate for the agent; (2) short-run relationships may be desirable; and (3) the supervisor lacks the decision power that his central informational position should confer upon him. Hierarchies tend to be run by rules (that is, to be bureaucracies).

In our model, coalitions unambiguously decrease the efficiency of the vertical structure. Coalitions and their enforcement mechanism, side transfers, ought to be fought. This conclusion is extreme. In practice, some side transfers exist because organizations do not want to (rather than cannot) curb them. The medicine can do more harm than the illness; preventing long-run relationships between members of a hierarchy may result in efficiency losses.

44. The supervisor may manipulate the accounting procedure if x is a monetary performance (profit); or the quality evaluation if x a quality parameter.

Employees then have lower incentives to develop knowledge specific to their positions or to their productive teamwork with other employees. Also, the moral hazard issue within teams of employees becomes more severe in the absence of a repeated relationship. Furthermore, an organization ought to encourage certain types of side transfers such as mutual help. Of course, such informal (covert) transfers can be used as vehicles for the formation of coalitions ("if you release this information about me, I will not help you adapt to your next task or problem"). But it is widely recognized by sociologists that without the countless acts of cooperation that take place everyday between members, most organizations would break down. They would also be poorly equipped to adapt to changes (which require an unusual amount of cooperation). In a similar vein, the benefits from authority are eliminated by the introduction of rules; as is now well recognized, many contingencies affecting an organization are hard to foresee or are costly to describe in advance. Allowing one of its members to make decisions when contingencies not contracted for (giving him or her "authority") gives flexibility to the organization (for instance, relative to rigid *ex ante* decisions). Of course, the member who is given authority acquires power because his or her decisions affect the other members, and this power can be used to generate favors. Again, the advantages and drawbacks of the authority relationship must be weighted against those of alternative arrangements (see also the discussion on discretion in multiagent situations).

The moral of this very incomplete discussion of the limits to the control of side transfers is that the very factors that give rise to coalitions may also give rise to desirable effects. This means that side transfers will be curbed (when possible) only if these other effects are small. A careful analysis of the trade-offs involved here would be quite worthwhile.

APPENDIX

A.1. PROOF OF PROPOSITION 1 (COLLUSION-FREE OUTCOME)

The Lagrangian for program (CF) is

$$L^{CF} = \sum_i p_i (\theta_i + e_i - W_i) + \mu (\sum_i p_i U(W_i - g(e_i)) - \bar{U}) \\ + \gamma (W_3 - g(e_3) - W_2 + g(e_2 - \Delta\theta)).$$

This Lagrangian depends only on $(W_i - g(e_i))$ and $(e_i - W_i)$ for $i \neq 2$. This implies that $\{e_i - g(e_i)\}$ must be maximized for $i \neq 2$. That is:

$$i \neq 2 \rightarrow g'(e_i) = 1, \text{ or } e_i = e^*.$$

The first order conditions then boil down to

$$\begin{aligned}
 (1) \quad & \mu U'(W_1 - g^*) = 1 \\
 (2) \quad & \mu U'(W_2 - g(e_2)) = 1 + \frac{\gamma}{p_2} \\
 (3) \quad & \mu U'(W_3 - g^*) = 1 - \frac{\gamma}{p_3} \\
 (4) \quad & \mu U'(W_4 - g^*) = 1 \\
 (5) \quad & (1 + \frac{\gamma}{p_2})g'(e_2) = 1 + \frac{\gamma}{p_2}g'(e_2 - \Delta\theta).
 \end{aligned}$$

If γ were equal to 0, the incentive constraint would be nonbinding and the first best solution would obtain. But we know that this first best solution is not incentive-compatible for the agent. Hence, γ is strictly positive, which, together with (5) and the strict convexity of g , implies that $e_2 < e^*$.

The ranking of the agent's utility levels in the various states of nature is given by equations (1) through (4).

The second order conditions are easily checked.

