

**"MANAGERIAL INCENTIVES  
AND ENVIRONMENTAL COMPLIANCE"**

by

**H. Landis GABEL\***  
and  
**Bernard SINCLAIR-DESGAGNE\*\***

**N° 91/48/EP/TM**

\* Associate Professor of Industrial Economics, INSEAD, Boulevard de Constance,  
Fontainebleau 77305 Cedex, France.

\*\* Assistant Professor of Decision Sciences, INSEAD, Boulevard de Constance,  
Fontainebleau 77305 Cedex, France.

Printed at INSEAD,  
Fontainebleau, France.

**MANAGERIAL INCENTIVES AND ENVIRONMENTAL COMPLIANCE**

**H. Landis Gabel and Bernard Sinclair-Desgagné <sup>1</sup>**

**INSEAD  
Boulevard de Constance  
77305 Fontainebleau Cedex  
France**

**Proposed running head: Managerial Incentives**

**Please send all correspondence to: Bernard Sinclair-Desgagné,  
Technology Management Area, INSEAD, Boulevard de Constance,  
77305 Fontainebleau Cedex, FRANCE. [EMAIL: Desgagne@freiba51]**

### ABSTRACT

This paper builds a multi-task principal-agent model and uses it to analyze the implementation of corporate environmental compliance policies. The main finding is that it may be inefficient to link managerial effort expended on reducing the risk of environmental accidents to the corporate compensation system. One implication is that monitoring of managerial performance on this activity should not be implemented for the sole purpose of supporting salary-based incentive schemes. To stimulate environmental risk reduction, firms' principals should rely on means like job design, individual liability, or corporate culture, rather than on monetary incentives.

## 1. INTRODUCTION

Misallocation of environmental resources can often be imputed to market failure. This is surely an uncontroversial statement among environmental economists. Indeed, much of the policy-oriented research in the field over the last decades aims mainly at finding ways to improve the functioning of markets (see, for example, Baumol and Oates [1], Dales [2], Kneese and Shultze [7]). There is no doubt that this work has had a significant influence on public policy (Tietenberg [13]).

Much environmental resources, however, are actually allocated **within** firms. Organizational failure, i.e. systematic deviation from the common assumption that firms behave as unitary and rational *personae fictae*, can then also be a major source of environmental problems. In fact, as we argue below, behind the corporate veil lie unescapable sources of misallocation of environmental resources, which are analogous to problems of externalities that are well-understood in the context of market-mediated transactions. Paradoxically, little attention has been paid in the environmental economics literature to the organizational shortcomings that affect the allocation of environmental resources. Yet, just as public policy tools like Pigouvian taxes, rules of civil liability, and marketable property rights might remedy market failures, there are corporate policy tools that might alleviate organizational failures. In addition to considering the correct **economic incentives** in a decentralized economy, environmental economists should examine as well the appropriate

**contractual incentives** faced by managers and employees in a firm.

In a recent article Xepapadeas [14] analyzed environmental policy-making concerning pollution in a setting in which the regulatory agency could not perfectly monitor the compliance of regulated firms. Such situations of hidden action or **moral hazard** abound within firms. Chief executives can only approximately measure how much effort a manager puts into reducing the risks of an environmental accident.<sup>2</sup> How should contracts be designed in order to alleviate environmental moral hazard?

The issue of corporate versus individual liability has been analyzed in some recent works (see, for instance, Segerson and Tietenberg [11]), using a principal-agent model. In this paper, we consider corporate monetary incentives and we also use the principal-agent framework. Our model, however, differs from those traditionally studied in the literature (for a survey, see Hart and Holmström [4]) in two important aspects. First, the agent (i.e. the manager) does not have one but **two tasks** to perform; they relate to the enhancement of expected profit and to the reduction of risk, respectively. Second, the agent has a **limited amount of effort** to split between tasks. Such "multi-task principal-agent" models were recently introduced by Holmström and Milgrom [5]. Contrary to the class of models they study, however, we allow for the realistic possibility that information signals are nonadditive and non-normally distributed, and that the agent does not have constant absolute risk aversion.

Although the focus of this paper is strictly within the

corporation, we believe that research behind the corporate veil has value not only for corporate environmental policy but for public policy as well. As Segerson and Tietenberg pointed out, and as it is acknowledged by actual enforcement policy, environmental regulatory agencies do not limit themselves to correcting market prices. They have at their disposal a variety of enforcement tools that can reach inside the corporation including individual liability, command and control policies, and organizational remedies.<sup>3</sup> We believe that efficient and effective use of these policy instruments must be founded on the understanding of the decision-making processes that underly corporate action.

The paper is structured as follows. The next section discusses the problem of environmental compliance from the viewpoint of a corporation's top management. We submit that top management sincerely intends to comply with environmental laws and regulations but that the delegation of tasks and discretion to subordinates makes actual compliance uncertain. This motivates the principal-agent model that is presented in the third section. Based on this model, qualitative propositions concerning salary-based incentive schemes to promote environmental compliance objectives are derived in section 4. Our main finding is that, in the plausible case of a positive shadow price for managerial effort, managers' salaries should not vary with environmental risk reducing performance. The appropriate way to fashion the incentives necessary to make managers focus on risk reduction should be based on other means. The section then concludes with a comment on the use of environ-

mental audits as a management control mechanism. Section 5 then sketches how variants of our model might be employed to examine means like job design, individual liability, and corporate culture, which have been suggested for the enhancement of "greener" management.

## 2. THE CHALLENGE OF ENVIRONMENTAL COMPLIANCE

Most of the literature in environmental economics adopts a "black box" view of the firm. The firm maximizes profit given the prices of its inputs and outputs. Hence, the environmental policy maker's sole challenge is to ensure that correct prices are set.

Public policy has not yet accomplished this objective, however, nor is it likely to do so in the near future. Prices of environmental resources are still badly distorted, so that alternative channels of enforcement are widely used. The mix of progressively more threatening enforcement measures, both civil and criminal, and the growing pressure from customers, communities, employees, and non-governmental organizations has now made "greener" management *de rigueur* in corporate board rooms.

The fact that corporate environmental compliance constitutes a serious practical challenge can be inferred from the rising number of environmental management consulting firms (more than 200 currently exist in the U. K., for example), from the proliferation of business school educational programs on the subject,<sup>4</sup> from the concerns expressed by business organizations like the International Chamber of Commerce, the Conference Board of Europe, and the US

Business Roundtable, and from the growing attention of business policy academics<sup>5</sup>.

The growing concern for "greener" management, however, indicates that neither academic research nor managerial experience are yet able to provide guidance on how "green" objectives can best be operationalized within a large and complex corporation's systems of planning, management, and control. There is a need for formal studies on the various ways of implementing corporate environmental policies.

Management surveys (see references [3], and [15] to [19]) describe several common practices to fulfill green management objectives. Environmental audits are the most frequent. Typically, their goal is to make an assessment of the company's performance relative to legal requirements. A second objective is to locate the risks. These objectives alone, however, are generally recognized as insufficient. As noted by *Business International* ([19], p. 107):

Without an overreaching environmental management system, auditing will achieve little. It is not a panacea, only a tool, offering at best a critical examination of performance. It is then up to management to provide the commitment and resources to act on the analysis to safeguard the environment.

In a similar vein, the International Chamber of Commerce ([18], p. 3) states that:

Environmental auditing should not be seen in isolation but as just one, albeit very important, element in a comprehensive approach to environmental management.

A more comprehensive approach might link the results of environmental audits to the firm's incentive compensation system. In

addition to profit objectives, line managers could be given non-profit goals like limiting the risk of effluent emissions or environmental accidents. Audits could be made of performance towards these goals, and the managers' salaries could depend in part on assessed performance. Although none of the surveys of management practice gives an example of a firm that directly and formally links employee compensation to audit results, many firms do so in-formally. As expressed in a survey by *The Economist* ([15], p. 23):

[Audits] allow chief executives to set goals for subsidiaries: get your reported emissions down to such-and-such level, or lose a bit of your bonus.

It is this policy of making managers' compensation depend in part on environmental performance that we analyze in the upcoming sections.

Another approach to compliance is via the firm's accounting and control system. Accounting measures may be modified in such a way as to mimic the market. For example, a salesman's commission may be reduced for environmentally hazardous products to spur substitution towards less dangerous products. Overhead costs for insurance premia or for the legal department may be allocated to specific products to change the financial incentives to produce them. Fictitious accounting costs (from the firm's viewpoint) may be charged against certain products to reduce their internal economic attractiveness.

