

JEAN-JACQUES LAFFONT: A LOOK BACK

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Jean-Jacques Laffont, economist extraordinaire and visionary founder of the Institut de l'Economie Industrielle (IDEI) in Toulouse, died at his home in Colomiers on May 1 after a valiant battle against cancer. He was fifty-seven years old.

Laffont is remarkable for having had three distinct professional identities and for performing at the very highest level in all of them.

First, he was one of the great economists of our time. He was instrumental in transforming public economics, regulatory economics, and the economics of organizations into fields of study that put primary emphasis on conflicts in incentives. In a dozen books and many scores of articles, he examined these conflicts, which arise when the objectives of a society, industry, or organization differ from those of the agents (e.g., people or firms) that belong to them.

Second, as an institution builder, Laffont assembled a formidable array of economic talent at IDEI, now one of the finest educational and research groups in the world. Somehow Laffont overcame the gravitational attraction of Paris and brought this talent to Toulouse—then a relative backwater. On a continent where universities are supported by the state, he put an alternative model on display: IDEI's funders come largely from the corporate world. They support the basic research vital to the intellectual life of the place in exchange for expert advice from IDEI's economists. Laffont not only invented this imaginative approach to funding research but personally attracted most of the partner firms that support IDEI today.

Third, he proved to be a forceful and influential policy advisor on regulation, competition, and economic development. More than most other theorists, he was a natural in this role. Even his purest theoretical papers were invariably motivated by issues of genuine practical consequence, and his scientific work provided a remarkably coherent and detailed conception of the role of public intervention.

Jean-Jacques Laffont was born in Toulouse on April 13, 1947. Educated in mathematics and economics at the University of Toulouse and ENSAE in Paris, he

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completed his doctorate under Kenneth Arrow at Harvard in 1975. He then taught first at the Ecole Polytechnique in Paris and, after passing the "Aggrégation,"¹ briefly at the University of Amiens. But he lost little time before returning to Toulouse in 1978. At the university he created GREMAQ (Groupe de Recherche en Economie Mathématique et Quantitative) in 1981 and IDEI in 1990; he directed the Institut until illness forced him to step down in 2002. Toulouse remained his home to the end, although he traveled frequently and held visiting positions at many places including Caltech and Harvard. Beginning in 2001, he spent part of his time at the University of Southern California, where he was named Distinguished Professor earlier this year. He is survived by Colette, his wife of 33 years; his three daughters, Cécile, Bénédicte, and Charlotte; and his son, Bertrand.

Laffont was showered with many honors and awards in recognition of his work. To mention only a few: He received the first Yrjö-Jahnsson Prize (jointly with Jean Tirole) from the European Economic Association; he served as president of both the European Economic Association and the Econometric Society; he was elected an honorary fellow of both the American Academy of Arts and Sciences and the American Economic Association, and in 2002 he was named Officer de la Légion d' Honneur.

1. Public Decision Making

Laffont first came to international prominence for his work with Jerry Green on incentives in public decision making. Imagine that society must choose from a set of possible public alternatives A . If society consists of n individuals, $1, \dots, n$, then, in principle, a social planner would like to choose the alternatives a^* that is optimal in the sense that

$$a^* = \arg \max_{a \in A} \sum_{i=1}^n v_i(a), \quad (1)$$

where $v_i(a)$ is individual i 's utility for alternative a (individual i 's overall utility is $v_i(a) + t_i$, where t_i is a monetary transfer). Suppose, however, that the planner does not know individuals' utility functions. He could ask individuals to report them, but they might well not have the incentive to do so truthfully.

Groves (1973) and Clarke (1971) proposed transfer mechanisms for solving this incentive problem. Specifically, Clarke showed that if, when individuals

1. This is the mandatory exam for those aspiring to senior positions in French universities. Laffont was a pioneer among French economists with foreign Ph.D.'s to surmount this hurdle.

report utility functions $(\hat{v}_1, \dots, \hat{v}_n)$, alternative \hat{a} is selected to solve

$$\hat{a} = \arg \max_{a \in A} \sum_{i=1}^n \hat{v}_i(a), \quad (2)$$

and each individual i is given monetary transfer

$$t_i(\hat{v}_1, \dots, \hat{v}_n) = \sum_{j \neq i} \hat{v}_j(\hat{a}) - \max_{a \in A} \sum_{j \neq i} \hat{v}_j(a), \quad (3)$$

then it is a dominant strategy for individual i to report $\hat{v}_i = v_i$ (i.e., regardless of what the others do, individual i is best off reporting truthfully), and so, from (1) and (2), the optimal alternative a^* is the equilibrium outcome.²