A.2. PROOF OF LEMMA 1 (SUPERVISOR/AGENT COALITION)

Let us now introduce the supervisor's *IR* constraint and the coalition incentive constraints. We ignore (CIC 1); we will later check that this constraint is satisfied. The new Lagrangian is

$$\begin{aligned}
 L^C = & \sum_i p_i (\theta_i + e_i - S_i - W_i) + v (\sum_i p_i V(S_i) - \bar{V}) \\
 & + \mu (\sum_i p_i U(W_i - g(e_i)) - \bar{U}) + \gamma (W_3 - g(e_3) - \\
 & \quad W_2 + g(e_2 - \Delta\theta)) \\
 & + \Pi (S_3 + W_3 - g(e_3) - S_2 - W_2 + g(e_2 - \Delta\theta)) \\
 & + \varepsilon (S_4 + W_4 - g(e_4) - S_3 - W_3 + g(e_3)).
 \end{aligned}$$

First, notice that for $i \neq 2$, L^C depends on e_i and W_i only through $(e_i - W_i)$ and $(W_i - g(e_i))$. The optimum maximizes $(e_i - g(e_i))$, which leads to

$$i \neq 2 \rightarrow e_i = e^*.$$

Taking the derivatives of L^C with respect to S_i , W_i , e_2 successively gives

$$(6) \nu V' (S_1) = 1$$

$$(7) \nu V' (S_2) = 1 + \frac{\Pi}{p_2}$$

$$(8) \nu V' (S_3) = 1 + \frac{\varepsilon - \Pi}{p_3}$$

$$(9) \nu V' (S_4) = 1 + \frac{\varepsilon}{p_4}$$

$$(10) \mu U' (W_1 - g^*) = 1$$

$$(11) \mu U' (W_2 - g(e_2)) = 1 + \frac{\gamma + \Pi}{p_2}$$

$$(12) \mu U' (W_3 - g^*) = 1 - \frac{\gamma + \Pi - \varepsilon}{p_2}$$

$$(13) \mu U' (W_4 - g^*) = 1 - \frac{\varepsilon}{p_4}$$

$$(14) \left(1 + \frac{\gamma + \Pi}{p_2} \right) g' (e_2) = 1 + \frac{\gamma + \Pi}{p_2} g' (e_2 - \Delta\theta).$$

Let us show that the agent IC constraint is binding, i.e., that $\gamma > 0$. Suppose that $\gamma = 0$. Equations (7), (8), (11), and (12) imply that Borch's rule hold between states 2 and 3:

$$(15) \frac{V' (S_2)}{V' (S_3)} = \frac{U' (W_2 - g(e_2))}{U' (W_3 - g^*)}.$$

But from (AIC),

$$(16) W_3 - g^* \geq W_2 - g(e_2 - \Delta\theta) > W_2 - g(e_2).$$

Equations (15) and (16) imply that

$$(17) S_3 > S_2.$$

From (16) and (17), (CIC 3) is not binding, which implies $\Pi = 0$. But then (11) and (12) imply

$$(18) W_3 - g^* \leq W_2 - g(e_2),$$

which contradicts (16). Thus, $\gamma > 0$.

Let us now show that (CIC 3) is binding, i.e., that $\Pi > 0$. Suppose that $\Pi = 0$. Equations (7) and (8) imply that $S_3 < S_2$, which is impossible from (CIC 3) and the fact that (AIC) is binding. So, $\Pi > 0$, which implies that $S_2 = S_3$.

From (6) and (7), $S_1 > S_2$, and from (6) and (8) and the fact that $S_2 = S_3 < S_1$, $\varepsilon > \Pi$; (6) and (9) imply that $S_1 < S_4$.

Next, let us consider the agent's wage. Equations (10), (11), and (13) imply that $W_4 - g^* > W_1 - g^* > W_2 - g(e_2)$. Also, from (CIC 2), $W_3 + S_3 = W_4 + S_4$, which implies that $W_3 > W_4$.

Last, observe that from (14), $g'(e_2) < 1$ or, $e_2 < e^*$.