Finally, task reorganization is often observed. Staff experts may be employed with responsibility, authority, and financial

resources to handle the investment in and operations of environmental controls. Also, decisions with environmental implications may be centralized and shifted up in the corporate hierarchy.

All these practices implicitly recognize that in large complex organizations, senior management necessarily delegates decision making to subordinate managers and other employees whose behavior cannot be perfectly controlled. Hence, incomplete information, hidden action, incentives, and moral hazard are pervasive constraints of contractual arrangements.

### 3. A PRINCIPAL-AGENT MODEL

Imagine that a corporation's principal - its chief executive officer (CEO) or chairman of the board - is worried that risks of environmental accident lurk throughout the company. These risks could be reduced if subordinate line managers were to spend more effort tackling them, but effort so spent would be at the expense of activities that generate the profit figures on which the managers' compensation is currently based. Furthermore, the CEO cannot perfectly observe the amount of effort managers would allocate to the various tasks. Effort can only be inferred indirectly through some realized performance level. Should the CEO link managerial compensation to performance with respect to environmental risk reduction?

The CEO's problem can be modelled as follows. Let a line manager, whom we shall call the agent, select actions in the compact polyhedron  $A = \{a = (a_1, a_2) \mid a_1 + a_2 \leq 1, a \geq 0\}$  of  $\mathbb{R}^2$ . The

first and second components of an  $\mathbf{a}$  in  $\mathbf{A}$  are the relative amounts of effort devoted to profit-seeking and environmental risk-reducing activities respectively. The action chosen, i.e. the allocation of effort, is known only by the agent. The agent's actions would nonetheless be costlessly monitored by the principal and would generate a compound discrete score  $\mathbf{s} \in \mathbf{S} = \{\mathbf{s} = (s_1, s_2) \mid s_1 = 0, 1, \dots, S_1; s_2 = 0, 1, \dots, S_2\}$ . Let the conditional likelihood of a score  $\mathbf{s}$  with respect to an action  $\mathbf{a}$  be given by  $p(\mathbf{s}|\mathbf{a})$ .

A standard assumption about the probability distributions  $p(\cdot|\mathbf{a})$  is that a higher score  $\mathbf{s}$  makes a greater effort  $\mathbf{a}$  more plausible. Formally, this means that the likelihoods  $p(\mathbf{s}|\mathbf{a})$  display the monotone likelihood ratio property (Milgrom [9]), a multivariate version of which is the following.

**ASSUMPTION:** The ratios  $p_t(\mathbf{s}|\mathbf{a})/p(\mathbf{s}|\mathbf{a})$  is nondecreasing in  $\mathbf{s}$ , for every  $t$  and  $\mathbf{a}$ .<sup>6</sup>

Observing the performance score  $\mathbf{s}$ , the CEO may estimate the profit to be

$$\pi(s) = \pi(s_1, s_2) = \pi_L(s_2) + \beta(s_1) [\pi_H(s_2) - \pi_L(s_2)] \quad (1)$$

The estimated profit is thus an interpolation of high ( $\pi_H$ ) and low ( $\pi_L$ ) profit levels. Let the measurements  $s_1$  and  $s_2$  refer respectively to profit-seeking and risk-reducing activities. So the weight on high profit levels  $\beta(s_1)$  increases with  $s_1$ ; but  $\pi_L$  decreases and the gap between  $\pi_H$  and  $\pi_L$  increases with environmental risk, i.e. when  $s_2$  goes down. Formally,

$$\pi_H(s_2) > \pi_L(s_2) \text{ for all } s_2,$$

$$\beta(s_1) > \beta(s_1') \text{ if } s_1 > s_1',$$

and  $\pi_L(s_2) > \pi_L(s_2')$ ,  $\pi_H(s_2) - \pi_L(s_2) < \pi_H(s_2') - \pi_L(s_2')$  when  $s_2 > s_2'$ . Note, however, that the probability distributions  $p(\cdot | \mathbf{a})$  being non-separable, either action selected may influence the score on the other.

If one assumes, furthermore, that

$$\text{for all } s_1, s_2, s_2': \pi(s_1, s_2) = \pi(s_1, s_2'), \quad (2)$$

the second activity is a pure environmental risk reducing activity. It has no effect on the expected level of profit, but only on its variance. At this point, this would not mean that an increase in  $s_2$  alone would not be rewarded. Such an increase makes it more likely that the agent spent higher effort in both activities, so the provision of incentives may require that some extra pay be given (see proposition 1 below).

In this model the principal/CEO is risk neutral. The agent /manager, on the other hand, is attributed a separable Von Neumann-Morgenstern utility function over income and action, which is given by  $v(y) - c(\mathbf{a})$ . The function  $v(\cdot)$  is defined on the real line; it is strictly increasing and displays strict risk aversion in income. The cost function  $c(\cdot)$  is convex.

The principal's objective is to set a contingent wage schedule  $w = w(\mathbf{s})$  that maximizes her expected utility, given that the agent will optimize over his action space and that he can always get a (status quo) utility level  $V^*$  in some other employment. This yields the following multi-task principal-agent problem.

$$\begin{aligned}
& \max_{a, w} \sum_{s \in S} p(s|a) (\pi(s) - w(s)) \\
& \text{subject to:} \\
& a \in \operatorname{argmax}_{\hat{a} \in A} \sum_{s \in S} p(s|\hat{a}) v(w(s)) - c(\hat{a}) \\
& \sum_{s \in S} p(s|a) v(w(s)) - c(a) \geq V^*
\end{aligned} \tag{3}$$

The first constraint above implies incentive compatibility and the second implies individual rationality. As a technical matter, the incentive compatibility constraint is hardly tractable, for it involves a continuum of inequalities. Under some conditions, however, this constraint can be replaced by the first-order necessary conditions for  $a$  to be the agent's optimal action.<sup>7</sup> This "first-order approach" yields the following equivalent formulation of the multi-task principal-agent problem, which is easier to solve.

$$\begin{aligned}
& \max_{a, w, \gamma} \sum_{s \in S} p(s|a) (\pi(s) - w(s)) \\
& \text{subject to:} \\
& \sum_{s \in S} p_t(s|a) v(w(s)) - c_t(a) - \gamma \geq 0 \\
& \text{for } t=1, 2, \\
& (1 - \sum_{t=1}^2 a_t) \gamma \leq 0, \quad \gamma \geq 0, \quad a \in A; \\
& \sum_{s \in S} p(s|a) v(w(s)) - c(a) \geq V^*
\end{aligned} \tag{4}$$

The Greek letter  $\gamma$  denotes the agent's shadow price of attention.

Our next task is to explore the qualitative properties of an optimal compensation scheme.

#### 4. ENVIRONMENTAL RISK-REDUCING PERFORMANCE AND SALARIES

Under the usual constraints qualification assumptions, a solution to problem (4) must satisfy the following Kuhn-Tucker conditions.<sup>8</sup>

$$\frac{1}{v'(w(s))} = \mu + \frac{\sum_{t=1}^2 \delta_t p_t(s|a)}{p(s|a)} \quad (5)$$

for every  $w(s)$ , and

$$\sum_{s \in S} p_t(s|a) (\pi(s) - w(s)) + \sum_{r=1}^2 \delta_r \left\{ \sum_{s \in S} p_{rt}(s|a) v(w(s)) - c_{rt}(a) \right\} \\ + \mu \left\{ \sum_{s \in S} p_t(s|a) v(w(s)) - c_t(a) - \gamma \right\} - \lambda - \rho \gamma + \mu \gamma \leq 0 \quad \text{if } a_t = 0 \\ = 0 \quad \text{if } a_t > 0 \quad (6)$$

for  $t=1, 2$  ;

$$-\sum_{r=1}^2 \delta_r + \rho \left( 1 - \sum_{t=1}^2 a_t \right) \leq 0 \quad \text{if } \gamma = 0 ; \\ = 0 \quad \text{if } \gamma > 0 \\ \rho \leq 0 \quad \lambda \geq 0 \quad \delta_r \geq 0$$

Here,  $\lambda$  is the principal's shadow price for the agent's effort;  $\rho$  is the opportunity cost she would incur if the agent were to waste an amount of attention that is worth one utile to him;  $\delta_r$  denotes the shadow price of the incentive compatibility constraint for task  $r$ , i.e., the increase in the principal's utility of a marginal deviation from the agent's utility-maximizing level of effort on task  $r$ ; and  $\mu$  is the principal's shadow price for the individual rationality constraint, i.e., the increase in the principal's

utility from a marginal decrease in the agent's reservation utility  $V^*$ .