This mechanism, although very influential, is only one example from a large class of "satisfactory" mechanisms, ones in which (a) truth-telling is a dominant strategy and (b) the optimal alternative a^* is implemented. It was clearly an important outstanding problem to characterize the class of all satisfactory mechanisms. Green and Laffont (1977) provided the solution; they showed that the satisfactory class consists of mechanisms in which individual i 's transfer takes the form

$$t_i(\hat{v}_1, \dots, \hat{v}_n) = \sum_{j \neq i} \hat{v}_j(\hat{a}) + k(v_{-i}), \quad (4)$$

where v_{-i} is the vector of all utility functions but individual i 's.³

In a sequence of articles (Green and Laffont 1978, 1979a, and 1979b) and an influential monograph (Green and Laffont 1979c), Green and Laffont derived many implications from this characterization. For example, they showed that there exists no satisfactory scheme in which (a) the transfers *balance*, that is, in which they sum to zero; or (b) truth telling constitutes a dominant strategy for *coalitions*. In part 3 of Green and Laffont (1979c), they examined the possibility of satisfying such properties as (a) and (b) in a *statistical* sense. For example, they demonstrated that, for large n , one can find satisfactory mechanisms that, with arbitrarily high probability, make per capita imbalance and the probability of untruthfulness by a coalition of a given size as small as one likes.

Green and Laffont imposed no differentiability assumptions on utility functions. Laffont and Maskin (1980) showed that if individual i 's possible preferences

2. Notice that individual i 's transfer does not directly depend on his report and thus resembles the payment rule in a second-price or "Vickrey" auction. Hence, this scheme is sometimes called the Vickrey-Clarke-Groves mechanism.

3. Green and Laffont (1977) also included an early enunciation of the *revelation principle*, the idea that in searching for mechanisms to achieve particular ends, it generally suffices (if one ignores multiple equilibria) to restrict attention to *direct revelation mechanisms*, in which individuals simply announce their preferences and, in equilibrium, do so truthfully.

can be expressed as the class $\{v_i(\cdot, \theta_i)\}_{\theta_i \in \Theta_i}$, where $v_i(a, \theta_i)$ is differentiable in a and θ , then the conclusion that for satisfactory mechanisms, transfers must take the form (4) follows directly from integrating the first-order condition for truth telling by individual i ,⁴ the function $k(v_{-i})$ falls out as a constant of integration. Many others results, such as the conclusions above about balanced transfers and coalitions, follow equally easily with this approach.

Green and Laffont's demonstration that satisfactory mechanisms do not have balanced transfers led d'Aspremont and Gérard-Varet (1979) to weaken the dominant-strategy requirement and demand only that truth telling constitute a *Bayesian-Nash-Equilibrium*. For that equilibrium concept, they showed that balanced transfers are possible when the θ_i 's are distributed independently. Assuming differentiability as in Laffont and Maskin (1980), Laffont and Maskin (1979a) characterized the entire class of such mechanisms (i.e., those in which truth telling is a Bayesian Equilibrium, the outcome is optimal alternative a^* , and transfers balance). They demonstrated, moreover, that if there exists a positive measure of parameter values $(\theta_1, \dots, \theta_n)$ such that $v_i(a^*, \theta_i) < 0$, for some i , then *no* mechanism from that class satisfies *individual rationality* in the sense that

$$E_{v_{-i}}[v_i(a^*, \theta_i) + t_i] \geq 0 \quad \text{for all } i \text{ and } \theta_i,$$
⁵

where $E_{v_{-i}}$ denotes the expectation with respect to the other individuals' utility functions v_{-i} .⁶

2. Regulation

Inspired by a renewed concern in Europe and the United States over how natural monopolies and oligopolies should be regulated, Laffont's main work on incentive issues next shifted to models of regulation,⁷ largely in collaboration with Jean Tirole. Much of their joint work was consolidated in the treatise Laffont and Tirole (1993). The following are some of their findings.