Checking that (CIC 1) is satisfied is trivial, as $S_1 > S_2$ and $W_1 - g^* > W_2 - g(e_2)$.

A.3. PROOFS OF PROPOSITIONS 3 AND 4 (SUPERVISOR'S RISK NEUTRALITY AND EXTREME RISK AVERSION)

Proposition 3. We know that for any specification of preferences, the principal cannot do better than in the collusion-free case, because he is facing more constraints. Conversely, let us show that he can do as well as in the collusion-free case if the supervisor is risk-neutral. Suppose he sells the vertical structure to the supervisor. In other words, the principal's profit is independent of the state of nature (which will imply that the final allocations is immune to a supervisor-agent coalition). The supervisor signs the optimal contract with the agent given the supervisor's information. Thus, the agent's allocation is the same as in the collusion-free outcome. The principal can then sell the vertical structure to the supervisor at a price such that the latter's expected profit net of the sale price is equal to his reservation wage (the supervisor bears risk, but cares only about his expected wage if he is risk-neutral).

A more formal way of proving proposition 3 is to compare (1) through (5) to (10) through (14). These equations give the same answer (for a given μ) if one takes $\Pi = \gamma = 0$ (i.e., if the coalition incentive constraints are not binding!); (6) through (9) are then satisfied by the appropriate choice of v .

Proposition 4. Let us now assume that the supervisor is infinitely risk-averse. Then the ratio of the supervisor's marginal utilities in two states of nature is infinite (or zero) unless the wages in these two states are equal. If the supervisor's wage is not a constant, then from (6) through (9) $\Pi = +\infty$ or $\varepsilon = +\infty$ (I am a bit informal here; the correct way to prove proposition 4 is to take the limit when V converges to the min function). Equations (10) through (13) then show that the agent's wage is $+\infty$ or $-\infty$ in some state of nature. We assumed that it cannot fall below w . But if the agent's wage is $+\infty$ in some state of nature, it must be $-\infty$ in another state, in order for the principal not to lose money. Again, this is impossible.

Hence, S_i is a constant (S_0). (CIC 2) implies that $W_3 = W_4$; that is, the principal does not try to distinguish between states 3 and 4. It is then clear that

the principal-agent contract is the optimal contract given that the principal has information structure $\{s_1 = \underline{\theta}, s_2 = s_3 = s_4 = \emptyset\}$.

A.4. PROOF OF PROPOSITION 6

The solution $\{S_i, W_i, e_i\}$ to (C) satisfies conditions (a) through (e) of lemma 1. If it is coalition-proof (which we want to show), it describes what happens on the equilibrium path for each state of nature. Of course, we are free to specify what happens off the equilibrium path, as long as we do not create scope for coalitions.

Thus, let us give a more complete description of the coalition-proof mechanism that implements the solution to (C). First, the supervisor produces his report after the profit is observed. Second, the supervisor gets wage S_1 and S_4 when he provides evidence that the state is 1 and 4, respectively (regardless of the profit level). Third, the three parties are heavily fined whenever the {report, profit} pair is not one of the four equilibrium pairs described by the solution to (C), with the exception of the supervisor when he produces evidence about states 1 and 4 (only the other two parties are then fined if the profit differs from $[\theta + e^*]$). These three points complete the description of the mechanism.

For simplicity, I assume that side contracts between two parties are not observed by the third party. By definition of (C), the mechanism is immune to a supervisor-agent coalition.

Let us show that it is immune to a principal-agent coalition. For this notice that in states 1 and 4, the supervisor has a dominant strategy: tell the truth. The supervisor's wage is lowest, and it is the same in states of nature 2 and 3. Hence, there is nothing that the principal and the agent can do to reduce the supervisor's wage.