It is intuitively appealing that the optimal wage schedule increases with an improvement in the profit enhancing or the risk reducing scores. As the next proposition shows, this holds provided the incentive compatibility constraints are binding.

**PROPOSITION 1:** If all the  $\delta_r$ 's are positive, the optimal wage schedule  $w(s)$  is nondecreasing in  $s$ .

**PROOF:** First note that positive  $\delta_1$  and  $\delta_2$  ensure that a solution to problem (4) is also a solution to the multi-task principal-agent problem (see Sinclair-Desgagné [12]).

The statement then follows from equation (5) and the previous assumption concerning  $p(s|a)$ . **Q.E.D.**

The fact that  $\delta_1$  and  $\delta_2$  are positive entails that  $\gamma = 0$  (so the constraint on the manager's effort is nonbinding) by the last two lines of (6). Positive shadow prices on the incentive constraints mean that the manager would spontaneously resist spending extra effort on any task (i.e., deviating from his current optimum); he must then assign a value of 0 to incremental attention. Suppose, on the contrary, that the manager would like to spend extra effort but that the limit has been reached. Then  $\gamma$  is positive. In this case the following proposition shows that, in a wide range of circumstances, wages should not vary when only the performance score on the risk reduction task improves.

**PROPOSITION 2:** Let the manager's effort be fully extended, so that  $\gamma > 0$ . If also

$$\lambda \leq (\mu - \rho) \gamma , \quad (7)$$

then

$$\text{for all } s_1, s_2, s_2': w(s_1, s_2) = w(s_1, s_2') . \quad (8)$$

Condition (7) has an interesting interpretation. Suppose that the agent is given one percent more of effort. His total amount of effort available is now 101%. The principal's and the agent's utilities increase then by  $\lambda$  and  $\gamma$ , respectively. Expressed in terms of the principal's utiles, however, the agent's additional satisfaction is  $(\mu - \rho)$ . Inequality (7) thus says that the agent is more eager than the principal to get this extra unit of attention.

**PROOF OF PROPOSITION 2:** Condition (7) ensures again that a solution to problem (4) also solves the multi-task principal-agent problem (see Sinclair-Desgagné [12]).

Now, a positive shadow price  $\gamma$  implies that  $\delta_1 = \delta_2 = 0$  by the last two lines of (6). Thus, equation (5) can be satisfied only if (8) is true. **Q.E.D.**

Proposition 2 has an intuitive rationale. A positive shadow price for managerial effort implies that the agent is using 100% of his attention, and would like to use more but can't. The incentive constraints are then irrelevant, so  $\delta_1 = \delta_2 = 0$ . Interaction between the principal and the agent is now limited to risk sharing,

but efficient risk sharing requires that their marginal rates of substitution between the various income levels be equal. Given that the principal is risk neutral, this can only be achieved if the wage schedule is invariant in the risk reduction score.

Another way to look at the result of proposition 2 is as follows. Under the stated conditions ( $\gamma > 0$  and inequality (7)), suppose that the wage schedule was instead tied to the score on environmental risk reduction. This would increase the amount of environmental risk borne by the agent. In order to avoid low  $s_2$  scores the risk averse agent would then devote more effort to risk reduction and less to profit enhancement than the risk neutral principal would wish.

The proposition that a manager's salary should not always be based on observed effort to reduce environmental risks is consistent with Holmström and Milgrom [5]'s theoretical result that relatively flat salary schedules are appropriate for activities that are relatively hard to monitor. This is inherently the case for activities that affect risk compared to activities that yield current profit. But our model reaches this result without invoking any explicit difference in monitoring costs or accuracy. The irrelevance of incentive pay for environmental risk reduction is rather due to the fact that managers are "workaholic".

One specific implication of proposition 2 is that linking salaries and environmental audits may be unsuited as a means of managerial control. If managerial effort is at an upper bound, the CEO should simply appraise profit performance and pay contingent

wages  $w^*(s_1)$  that mimic the solution  $w(s_1, s_2)$  to problem (4). That is

$$\text{for all } s_1: w^*(s_1) = w(s_1, 0) . \quad (9)$$

## 5. OTHER INCENTIVE SCHEMES AND DIRECTIONS FOR FUTURE RESEARCH

If incentive compensation and monitoring might be inappropriate for controlling environmental risks in large decentralized firms, what other means are there at the disposal of corporate principals? In this section we will consider how several of the alternatives discussed in section 2 could be explored using the multi-task principal-agent framework we have laid out.

An alternative to assigning both profit and environmental risk reduction responsibilities to a single agent is to assign the different tasks to different agents. This is common in the business arena as was noted in section 2. Holmström and Milgrom [5] argue that tasks in which performance is relatively easy to assess should be assigned to one manager, while tasks that are inherently difficult to monitor should be assigned to another manager. The former's compensation should be incentive-based while the latter's should not be. In our context, this would imply that profit should be the responsibility of line managers with incentive contracts while environmental risk reduction should be assigned to a staff under a fixed-salary contract. Is this splitting of tasks and responsibilities according to a "monitoring criterion" reasonable in

the environmental context? In our model, the problem of job design could be tackled by introducing a second agent and expanding the set of actions and performance scores accordingly. This would greatly increase the complexity of the problem, and the Kuhn-Tucker conditions, in particular, would become intricate. Yet qualitative insights yielding propositions like those above should still be possible.

Another frequently observed alternative is to shift some corporate liability to the individual agent. This is a corporate policy analogous to the public policy of individual criminal penalties. Companies can and do, for instance, make it clear to employees that negligent conduct causing environmental liability is ground for disciplinary action, and that legal aid and indemnification of fines would be denied to any employee personally liable for an environmental accident. To analyze such a case, liability costs functions  $c_p(D)$  and  $c_A(D)$ , increasing with the extent of environmental damage  $D$ , would have to be subtracted from the principal's and the agent's respective utility functions; and a conditional likelihood  $q(D|\mathbf{a})$  would have to be specified. Qualitative insights should then again be possible.

Finally, companies can and do place great emphasis on corporate "culture". If a recent article, Kreps [8] defines corporate culture as a focal point in a noisy reputation game. Corporate reputation might influence the agent's reservation utility  $V^*$ ; it might figure as an argument of the agent's utility function; or it might protect the company from harsh penalties in

the event of an environmental accident. Also, in the presence of ambiguity, the impact of a focal point would be to point out a specific likelihood  $p(\mathbf{s}|\mathbf{a})$ , i.e., the types of inference on  $\mathbf{a}$  the principal may draw from observing  $\mathbf{s}$ .

## 6. CONCLUSIONS

This paper has presented a multi-task principal-agent model and has used it to assess the relevance of incentive pay linked to performance on environmental risk reduction. The main conclusion was that, if a manager's attention is at its peak, it might not be appropriate to make his salary vary with the observed reduction of environmental risk. If one accepts the common assertion that managers are people whose attention is typically oversolicited, this is a useful insight.