4. A closely related result was obtained by Holmstrom (1979).

5. This is essentially the same as the main result obtained by Myerson and Satterthwaite (1983). The latter paper specializes to the case where $n = 2$ and a "public decision" consists of the exchange of a good and a payment between the two individuals; unlike Laffont and Maskin (1979a), it does not assume differentiability.

6. Additional results using the differentiable approach to incentives were developed in Laffont and Maskin (1979b) and (1982). In particular, the former showed that one cannot find satisfactory mechanisms in which richer individuals receive lower transfers. Much of the work on differentiability was summarized in Laffont and Maskin (1983).

7. At the same time Laffont worked on regulation, he continued to explore other sorts of incentive problems. In particular, Guesnerie and Laffont (1984) provided a rigorous analysis of a general class of principal-agent models featuring adverse selection; Laffont, Maskin, and Rochet (1987) studied optimal price discrimination by a monopolist when buyers' preference parameters θ_i are two-dimensional.

A typical Laffont-Tirole regulatory model consists of a regulator and a single firm whose cost of production (suppose that only one level of production is possible) is

$$C = \theta - e + \tilde{\varepsilon},$$

where e is the firm's effort to reduce cost; $\theta \in [\underline{\theta}, \bar{\theta}]$ is a parameter known only to the firm and drawn from cumulative distribution function $F(\theta)$; and $\tilde{\varepsilon}$ is a random variable with mean zero. If the regulator reimburses the firm for its production cost, then the firm's utility U is

$$U = t - c(e),$$

where $c(e)$, a convex and increasing function, is the cost of effort, and t is a monetary transfer beyond the reimbursement of cost C . The regulator, representing the overall welfare of society (including that of the firm), has utility

$$S - (1 + \lambda)(t + C) + U,$$

where S is the social benefit of the firm's production, and λ is the marginal deadweight loss from the taxes needed to finance the gross transfer $t + C$.

If, for now, we omit $\tilde{\varepsilon}$, the regulator's problem amounts to finding an incentive scheme $(t(\theta), C(\theta))$ that solves

$$\max \int_{\underline{\theta}}^{\bar{\theta}} [S - (1 + \lambda)(t(\theta) + C(\theta)) + U(\theta)] dF(\theta) \quad (5)$$

subject to

$$U(\theta) = t(\theta) - c(\theta - C(\theta)) \geq t(\hat{\theta}) - c(\theta - C(\hat{\theta})) \quad \text{for all } \theta, \hat{\theta} \quad (6)$$

and

$$U(\bar{\theta}) \geq 0, \quad (7)$$

where (6) comprises the firm's incentive constraints, and (7) constitutes its individual rationality constraint.

Following Mirrlees (1971), one can show that the optimal scheme $(t^*(\theta), C^*(\theta))$ has the properties that (a) if it has the highest cost (i.e., $\theta = \bar{\theta}$), the firm enjoys no surplus (i.e., (7) is binding), but surplus is positive for every $\theta < \bar{\theta}$ (i.e., $U(\theta) > 0$); and (b) effort is efficient for the lowest cost (i.e., $c'(\underline{\theta} - C^*(\underline{\theta})) = 1$) out below the efficient level for all $\theta > \underline{\theta}$ (i.e., $c'(\theta - C^*(\theta)) < 1$).

Laffont and Tirole (1986) showed that one can choose scalars $a(\hat{\theta})$ and $b(\hat{\theta})$, for all $\hat{\theta}$, such that $(t^*(\theta), C^*(\theta))$ can be decentralized as a menu of linear contracts

$$t = a(\hat{\theta}) - b(\hat{\theta})(C - C^*(\hat{\theta})), \quad (8)$$

where C is the actual production cost. In other words, the regulator can implement the optimal scheme by letting the firm select the contract it prefers from among the menu (8); for suitably chosen scalars, the firm will, in fact, choose the one for which $\hat{\theta} = \theta$. Indeed, because (8) is linear in C and the firm is assumed to be risk-neutral,⁸ this menu will implement the optimum even when we reintroduce the noise term $\tilde{\varepsilon}$.