Finally, let us show that the mechanism is immune to a principal-supervisor coalition. The object of this coalition can only be to induce the supervisor to hide the evidence in states 1 and 4. The agent's utility is higher in state 1 than in state 2. In state 1, the agent, by exerting effort e^* , forces the supervisor to reveal the evidence.⁴⁵ The agent's wage in state 4 is lower than in state 3 and his effort is the same in both states. Thus, a principal-supervisor coalition cannot gain by inducing the supervisor not to reveal the evidence in state 4. Hence, the principal-supervisor coalition cannot form either.

45. Unless the supervisor and the principal have signed a side contract that penalizes the supervisor when $\{x = \underline{\theta} + e^*, r = \underline{\theta}\}$ even more than the main contract does when $\{x = \underline{\theta} + e^*, r = \emptyset\}$. But the supervisor would not accept such a side contract, which would give him a very negative utility with probability p_1 (remember that side contracts are assumed not to be observable).

REFERENCES

- Aghion, P., and P. Bolton. 1985. "Entry Prevention through Contracts with Customers." Mimeo, Massachusetts Institute of Technology.
- Alchian, A., and H. Demsetz. 1972. "Production, Information Costs, and Economic Organization," *American Economic Review* 777.
- Antle, R. 1982. "An Agency Model of Auditing," *Journal of Accounting Research* 503.
- . 1984. "Auditor Independence." *Journal of Accounting Research* 1.
- Arrow, K. 1974. *The Limits of Organization*. New York: Norton.
- Bhattacharya, S. 1983. "Tournaments, Termination Schemes and Forcing Contracts." Mimeo, University of California, Berkeley.
- Caillaud, B., R. Guesnerie, P. Rey, and J. Tirole. 1985. "The Normative Economics of Government Intervention in Production." Stanford University, IMSSS TR #473.
- Calvo, G., and S. Wellisz. 1978. "Supervision, Loss of Control, and the Optimal Size of the Firm," *Journal of Political Economy* 943.
- Crozier, M. 1963. *Le Phenomene Bureaucratique*. Paris: Editions du Seuil. Translated by Crozier as *The Bureaucratic Phenomenon*. Chicago: University of Chicago Press, 1967.
- Cyert, R., and J. March. 1963. *A Behavioral Theory of the Firm*. Englewood Cliffs: Prentice-Hall.
- Dalton, M. 1959. *Men Who Manage*. New York: Wiley and Sons.
- Downs, A. 1965. *Inside Bureaucracy*. Boston: Little, Brown, and Co.
- Etzioni, A. 1964. *Modern Organizations*. Englewood Cliffs: Prentice-Hall.
- Geanakoplos, J., and P. Milgrom. 1984. "A Theory of Hierarchies Based on Limited Managerial Attention." Mimeo, School of Management, Yale University.
- Gjesdal, F. 1981. "Accounting for Stewardship," *Journal of Accounting Research* 208.
- Gouldner, A. 1954. *Patterns of Industrial Bureaucracy*. New York: Free Press.
- . 1961. "The Norm of Reciprocity," *American Sociological Review* 161.
- Green, J., and N. Stokey. 1983. "A Comparison of Tournaments and Contest," *Journal of Political Economy* 349.
- Grossman, S., and O. Hart. 1983. "An Analysis of the Principal-Agent Problem," *Econometrica* 7.
- Harris, M., and B. Holmstrom. 1983. "On the Duration of Agreements." Stanford University, IMSSS TR #424.
- Hart, O. 1983. "The Market Mechanism as an Incentive Scheme" *Bell Journal of Economics* 366.
- Holmström, B. 1979. "Moral Hazard and Observability," *Bell Journal of Economics* 74.
- . 1982. "Moral Hazard in Syndicates," *Bell Journal of Economics* 324.
- Ijiri, Y. 1971. "A Defense of Historical Cost," R. B. Sterling, ed., in *Asset Valuation and Income Determination*. University of Kansas Press.
- Katz, D., and R. Kahn. [1966] 1978. *The Social Psychology of Organizations*, 2d ed. New York: Wiley and Sons.
- Kreps, D. 1984. "Corporate Culture and Economic Theory." Mimeo, Stanford University.
- Kreps, D., P. Milgrom, J. Roberts, and R. Wilson. 1982. "Symposium on Finitely Repeated Models of Reputation," *Journal of Economic Theory* 245–52, 253–79, 280–312.
- Lazear, E., and S. Rosen. 1981. "Rank Order Tournaments as Optimum Labor Contracts," *Journal of Political Economy* 841.
- Malcomson, J. 1984. "Work Incentive, Hierarchy, and Internal Labor Markets," *Journal of Political Economy* 486.