## REFERENCES

1. W. Baumol and W. Oates, "The Theory of Environmental Policy", Cambridge Univ. Press, Cambridge, UK (1988).
2. J. Dales, "Pollution, Property, and Prices", University Press, Toronto (1968).
3. M. Flaherty and A. Rappaport, "Multinational corporations and the environment: A survey of global practices", The Center for Environmental Management, Tufts University (1991).
4. O. Hart and B. Holmström, The theory of contracts, in "Advances in Economic Theory, Fifth World Congress" (T. Bewley, ed.), Cambridge University Press, MA (1987).
5. B. Holmström and P. Milgrom, "Multi-task principal-agent analysis: Incentive contract, asset ownership and job design", Yale School of Organization and Management, CT (1990).
6. R. S. Kaplan and A.A. Atkinson, "Advanced Management Accounting" (2nd edition), Prentice-Hall, Englewood Cliffs, New Jersey (1989).
7. A. Kneese and C. Schultze, "Pollution, Prices, and Public Policy", The Brookings Institution, Washington, D.C. (1975).
8. D. M. Kreps, Corporate culture and economic theory, in "Perspectives on Positive Political Economy" (J. E. Alt and K. A. Shepsle, eds), Cambridge University Press (1990),
9. P. Milgrom, Good news and bad news: representation theorems and applications, *Bell J. of Econ.* **12**, 380-391 (1981).
10. D. Sappington, Incentives in principal-agent relationships, *J. Econ. Perspectives* **5**, 45-66 (1991).
11. K. Segerson and T. Tietenberg, "The structure of penalties in environmental enforcement: an economic analysis", Paper presented at the Environmental Law Workshop, Woods Hole, MA (1991).
12. B. Sinclair-Desgagné, "The first-order approach to multi-task principal-agent problems", INSEAD (1991).
13. T. Tietenberg, Economic instruments for environmental regulation, *Oxford Rev. Econ. Pol.* **6**, 17-33 (1990).
14. A. P. Xepapadeas, Environmental policy under imperfect information: Incentives and moral hazard, *J. Env. Econ. Man.* **20**, 113-126 (1991).

15. A survey of industry and the environment, *The Economist*, 23 (1990).
16. "Companies' Organization and Public Information to Deal with Environmental Issues", United Nations Environment programme (1990).
17. "Corporate response to the environmental challenge", McKinsey and Company (1991).
18. "Environmental auditing", Technical Report Series no. 2, International Chamber of Commerce (1991).
19. "Managing the Environment. The Greening of European Business." Business International Ltd, London UK (1990).

## ENDNOTES

1. The first version of this paper was presented at the annual meeting of the European Association of Environmental and Resource Economists, Stockholm School of Economics, June 10-14, 1991. We thank the participants of our session, particularly David Miltz and Tom Tietenberg, for helpful comments. We gratefully acknowledge INSEAD 's financial support through its Management of Environmental Resources programme (grant 2097R).

2. Environmental audits, about which more will be said in this paper, are one, albeit imperfect, means of measurement.

3. To the best of our knowledge, organizational remedies have not been used under the U.S. environmental laws, but they have been in other countries. In Germany, for example, most large firms must by law designate a top manager who is responsible for compliance with environmental regulations and who must present the company's compliance plans to the government. Similar organizational remedies have been used in the U.S., but to ensure compliance in other areas such as antitrust law.

4. As an indication of this proliferation, a conference held at the authors' institution in October 1990 for teachers in such programs drew 60 participants. The authors are unaware that any similar conference was previously held. Had one been organized several years earlier, it is unlikely that it would have had more than a handful of attendees. In fact, many institutions dedicated to executive education on environmental matters have been created in Europe and in the United States over the last two years.

5. For instance, the 1991 annual meeting of the Strategic Management Association is devoted to "The Greening of Strategy".

6. The index  $t$  refers to the action - profit making or risk reducing. The subscript  $t$  in  $p_t(\mathbf{s}|\mathbf{a})$  denotes the first-order partial derivative with respect to  $a_t$  ( $t = 1, 2$ ) at  $\mathbf{a}$ .

7. These conditions are essentially that all functions  $v(\cdot)$ ,  $p(\mathbf{s}|\cdot)$ ,  $c(\cdot)$  be twice continuously differentiable, and that the probability of a signal being less than or equal to  $\mathbf{s}$  decrease, at a decreasing rate, as  $\mathbf{a}$  grows. See Sinclair-Desgagné [12].

8. In the following expressions,  $v'(w(\mathbf{s}))$  denotes the first-order derivative of  $v$  at  $w(\mathbf{s})$ , and  $p_{rt}(\mathbf{s}|\mathbf{a})$ ,  $c_{rt}(\mathbf{a})$  stand for second-order partial derivatives with respect to  $a_r$  and  $a_t$  at  $\mathbf{a}$ .

INSEAD WORKING PAPERS SERIES

			88/12	Spyros MAKRIDAKIS	"Business firms and managers in the 21st century", February 1988
			88/13	Manfred KETS DE VRIES	"Alexithymia in organizational life: the organization man revisited", February 1988.
<u>1988</u>			88/14	Alain NOEL	"The interpretation of strategies: a study of the impact of CEOs on the corporation", March 1988.
88/01	Michael LAWRENCE and Spyros MAKRIDAKIS	"Factors affecting judgemental forecasts and confidence intervals", January 1988.			
88/02	Spyros MAKRIDAKIS	"Predicting recessions and other turning points", January 1988.	88/15	Anil DEOLALIKAR and Lars-Hendrik RÖLLER	"The production of and returns from industrial innovation: an econometric analysis for a developing country", December 1987.
88/03	James TEBOUL	"De-industrialize service for quality", January 1988.			
88/04	Susan SCHNEIDER	"National vs. corporate culture: implications for human resource management", January 1988.	88/16	Gabriel HAWAWINI	"Market efficiency and equity pricing: international evidence and implications for global investing", March 1988.
88/05	Charles WYPLOSZ	"The swinging dollar: is Europe out of step?", January 1988.	88/17	Michael BURDA	"Monopolistic competition, costs of adjustment and the behavior of European employment", September 1987.
88/06	Reinhard ANGELMAR	"Les conflits dans les canaux de distribution", January 1988.	88/18	Michael BURDA	"Reflections on "Wait Unemployment" in Europe", November 1987, revised February 1988.
88/07	Ingemar DIERICKX and Karel COOL	"Competitive advantage: a resource based perspective", January 1988.	88/19	M.J. LAWRENCE and Spyros MAKRIDAKIS	"Individual bias in judgements of confidence", March 1988.
88/08	Reinhard ANGELMAR and Susan SCHNEIDER	"Issues in the study of organizational cognition", February 1988.	88/20	Jean DERMINE, Damien NEVEN and J.F. THISSE	"Portfolio selection by mutual funds, an equilibrium model", March 1988.
88/09	Bernard SINCLAIR- DESGAGNÉ	"Price formation and product design through bidding", February 1988.	88/21	James TEBOUL	"De-industrialize service for quality", March 1988 (88/03 Revised).
88/10	Bernard SINCLAIR- DESGAGNÉ	"The robustness of some standard auction game forms", February 1988.	88/22	Lars-Hendrik RÖLLER	"Proper Quadratic Functions with an Application to AT&T", May 1987 (Revised March 1988).
88/11	Bernard SINCLAIR- DESGAGNÉ	"When stationary strategies are equilibrium bidding strategy: The single-crossing property", February 1988.			

88/23	Sjur Didrik FLAM and Georges ZACCOUR	"Equilibres de Nash-Cournot dans le marché européen du gaz: un cas où les solutions en boucle ouverte et en feedback coïncident", Mars 1988.	88/34	Mihkel M. TOMBAK	"Flexibility: an important dimension in manufacturing", June 1988.
			88/35	Mihkel M. TOMBAK	"A strategic analysis of investment in flexible manufacturing systems", July 1988.
88/24	B. Espen ECKBO and Herwig LANGOHR	"Information disclosure, means of payment, and takeover premia. Public and Private tender offers in France", July 1985, Sixth revision, April 1988.	88/36	Vikas TIBREWALA and Bruce BUCHANAN	"A Predictive Test of the NBD Model that Controls for Non-stationarity", June 1988.
88/25	Everette S. GARDNER and Spyros MAKRIDAKIS	"The future of forecasting", April 1988.	88/37	Murugappa KRISHNAN Lars-Hendrik RÖLLER	"Regulating Price-Liability Competition To Improve Welfare", July 1988.
88/26	Sjur Didrik FLAM and Georges ZACCOUR	"Semi-competitive Cournot equilibrium in multistage oligopolies", April 1988.	88/38	Manfred KETS DE VRIES	"The Motivating Role of Envy : A Forgotten Factor in Management", April 88.
88/27	Murugappa KRISHNAN Lars-Hendrik RÖLLER	"Entry game with resalable capacity", April 1988.	88/39	Manfred KETS DE VRIES	"The Leader as Mirror : Clinical Reflections", July 1988.
88/28	Sumantra GHOSHAL and C. A. BARTLETT	"The multinational corporation as a network: perspectives from interorganizational theory", May 1988.	88/40	Josef LAKONISHOK and Theo VERMAELEN	"Anomalous price behavior around repurchase tender offers", August 1988.
88/29	Naresh K. MALHOTRA, Christian PINSON and Arun K. JAIN	"Consumer cognitive complexity and the dimensionality of multidimensional scaling configurations", May 1988.	88/41	Charles WYPLOSZ	"Assymetry in the EMS: intentional or systemic?", August 1988.
88/30	Catherine C. ECKEL and Theo VERMAELEN	"The financial fallout from Chernobyl: risk perceptions and regulatory response", May 1988.	88/42	Paul EVANS	"Organizational development in the transnational enterprise", June 1988.
88/31	Sumantra GHOSHAL and Christopher BARTLETT	"Creation, adoption, and diffusion of innovations by subsidiaries of multinational corporations", June 1988.	88/43	B. SINCLAIR-DESGAGNÉ	"Group decision support systems implement Bayesian rationality", September 1988.
88/32	Kasra FERDOWS and David SACKRIDER	"International manufacturing: positioning plants for success", June 1988.	88/44	Essam MAHMOUD and Spyros MAKRIDAKIS	"The state of the art and future directions in combining forecasts", September 1988.
88/33	Mihkel M. TOMBAK	"The importance of flexibility in manufacturing", June 1988.	88/45	Robert KORAJCZYK and Claude VIALLET	"An empirical investigation of international asset pricing", November 1986, revised August 1988.
			88/46	Yves DOZ and Amy SHUEN	"From intent to outcome: a process framework for partnerships", August 1988.
			88/47	Alain BULTEZ, Els GUSBRECHTS,	"Asymmetric cannibalism between substitute items listed by retailers", September 1988.