Next, suppose that there are *several* alternative firms that could produce the same good but that is too costly to have more than one do so. Then, it is desirable to have a *competition* among the firms for the right to become a regulated monopolist. Laffont and Tirole (1987) established that, if the different firms' cost parameters θ are drawn independently from the distribution $F(\theta)$, then under standard regularity conditions the *optimal* competition (from the standpoint of maximizing the regulator's payoff) takes the form of an *auction* in which each firm makes a monetary bid to become the monopolist, and the winner is the high bidder and pays the second-highest bid. Furthermore, the winner should be confronted with the same menu of contracts as in the preceding paragraph. Thus, the effect of competition is only to reduce (but not eliminate) the net transfer that is made to the monopolist; in particular, the winning firm's effort is the *same* as though it had no competitors.

Now let us suppose that the one-period model is extended to two periods, and that the firm produces in both (maintaining the same cost parameter θ throughout). Assume that the firm and regulator share the same discount rate. If ex ante the regulator could offer the firm a menu of two-period contracts, then, as Baron and Besanko (1984) showed, the optimum would simply repeat the optimal one-period contract. Matters are different, however, when the regulator cannot commit in advance to a second-period agreement. In that case, Laffont and Tirole (1988) proved that there must be a nondegenerate interval of cost parameters such that, for all θ in the interval, the firm chooses the *same* first-period contract, i.e., there is *pooling*. The idea is that a firm will be reluctant to reveal its true θ because if it did so, the regulator would be able to extract all its surplus in the second period.

Finally, imagine that the regulator can hire an inspector who, with some probability, can verifiably determine the firm's true θ . Such a determination, if turned over to the regulator, would enable him to extract all surplus from a firm with cost parameter $\theta < \bar{\theta}$. Thus, the firm has an incentive to bribe the inspector to keep quiet. Laffont and Tirole (1991) demonstrated that to minimize the welfare loss from such bribery it is optimal to lower the *power* of the incentive scheme. That is, the regulator should choose a smaller gradient $U'(\theta)$ than in the case where bribery is ruled out.

8. Laffont and Rochet (1998) generalized the analysis to handle risk-averse firms.

3. Collusion in Organizations

Laffont's last extended exploration of incentive issues focused on collusion in organizations. This reflected his conviction, based in part on his direct observation, that manipulation of information by coalitions of agents (e.g., the firm bribing the inspector to keep him quiet in the model of the preceding paragraph) is a major constraint on the performance of bureaucracies such as corporations and governments. He conducted much of his work in this area in collaboration with David Martimort.

Laffont and Martimort (1997) set out a useful methodology for studying collusion in a principal-multiagent setting. They supposed that first a third party (the collusion coordinator) proposes a contract under which the agents $1, \dots, n$, agree to share all transfers from the principal equally. Then, the agents privately learn their preference parameters $\theta_1, \dots, \theta_n$. Next, the principal specifies a mechanism that assigns a transfer to each agent as a function of the public announcements $\hat{\theta}_1, \dots, \hat{\theta}_n$ that agents make later. After that, the collusion coordinator offers the agents a side contract in which their public announcements are prescribed by what they tell the coordinator their parameters are. The contract also specifies transfers that give them the incentive to tell the coordinator the truth (this makes explicit the idea that collusion is subject to the same sort of incentive constraints as any other kind of agreement). In the final stage, the coordinator's side contract is executed, and the actions and transfers specified by the principal's mechanism are carried out.

One notable application of this framework was developed in Laffont and Martimort (2000). Researchers had been troubled by the stark difference between principal-multiagent problems in which agents' information parameters are drawn independently and those where they are correlated. Recall the regulatory model with competition from Section 2, where it was noted that competition reduces but does not eliminate the winning firm's surplus and does not affect the "distortion" of the winner's effort (recall that e is below the efficient level for all $\theta > \underline{\theta}$). This conclusion depends crucially on the different firms' cost parameters being independent; matters change dramatically as soon as the θ 's are correlated. Using the methods of Crémer and McLean (1988), the regulator in the latter case can devise an incentive scheme that (a) extracts all surplus from the winning firm, and (b) induces the efficient level of effort.

Laffont and Martimort (2000) observed, however, that Crémer-McLean mechanisms are not immune to collusion by agents. More significantly, they showed that once one takes the constraints induced by the possibility of collusion into account, the above discontinuity *vanishes*. That is, the nature of the optimal incentive scheme changes *continuously* as one passes from the case of correlation to that of independence.