- March, J., and H. Simon. 1958. *Organizations*. New York: Wiley and Sons.
- Mirrlees, J. 1975. "The Theory of Moral Hazard and Unobservable Behavior, Part I." Mimeo, Nuffield College, Oxford.
- . 1976. "The Optimal Structure of Incentives and Authority within an Organizational," *Bell Journal of Economics* 105.
- Mookherjee, D. 1984. "Optimal Incentive Schemes with Many Agents." *Review of Economic Studies* 433.
- Nalebuff, B., and J. Stiglitz. 1983. "Prizes and Incentives: Towards a General Theory of Compensation and Competition," *Bell Journal of Economics* 21.
- Nelson, R., and S. Winter. 1982. *An Evolutionary Theory of Economic Change*. Cambridge, Mass.: Harvard University Press.
- Niskanen, W. 1971. *Bureaucracy and Representative Government*. Chicago: Athaton Aldine.
- Olson, M. 1965. *The Logic of Collective Action: Public Goods and the Theory of Collective Action*. Cambridge, Mass.: Harvard University Press.
- Peck, M., and F. Sherer. 1962. *The Weapons Acquisition Process: An Economic Analysis*. Harvard University, Graduate School of Business.
- Pettigrew, A. 1972. "Information Control as a Power Resource," *Sociology* 187.
- Posner, R. 1974. "Theories of Economic Regulation," *Bell Journal of Economics*.
- Rose-Ackerman, S. 1978. *Corruption: A Study in Political Economy*. New York: Academic Press.
- Ross, S. 1973. "The Economic Theory of Agency: The Principal's Problem," *American Economic Review* 134.
- Sah, R., and J. Stiglitz. 1985. "Human Fallability and Economic Organization," *American Economic Review* 292.
- Scherer, F. 1964. *The Weapons Acquisition Process: Economic Incentives*. Harvard University, Graduate School of Business.
- Schmalensee, R. 1980. *The Control of Natural Monopolies*. Lexington, Mass.: Lexington Books.
- Scott, W. Richard. 1981. *Organization: Rational, Natural, and Open Systems*. Englewood Cliffs: Prentice-Hall.
- Selznick, P. 1949. *TVA and the Grass Roots*. Berkeley and Los Angeles: University of California Press.
- Shavell, S. 1979. "Risk-Sharing Incentives in the Principal and Agent Relationship," *Bell Journal of Economics* 55.
- Simon H. 1976. *Administrative Behavior*, 3rd ed. New York: Macmillan.
- Sobel, J. 1985. "A Theory of Credibility," *Review of Economic Studies* 557.
- Stigler, G. 1971. "The Theory of Economic Regulation," *Bell Journal of Economics* 3.
- Stiglitz, J. 1975. "Incentives, Risk, and Information: Notes towards a Theory of Hierarchy," *Bell Journal of Economics*.
- Tullock, G. 1965. *The Politics of Bureaucracy*. Washington, D.C.: Public Affairs Press.
- Weber, M. 1974. *The Theory of Social and Economic Organization*. New York: Oxford University Press.
- Williamson, O. 1967a. "The Economics of Defense Contracting: Incentives and Performance," in R. McKean, ed., *Issues in Defense Economics*. New York: Columbia University Press.
- . 1967b. "Hierarchical Control and Optimal Firm Size," *Journal of Political Economy* 123.
- . 1975. *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: Free Press.
- . 1985. *The Economics Institutions of Capitalism*. New York: Free Press.