	Philippe NAERT and Piet VANDEN ABBELE		88/59	Martin KILDUFF	"The interpersonal structure of decision making: a social comparison approach to organizational choice", November 1988.
88/48	Michael BURDA	"Reflections on 'Wait unemployment' in Europe, II", April 1988 revised September 1988.	88/60	Michael BURDA	"Is mismatch really the problem? Some estimates of the Chelwood Gate II model with US data", September 1988.
88/49	Nathalie DIERKENS	"Information asymmetry and equity issues", September 1988.	88/61	Lars-Hendrik RÖLLER	"Modelling cost structure: the Bell System revisited", November 1988.
88/50	Rob WEITZ and Arnoud DE MEYER	"Managing expert systems: from inception through updating", October 1987.	88/62	Cynthia VAN HULLE, Theo VERMAELEN and Paul DE WOUTERS	"Regulation, taxes and the market for corporate control in Belgium", September 1988.
88/51	Rob WEITZ	"Technology, work, and the organization: the impact of expert systems", July 1988.	88/63	Fernando NASCIMENTO and Wilfried R. VANHONACKER	"Strategic pricing of differentiated consumer durables in a dynamic duopoly: a numerical analysis", October 1988.
88/52	Susan SCHNEIDER and Reinhard ANGELMAR	"Cognition and organizational analysis: who's minding the store?", September 1988.	88/64	Kasra FERDOWS	"Charting strategic roles for international factories", December 1988.
88/53	Manfred KETS DE VRIES	"Whatever happened to the philosopher-king: the leader's addiction to power, September 1988.	88/65	Arnoud DE MEYER and Kasra FERDOWS	"Quality up, technology down", October 1988
88/54	Lars-Hendrik RÖLLER and Mihkel M. TOMBAK	"Strategic choice of flexible production technologies and welfare implications", October 1988	88/66	Nathalie DIERKENS	"A discussion of exact measures of information asymmetry: the example of Myers and Majluf model or the importance of the asset structure of the firm", December 1988.
88/55	Peter BOSSAERTS and Pierre HILLION	"Method of moments tests of contingent claims asset pricing models", October 1988.	88/67	Paul S. ADLER and Kasra FERDOWS	"The chief technology officer", December 1988.
88/56	Pierre HILLION	"Size-sorted portfolios and the violation of the random walk hypothesis: Additional empirical evidence and implication for tests of asset pricing models", June 1988.	<u>1989</u>		
88/57	Wilfried VANHONACKER and Lydia PRICE	"Data transferability: estimating the response effect of future events based on historical analogy", October 1988.	89/01	Joyce K. BYRER and Tawfik JELASSI	"The impact of language theories on DSS dialog", January 1989.
88/58	B. SINCLAIR-DESGAGNÉ and Mihkel M. TOMBAK	"Assessing economic inequality", November 1988.	89/02	Louis A. LE BLANC and Tawfik JELASSI	"DSS software selection: a multiple criteria decision methodology", January 1989.

89/03	Beth H. JONES and Tawfik JELASSI	"Negotiation support: the effects of computer intervention and conflict level on bargaining outcome", January 1989.	89/13	Manfred KETS DE VRIES	"The impostor syndrome: a disquieting phenomenon in organizational life", February 1989.
89/04	Kasra FERDOWS and Arnoud DE MEYER	"Lasting improvement in manufacturing performance: In search of a new theory", January 1989.	89/14	Reinhard ANGELMAR	"Product innovation: a tool for competitive advantage", March 1989.
89/05	Martin KILDUFF and Reinhard ANGELMAR	"Shared history or shared culture? The effects of time, culture, and performance on institutionalization in simulated organizations", January 1989.	89/15	Reinhard ANGELMAR	"Evaluating a firm's product innovation performance", March 1989.
89/06	Mihkel M. TOMBAK and B. SINCLAIR-DESGAGNÉ	"Coordinating manufacturing and business strategies: I", February 1989.	89/16	Wilfried VANHONACKER, Donald LEHMANN and Fareena SULTAN	"Combining related and sparse data in linear regression models", February 1989.
89/07	Damien J. NEVEN	"Structural adjustment in European retail banking. Some view from industrial organisation", January 1989.	89/17	Gilles AMADO, Claude FAUCHEUX and André LAURENT	"Changement organisationnel et réalités culturelles: contrastes franco-américains", March 1989.
89/08	Arnoud DE MEYER and Hellmut SCHÜTTE	"Trends in the development of technology and their effects on the production structure in the European Community", January 1989.	89/18	Srinivasan BALAK- RISHNAN and Mitchell KOZA	"Information asymmetry, market failure and joint-ventures: theory and evidence", March 1989.
89/09	Damien NEVEN, Carmen MATUTES and Marcel CORSTJENS	"Brand proliferation and entry deterrence", February 1989.	89/19	Wilfried VANHONACKER, Donald LEHMANN and Fareena SULTAN	"Combining related and sparse data in linear regression models", Revised March 1989.
89/10	Nathalie DIERKENS, Bruno GERARD and Pierre HILLION	"A market based approach to the valuation of the assets in place and the growth opportunities of the firm", December 1988.	89/20	Wilfried VANHONACKER and Russell WINER	"A rational random behavior model of choice", Revised March 1989.
89/11	Manfred KETS DE VRIES and Alain NOEL	"Understanding the leader-strategy interface: application of the strategic relationship interview method", February 1989.	89/21	Arnoud de MEYER and Kasra FERDOWS	"Influence of manufacturing improvement programmes on performance", April 1989.
89/12	Wilfried VANHONACKER	"Estimating dynamic response models when the data are subject to different temporal aggregation", January 1989.	89/22	Manfred KETS DE VRIES and Sydney PERZOW	"What is the role of character in psychoanalysis?" April 1989.
			89/23	Robert KORAJCZYK and Claude VIALLET	"Equity risk premia and the pricing of foreign exchange risk" April 1989.
			89/24	Martin KILDUFF and Michel ABOLAFIA	"The social destruction of reality: Organisational conflict as social drama" zApril 1989.