4. More Incentives

The previous three sections sketch Laffont's work on incentives in the three areas that preoccupied him most. But he strongly believed that incentives are at the heart of many other fields of economics, and undertook significant research into some of these fields himself. For example, Laffont (1999), (2000), Jeon and Laffont (1999), and Laffont and Martimort (1999) explored incentive issues that arise in political economy; Laffont and Tirole (1996) and Boyer and Laffont (1999) did the same for environmental issues, while Laffont and N'Guessan (1999) and Laffont and Meleu (1999) did so for development.⁹ Indeed, toward the end of his life, Laffont increasingly focused on the problems of emerging economies, both as researcher and policy consultant. His last completed book, Laffont (2004), analyzed how regulation of public services can crucially assist the development process.

Laffont and Martimort had planned to exposit the modern theory of incentives in a three-volume treatise. Sadly, only the first volume, Laffont and Martimort (2002), was published before Laffont's death. As of this writing, the second volume is nearly finished.

5. Econometrics

Laffont was highly unusual among world-class theorists in that he was also a first-rate econometrician. Indeed, his very first published article in English, joint with Dale Jorgenson, proposed a method for estimating nonlinear equations (Jorgenson and Laffont 1974).

He was a leading figure in the literature on the econometrics of "disequilibrium" models, where prices fail to adjust to clear markets so that quantity rationing becomes necessary. Articles in this line include Gourieroux, Laffont, and Monfort (1980) and Bouissou, Laffont, and Vuong (1986). Later, he made major contributions to the econometric analysis of auctions, for example, Laffont, Ossard, and Vuong (1995).

6. Other Work

Although Laffont will be remembered especially for his work on incentives, he in fact ranged widely within theory. The following are just a few examples of his breadth: Helpman and Laffont (1975) was an exploration of moral

9. The papers with N'Guessan and Meleu illustrate Laffont's frequent practice of giving a boost to promising young economists—particularly students from the developing world, whom he especially loved to teach—by collaborating with them on research projects.

hazard and adverse selection issues in general equilibrium settings. Kihlstrom and Laffont (1979) developed a theory of the firm based on the risk attitudes of entrepreneurs. Laffont and Laroque (1976) provided conditions for the existence of general equilibrium when firms are imperfectly competitive. Laffont and Moreaux (1983) studied the properties of economies in which workers own the means of production. Laffont (1985) (Laffont's Walras-Bowley lecture) studied the welfare properties of equilibrium in competitive models when prices serve not only to clear markets but also to aggregate information. Green and Laffont (1994) explored the theoretical implications of contract renegotiation. Laffont and Maskin (1990) examined the positive and normative consequences of allowing insiders to trade on the stock market. Guesnerie and Laffont (1988) investigated the possibility of competitive equilibria that depend on "sunspots," signals that have no effect at all on the fundamentals of the economy. Laffont and Robert (1996) showed how to design a revenue-maximizing auction when buyers are budget-constrained. Finally, Laffont, Rey, and Tirole (1998a, 1998b) analyzed the nature of competition between interconnected networks.¹⁰

7. Concluding Remark

Creating an institution like IDEI calls for intellectual leadership and vision, and Jean-Jacques Laffont was in short supply of neither. But these virtues are not enough; the would-be creator's personal qualities play an indispensable role too. Nobody would deny that Jean-Jacques was intense—someone so prodigiously productive could scarcely have been otherwise. But he had a lightness of touch, a warmth, and above all an enthusiasm that people—colleagues, clients, and administrators alike—were drawn to irresistibly.

To the economics profession, Jean-Jacques has bequeathed his scientific work, his beloved IDEI, and the memory of his irrepressible personality. Losing him so prematurely is a tragedy. These things, however, will endure.¹¹

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10. This work together with Laffont and Tirole's collaboration on regulation inspired the policy-oriented monograph, Laffont and Tirole (2000), on telecommunications.

11. Colette Laffont has set up a foundation, Association Jean-Jacques Laffont, (<http://jllaffont.org>), in Jean-Jacques' memory. The foundation will foster economics education, with an emphasis on students from developing countries, about whom Jean-Jacques cared so deeply.

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