89/25	Roger BETANCOURT and David GAUTSCHI	"Two essential characteristics of retail markets and their economic consequences" March 1989.	89/36	Martin KILDUFF	"A dispositional approach to social networks: the case of organizational choice", May 1989.
89/26	Charles BEAN, Edmond MALINVAUD, Peter BERNHOLZ, Francesco GIAVAZZI and Charles WYPLOSZ	"Macroeconomic policies for 1992: the transition and after", April 1989.	89/37	Manfred KETS DE VRIES	"The organisational fool: balancing a leader's hubris", May 1989.
89/27	David KRACKHARDT and Martin KILDUFF	"Friendship patterns and cultural attributions: the control of organizational diversity", April 1989.	89/38	Manfred KETS DE VRIES	"The CEO blues", June 1989.
89/28	Martin KILDUFF	"The interpersonal structure of decision making: a social comparison approach to organizational choice", Revised April 1989.	89/39	Robert KORAJCZYK and Claude VIALLET	"An empirical investigation of international asset pricing", (Revised June 1989).
89/29	Robert GOGEL and Jean-Claude LARRECHE	"The battlefield for 1992: product strength and geographic coverage", May 1989.	89/40	Balaji CHAKRAVARTHY	"Management systems for innovation and productivity", June 1989.
89/30	Lars-Hendrik ROLLER and Mihkel M. TOMBAK	"Competition and Investment in Flexible Technologies", May 1989.	89/41	B. SINCLAIR-DESGAGNE and Nathalie DIERKENS	"The strategic supply of precisions", June 1989.
89/31	Michael C. BURDA and Stefan GERLACH	"Intertemporal prices and the US trade balance in durable goods", July 1989.	89/42	Robert ANSON and Tawfik JELASSI	"A development framework for computer-supported conflict resolution", July 1989.
89/32	Peter HAUG and Tawfik JELASSI	"Application and evaluation of a multi-criteria decision support system for the dynamic selection of U.S. manufacturing locations", May 1989.	89/43	Michael BURDA	"A note on firing costs and severance benefits in equilibrium unemployment", June 1989.
89/33	Bernard SINCLAIR-DESGAGNÉ	"Design flexibility in monopsonistic industries", May 1989.	89/44	Balaji CHAKRAVARTHY and Peter LORANGE	"Strategic adaptation in multi-business firms", June 1989.
89/34	Sumantra GHOSHAL and Nittin NOHRIA	"Requisite variety versus shared values: managing corporate-division relationships in the M-Form organisation", May 1989.	89/45	Rob WEITZ and Arnoud DE MEYER	"Managing expert systems: a framework and case study", June 1989.
89/35	Jean DERMINE and Pierre HILLION	"Deposit rate ceilings and the market value of banks: The case of France 1971-1981", May 1989.	89/46	Marcel CORSTJENS, Carmen MATUTES and Damien NEVEN	"Entry Encouragement", July 1989.
			89/47	Manfred KETS DE VRIES and Christine MEAD	"The global dimension in leadership and organization: issues and controversies", April 1989.
			89/48	Damien NEVEN and Lars-Hendrik RÖLLER	"European integration and trade flows", August 1989.

89/49	Jean DERMINE	"Home country control and mutual recognition", July 1989.	89/62 (TM)	Arnoud DE MEYER	"Technology strategy and international R&D operations", October 1989.
89/50	Jean DERMINE	"The specialization of financial institutions, the EEC model", August 1989.	89/63 (TM)	Enver YUCESAN and Lee SCHRUBEN	"Equivalence of simulations: A graph approach", November 1989.
89/51	Spyros MAKRIDAKIS	"Sliding simulation: a new approach to time series forecasting", July 1989.	89/64 (TM)	Enver YUCESAN and Lee SCHRUBEN	"Complexity of simulation models: A graph theoretic approach", November 1989.
89/52	Arnoud DE MEYER	"Shortening development cycle times: a manufacturer's perspective", August 1989.	89/65 (TM, AC, FIN)	Soumitra DUTTA and Piero BONISSONE	"MARS: A mergers and acquisitions reasoning system", November 1989.
89/53	Spyros MAKRIDAKIS	"Why combining works?", July 1989.	89/66 (TM,EP)	B. SINCLAIR-DESGAGNÉ	"On the regulation of procurement bids", November 1989.
89/54	S. BALAKRISHNAN and Mitchell KOZA	"Organisation costs and a theory of joint ventures", September 1989.	89/67 (FIN)	Peter BOSSAERTS and Pierre HILLION	"Market microstructure effects of government intervention in the foreign exchange market", December 1989.
89/55	H. SCHUTTE	"Euro-Japanese cooperation in information technology", September 1989.			
89/56	Wilfried VANHONACKER and Lydia PRICE	"On the practical usefulness of meta-analysis results", September 1989.			
			<u>1990</u>		
89/57	Tackwon KIM, Lars-Hendrik RÖLLER and Mihkel TOMBAK	"Market growth and the diffusion of multiproduct technologies", September 1989.	90/01 TM/EP/AC	B. SINCLAIR-DESGAGNÉ	"Unavoidable Mechanisms", January 1990.
89/58 (EP,TM)	Lars-Hendrik RÖLLER and Mihkel TOMBAK	"Strategic aspects of flexible production technologies", October 1989.	90/02 EP	Michael BURDA	"Monopolistic Competition, Costs of Adjustment, and the Behaviour of European Manufacturing Employment", January 1990.
89/59 (OB)	Manfred KETS DE VRIES, Daphna ZEVADI, Alain NOEL and Mihkel TOMBAK	"Locus of control and entrepreneurship: a three-country comparative study", October 1989.	90/03 TM	Arnoud DE MEYER	"Management of Communication in International Research and Development", January 1990.
89/60 (TM)	Enver YUCESAN and Lee SCHRUBEN	"Simulation graphs for design and analysis of discrete event simulation models", October 1989.	90/04 FIN/EP	Gabriel HAWAWINI and Eric RAJENDRA	"The Transformation of the European Financial Services Industry: From Fragmentation to Integration", January 1990.
89/61 (All)	Susan SCHNEIDER and Arnoud DE MEYER	"Interpreting and responding to strategic issues: The impact of national culture", October 1989.	90/05 FIN/EP	Gabriel HAWAWINI and Bertrand JACQUILLAT	"European Equity Markets: Toward 1992 and Beyond", January 1990.

90/06 FIN/EP	Gabriel HAWAWINI and Eric RAJENDRA	"Integration of European Equity Markets: Implications of Structural Change for Key Market Participants to and Beyond 1992", January 1990.	90/17 FIN	Nathalie DIERKENS	"Information Asymmetry and Equity Issues", Revised January 1990.
90/07 FIN/EP	Gabriel HAWAWINI	"Stock Market Anomalies and the Pricing of Equity on the Tokyo Stock Exchange", January 1990.	90/18 MKT	Wilfried VANHONACKER	"Managerial Decision Rules and the Estimation of Dynamic Sales Response Models", Revised January 1990.
90/08 TM/EP	Tawfik JELASSI and B. SINCLAIR-DESGAGNÉ	"Modelling with MCDSS: What about Ethics?", January 1990.	90/19 TM	Beth JONES and Tawfik JELASSI	"The Effect of Computer Intervention and Task Structure on Bargaining Outcome", February 1990.
90/09 EP/FIN	Alberto GIOVANNINI and Jac WON PARK	"Capital Controls and International Trade Finance", January 1990.	90/20 TM	Tawfik JELASSI, Gregory KERSTEN and Stanley ZIONTS	"An Introduction to Group Decision and Negotiation Support", February 1990.
90/10 TM	Joyce BRYER and Tawfik JELASSI	"The Impact of Language Theories on DSS Dialog", January 1990.	90/21 FIN	Roy SMITH and Ingo WALTER	"Reconfiguration of the Global Securities Industry in the 1990's", February 1990.
90/11 TM	Enver YUCESAN	"An Overview of Frequency Domain Methodology for Simulation Sensitivity Analysis", January 1990.	90/22 FIN	Ingo WALTER	"European Financial Integration and Its Implications for the United States", February 1990.
90/12 EP	Michael BURDA	"Structural Change, Unemployment Benefits and High Unemployment: A U.S.-European Comparison", January 1990.	90/23 EP/SM	Damien NEVEN	"EEC Integration towards 1992: Some Distributional Aspects", Revised December 1989
90/13 TM	Soumitra DUTTA and Shashi SHEKHAR	"Approximate Reasoning about Temporal Constraints in Real Time Planning and Search", January 1990.	90/24 FIN/EP	Lars Tyge NIELSEN	"Positive Prices in CAPM", January 1990.
90/14 TM	Albert ANGEHRN and Hans-Jakob LÜTHI	"Visual Interactive Modelling and Intelligent DSS: Putting Theory Into Practice", January 1990.	90/25 FIN/EP	Lars Tyge NIELSEN	"Existence of Equilibrium in CAPM", January 1990.
90/15 TM	Arnoud DE MEYER, Dirk DESCHOOLMEESTER, Rudy MOENAERT and Jan BARBE	"The Internal Technological Renewal of a Business Unit with a Mature Technology", January 1990.	90/26 OB/BP	Charles KADUSHIN and Michael BRIMM	"Why networking Fails: Double Binds and the Limitations of Shadow Networks", February 1990.
90/16 FIN	Richard LEVICH and Ingo WALTER	"Tax-Driven Regulatory Drag: European Financial Centers in the 1990's", January 1990.	90/27 TM	Abbas FOROUGHI and Tawfik JELASSI	"NSS Solutions to Major Negotiation Stumbling Blocks", February 1990.
			90/28 TM	Arnoud DE MEYER	"The Manufacturing Contribution to Innovation", February 1990.

90/29 FIN/AC	Nathalie DIERKENS	"A Discussion of Correct Measures of Information Asymmetry", January 1990.	90/40 OB	Manfred KETS DE VRIES	"Leaders on the Couch: The case of Roberto Calvi", April 1990.
90/30 FIN/EP	Lars Tyge NIELSEN	"The Expected Utility of Portfolios of Assets", March 1990.	90/41 FIN/EP	Gabriel HAWAWINI, Itzhak SWARY and Ik HWAN JANG	"Capital Market Reaction to the Announcement of Interstate Banking Legislation", March 1990.
90/31 MKT/EP	David GAUTSCHI and Roger BETANCOURT	"What Determines U.S. Retail Margins?", February 1990.	90/42 MKT	Joel STECKEL and Wilfried VANHONACKER	"Cross-Validating Regression Models in Marketing Research", (Revised April 1990).
90/32 SM	Srinivasan BALAK- RISHNAN and Mitchell KOZA	"Information Asymmetry, Adverse Selection and Joint-Ventures: Theory and Evidence", Revised, January 1990.	90/43 FIN	Robert KORAJCZYK and Claude VIALLET	"Equity Risk Premia and the Pricing of Foreign Exchange Risk", May 1990.
90/33 OB	Caren SIEHL, David BOWEN and Christine PEARSON	"The Role of Rites of Integration in Service Delivery", March 1990.	90/44 OB	Gilles AMADO, Claude FAUCHEUX and André LAURENT	"Organisational Change and Cultural Realities: Franco-American Contrasts", April 1990.
90/34 FIN/EP	Jean DERMINE	"The Gains from European Banking Integration, a Call for a Pro-Active Competition Policy", April 1990.	90/45 TM	Soumitra DUTTA and Piero BONISSONE	"Integrating Case Based and Rule Based Reasoning: The Possibilistic Connection", May 1990.
90/35 EP	Jae Won PARK	"Changing Uncertainty and the Time-Varying Risk Premia in the Term Structure of Nominal Interest Rates", December 1988, Revised March 1990.	90/46 TM	Spyros MAKRIDAKIS and Michèle HIBON	"Exponential Smoothing: The Effect of Initial Values and Loss Functions on Post-Sample Forecasting Accuracy".
90/36 TM	Arnoud DE MEYER	"An Empirical Investigation of Manufacturing Strategies in European Industry", April 1990.	90/47 MKT	Lydia PRICE and Wilfried VANHONACKER	"Improper Sampling in Natural Experiments: Limitations on the Use of Meta-Analysis Results in Bayesian Updating", Revised May 1990.
90/37 TM/OB/SM	William CATS-BARIL	"Executive Information Systems: Developing an Approach to Open the Possibles", April 1990.	90/48 EP	Jae WON PARK	"The Information in the Term Structure of Interest Rates: Out-of-Sample Forecasting Performance", June 1990.
90/38 MKT	Wilfried VANHONACKER	"Managerial Decision Behaviour and the Estimation of Dynamic Sales Response Models", (Revised February 1990).	90/49 TM	Soumitra DUTTA	"Approximate Reasoning by Analogy to Answer Null Queries", June 1990.
90/39 TM	Louis LE BLANC and Tawfik JELASSI	"An Evaluation and Selection Methodology for Expert System Shells", May 1990.	90/50 EP	Daniel COHEN and Charles WYPLOSZ	"Price and Trade Effects of Exchange Rates Fluctuations and the Design of Policy Coordination", April 1990.

90/51 EP	Michael BURDA and Charles WYPLOSZ	"Gross Labour Market Flows in Europe: Some Stylized Facts", June 1990.	90/63 SM	Sumantra GHOSHAL and Eleanor WESTNEY	"Organising Competitor Analysis Systems", August 1990
90/52 FIN	Lars Tyege NIELSEN	"The Utility of Infinite Menus", June 1990.	90/64 SM	Sumantra GHOSHAL	"Internal Differentiation and Corporate Performance: Case of the Multinational Corporation", August 1990
90/53 EP	Michael Burda	"The Consequences of German Economic and Monetary Union", June 1990.	90/65 EP	Charles WYPLOSZ	"A Note on the Real Exchange Rate Effect of German Unification", August 1990
90/54 EP	Damien NEVEN and Colin MEYER	"European Financial Regulation: A Framework for Policy Analysis", (Revised May 1990).	90/66 TM/SE/FIN	Soumitra DUTTA and Piero BONISSONE	"Computer Support for Strategic and Tactical Planning in Mergers and Acquisitions", September 1990
90/55 EP	Michael BURDA and Stefan GERLACH	"Intertemporal Prices and the US Trade Balance", (Revised July 1990).	90/67 TM/SE/FIN	Soumitra DUTTA and Piero BONISSONE	"Integrating Prior Cases and Expert Knowledge In a Mergers and Acquisitions Reasoning System", September 1990
90/56 EP	Damien NEVEN and Lars-Hendrik RÖLLER	"The Structure and Determinants of East-West Trade: A Preliminary Analysis of the Manufacturing Sector", July 1990	90/68 TM/SE	Soumitra DUTTA	"A Framework and Methodology for Enhancing the Business Impact of Artificial Intelligence Applications", September 1990
90/57 FIN/EP/ TM	Lars Tyege NIELSEN	Common Knowledge of a Multivariate Aggregate Statistic", July 1990	90/69 TM	Soumitra DUTTA	"A Model for Temporal Reasoning in Medical Expert Systems", September 1990
90/58 FIN/EP/TM	Lars Tyege NIELSEN	"Common Knowledge of Price and Expected Cost in an Oligopolistic Market", August 1990	90/70 TM	Albert ANGEHRN	"'Triple C': A Visual Interactive MCDSS", September 1990
90/59 FIN	Jean DERMINE and Lars-Hendrik RÖLLER	"Economies of Scale and Scope in the French Mutual Funds (SICAV) Industry", August 1990	90/71 MKT	Philip PARKER and Hubert GATIGNON	"Competitive Effects in Diffusion Models: An Empirical Analysis", September 1990
90/60 TM	Peri IZ and Tawfik JELASSI	"An Interactive Group Decision Aid for Multiobjective Problems: An Empirical Assessment", September 1990	90/72 TM	Enver YÜCESAN	"Analysis of Markov Chains Using Simulation Graph Models", October 1990
90/61 TM	Pankaj CHANDRA and Mihkel TOMBAK	"Models for the Evaluation of Manufacturing Flexibility", August 1990	90/73 TM	Arnoud DE MEYER and Kasra FERDOWS	"Removing the Barriers in Manufacturing", October 1990
90/62 EP	Damien NEVEN and Menno VAN DIJK	"Public Policy Towards TV Broadcasting in the Netherlands", August 1990	90/74 SM	Sumantra GHOSHAL and Nitin NOHRIA	"Requisite Complexity: Organising Headquarters- Subsidiary Relations in MNCs", October 1990

90/75 MKT	Roger BETANCOURT and David GAUTSCHI	"The Outputs of Retail Activities: Concepts, Measurement and Evidence", October 1990	90/87 FIN/EP	Lars Tyge NIELSEN	"Existence of Equilibrium in CAPM: Further Results", December 1990
90/76 MKT	Wilfried VANHONACKER	"Managerial Decision Behaviour and the Estimation of Dynamic Sales Response Models", Revised October 1990	90/88 OIB/MKT	Susan C. SCHNEIDER and Reinhard ANGELMAR	"Cognition in Organisational Analysis: Who's Minding the Store?" Revised, December 1990
90/77 MKT	Wilfried VANHONACKER	"Testing the Kozyck Scheme of Sales Response to Advertising: An Aggregation-Independent Autocorrelation Test", October 1990	90/89 OB	Manfred F.R. KETS DE VRIES	"The CEO Who Couldn't Talk Straight and Other Tales from the Board Room," December 1990
90/78 EP	Michael BURDA and Stefan GERLACH	"Exchange Rate Dynamics and Currency Unification: The Ostmark - DM Rate", October 1990	90/90 MKT	Philip PARKER	"Price Elasticity Dynamics over the Adoption Lifecycle: An Empirical Study," December 1990
90/79 TM	Anil GABA	"Inferences with an Unknown Noise Level in a Bernoulli Process", October 1990			
90/80 TM	Anil GABA and Robert WINKLER	"Using Survey Data in Inferences about Purchase Behaviour", October 1990	1991		
90/81 TM	Tawfik JELASSI	"Du Présent au Futur: Bilan et Orientations des Systèmes Interactifs d'Aide à la Décision," October 1990	91/01 TM/SM	Luk VAN WASSENHOVE, Leonard FORTUIN and Paul VAN BEEK	"Operational Research Can Do More for Managers Than They Think!," January 1991
90/82 EP	Charles WYPLOSZ	"Monetary Union and Fiscal Policy Discipline," November 1990	91/02 TM/SM	Luk VAN WASSENHOVE, Leonard FORTUIN and Paul VAN BEEK	"Operational Research and Environment," January 1991
90/83 FIN/TM	Nathalie DIERKENS and Bernard SINCLAIR-DESGAGNE	"Information Asymmetry and Corporate Communication: Results of a Pilot Study", November 1990	91/03 FIN	Pekka HIETALA and Timo LÖYTTYNIEMI	"An Implicit Dividend Increase in Rights Issues: Theory and Evidence," January 1991
90/84 MKT	Philip M. PARKER	"The Effect of Advertising on Price and Quality: The Optometric Industry Revisited," December 1990	91/04 FIN	Lars Tyge NIELSEN	"Two-Fund Separation, Factor Structure and Robustness," January 1991
90/85 MKT	Avijit GHOSH and Vikas TIBREWALA	"Optimal Timing and Location in Competitive Markets," November 1990	91/05 OB	Susan SCHNEIDER	"Managing Boundaries in Organisations," January 1991
90/86 EP/TM	Olivier CADOT and Bernard SINCLAIR-DESGAGNE	"Prudence and Success in Politics," November 1990	91/06 OB	Manfred KETS DE VRIES, Danny MILLER and Alain NOEL	"Understanding the Leader-Strategy Interface: Application of the Strategic Relationship Interview Method," January 1990 (89/11, revised April 1990)

91/07 EP	Olivier CADOT	"Lending to Insolvent Countries: A Paradoxical Story," January 1991	91/19 MKT	Vikas TIBREWALA and Bruce BUCHANAN	"An Aggregate Test of Purchase Regularity", March 1991
91/08 EP	Charles WYPLOSZ	"Post-Reform East and West: Capital Accumulation and the Labour Mobility Constraint," January 1991	91/20 MKT	Darius SABAVALA and Vikas TIBREWALA	"Monitoring Short-Run Changes in Purchasing Behaviour", March 1991
91/09 TM	Spyros MAKRIDAKIS	"What can we Learn from Failure?", February 1991	91/21 SM	Sumantra GHOSHAL, Harry KORINE and Gabriel SZULANSKI	"Interunit Communication within MNCs: The Influence of Formal Structure Versus Integrative Processes", April 1991
91/10 TM	Luc Van WASSENHOVE and C. N. POTTS	"Integrating Scheduling with Batching and Lot-Sizing: A Review of Algorithms and Complexity", February 1991	91/22 EP	David GOOD, Lars-Hendrik RÖLLER and Robin SICKLES	"EC Integration and the Structure of the Franco-American Airline Industries: Implications for Efficiency and Welfare", April 1991
91/11 TM	Luc VAN WASSENHOVE et al.	"Multi-Item Lotsizing in Capacitated Multi-Stage Serial Systems", February 1991	91/23 TM	Spyros MAKRIDAKIS and Michèle HIBON	"Exponential Smoothing: The Effect of Initial Values and Loss Functions on Post-Sample Forecasting Accuracy", April 1991 (Revision of 90/46)
91/12 TM	Albert ANGEHRN	"Interpretative Computer Intelligence: A Link between Users, Models and Methods in DSS", February 1991	91/24 TM	Louis LE BLANC and Tawfik JELASSI	"An Empirical Assessment of Choice Models for Software Evaluation and Selection", May 1991
91/13 EP	Michael BURDA	"Labor and Product Markets in Czechoslovakia and the Ex-GDR: A Twin Study", February 1991	91/25 SM/TM	Luk N. VAN WASSENHOVE and Charles J. CORBETT	"Trade-Offs? What Trade-Offs?" April 1991
91/14 MKT	Roger BETANCOURT and David GAUTSCHI	"The Output of Retail Activities: French Evidence", February 1991			
91/15 OB	Manfred F.R. KETS DE VRIES	"Exploding the Myth about Rational Organisations and Executives", March 1991			
91/16 TM	Arnoud DE MEYER and Kasra FERDOWS et al.	"Factories of the Future: Executive Summary of the 1990 International Manufacturing Futures Survey", March 1991			
91/17 TM	Dirk CATTRYSSE, Roelof KUIK, Marc SALOMON and Luk VAN WASSENHOVE	"Heuristics for the Discrete Lotsizing and Scheduling Problem with Setup Times", March 1991			
91/18 TM	C.N. POTTS and Luk VAN WASSENHOVE	"Approximation Algorithms for Scheduling a Single Machine to Minimize Total Late Work", March 1991			

91/30 MKT	Wilfried R. VANHONACKER and Lydia J. PRICE	"Using Meta-Analysis Results in Bayesian Updating: The Empty Cell Problem", June 1991	91/43 SM	Sumantra GHOSHAL and Christopher BARTLETT	"Building Transnational Capabilities: The Management Challenge", September 1991
91/31 FIN	Rezaul KABIR and Theo VERMAELEN	"Insider Trading Restrictions and the Stock Market", June 1991	91/44 SM	Sumantra GHOSHAL and Nitin NOHRIA	"Distributed Innovation in the 'Differentiated Network' Multinational", September 1991
91/32 OB	Susan C. SCHNEIDER	"Organisational Sensemaking: 1992", June 1991	91/45 MKT	Philip M. PARKER	"The Effect of Advertising on Price and Quality: An Empirical Study of Eye Examinations, Sweet Lemons and Self-Deceivers", September 1991
91/33 EP	Michael C. BURDA and Michael FUNKE	"German Trade Unions after Unification - Third Degree Wage Discriminating Monopolists?", June 1991	91/46 MKT	Philip M. PARKER	"Pricing Strategies in Markets with Dynamic Elasticities", October 1991
91/34 FIN	Jean DERMINE	"The BIS Proposal for the Measurement of Interest Rate Risk, Some Pitfalls", June 1991	91/47 MKT	Philip M. PARKER	"A Study of Price Elasticity Dynamics Using Parsimonious Replacement/Multiple Purchase Diffusion Models", October 1991
91/35 FIN	Jean DERMINE	"The Regulation of Financial Services in the EC, Centralization or National Autonomy?" June 1991			
91/36 TM	Albert ANGEHRN	"Supporting Multicriteria Decision Making: New Perspectives and New Systems", August 1991			
91/37 EP	Ingo WALTER and Hugh THOMAS	"The Introduction of Universal Banking in Canada: An Event Study", August 1991			
91/38 EP	Ingo WALTER and Anthony SAUNDERS	"National and Global Competitiveness of New York City as a Financial Center", August 1991			
91/39 EP	Ingo WALTER and Anthony SAUNDERS	"Reconfiguration of Banking and Capital Markets in Eastern Europe", August 1991			
91/40 TM	Luk VAN WASSENHOVE, Dirk CATTRYSSE and Marc SALOMON	"A Set Partitioning Heuristic for the Generalized Assignment Problem", August 1991			
91/41 TM	Luk VAN WASSENHOVE, M.Y. KOVALYOU and C.N. POTTS	"A Fully Polynomial Approximation Scheme for Scheduling a Single Machine to Minimize Total Weighted Late Work", August 1991			
91/42 TM	Rob R. WEITZ and Tawfik JELASSI	"Solving A Multi-Criteria Allocation Problem: A Decision Support System Approach", August 1991			