

# Incentives in Organizations: An Overview of Some of the Evidence and Theory

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## **Abstract**

This paper begins with a review of the different forms of evidence on incentives in organizations. It is argued that it is not possible to understand modern organizations using one kind of data or empirical model. There is a need to combine standard regression studies with survey and laboratory evidence to obtain a complete picture of how modern organizations operate. The evidence that we have points to the importance of finding solutions to the problem of incomplete contracting in organizations. This contracting problem can help us understand why it has been so difficult to consistently estimate and test empirical incentive models. An implication of this work is the impossibility of specifying the solution to the optimal contract problem in advance. Rather, incentive problems in organizations must be based on a combination of past experience and experimentation. More work is needed to understand how the market can be used to select those organizations that find efficient solutions to the incomplete contracting problem.

# 1 Introduction

The task of this essay is to study how incentive theory can help understand how to bring about efficient organization in the hierarchical firm. The standard agency model of incentives is concerned with the optimal contract that a principal will choose to induce effort from her employees given a number of constraints on the information available and the alternatives available to employees. There exist several excellent surveys that deal with agency theory and incentives in organizations. Aoki (1990) reviews the role of incentives and hierarchy in the Japanese firm, while the article by Itoh (1992) does a great job of showing how agency theory can be applied to the problem of hierarchical organizations. Tirole (1992) examines how the potential to collude under asymmetric information constrains contract form and delegation of responsibilities in organizations. Radner (1994) outlines a formal theory of hierarchy emphasizing the information and control aspects of a hierarchy. The book by Milgrom and Roberts (1992) provides a great overview of the theory of incentives and organizations, including a collection of fascinating case studies. Rosen's (1992) survey reviews the theory and evidence on contracts in the market for executives. Finally, one needs to mention the important work of Williamson (1975, 1985) that provided much of the impetus for the modern work on incentives and organizations.

Alchian and Demsetz (1972) have emphasized the importance of measurement problems as the basis of the theory of the firm. Production often involves an element of team work that cannot be mediated by markets, and therefore requires an entrepreneur who can provide direct incentives or, in Williamson's words, a governance structure. Williamson (1975) observes that in every organization there is the possibility of opportunism that raises organizational costs and therefore requires a careful design of the governance structure to deal with it. The basic incentive issue for the entrepreneur is to understand the cost of obtaining a given quality of work, recognizing the additional costs due to the governance structures created to deal with contract incompleteness. In this regard this essay considers only the simplest hierarchy as represented by the principal-agent model. The principal is assumed to have an authority relationship with the agent, and use this relationship to design an optimal contract.

The essay begins with a review of the different kinds of evidence that have been used to understand incentive theory. The first issue concerns

the qualitative properties of incentives. Do individuals respond to incentive schemes? How do individuals interact when team incentives are provided? What are the qualitative properties of intertemporal incentive systems? The second class of issue concerns the quantitative nature of incentives. How much does one have to pay to alter behaviour? How does one trade off the cost of providing incentives against the benefits?

The section reviewing the data is organized by the type of evidence one may use to study incentive theory, and begins with a review of studies that use traditional econometric methods to study incentive issues. We find that it is exceptionally difficult to construct convincing statistical models and tests of the theory. Consequently, much of what we know about incentive theory uses a variety of data sources in addition to standard economic times series such as the CPS, PSID or the NLSY. The subsequent sections discuss other forms of evidence including case studies, laboratory studies and informal historical evidence. From the evidence we are able to draw the following conclusions:

1. Individuals do respond to incentives in much the way the theory predicts. In relatively simple environments individuals choose actions that are in their own self-interest.
2. We have a poor understanding of the magnitudes of the incentive effect. At the moment there is no consistent way to link a dollar outlay in incentive payments with a dollar return in increased effort.
3. In more complex situations individuals make more mistakes, weakening the link between incentives and their consequences. The whole area of learning and bounded rationality is poorly understood.
4. There is a great deal of evidence suggesting that individual behaviour is constrained by its expected consequences on the future behaviour of others. This effect occurs in a variety of guises. In particular, there is evidence that social norms and other expectation formation activities are perceived to be important. The quantitative effects are not well understood.

Section 3 discusses the nature of incomplete contracts and why they may generate a need for the social norms discussed point under (4). Environmental complexity makes it impossible to write complete contingent

contracts, with the consequence that most contracts involve an element of opportunism which may make standard principal-agent models inappropriate. In the paradigm principal-agent model the principal offers the agents a contract incorporating the constraints imposed by imperfect information. The necessarily incomplete nature of contracts implies that there often exist actions unforeseen by the principal that have unintended consequences.

One organizational response to this problem is the use of implicit contracts, including the elusive objectives of high morale, loyalty and team spirit. As Alchian and Demsetz (1972) observe, these objectives help align the incentives of the group. Section 4 illustrates a way to model these concepts using the theory of self-enforcing contracts. Such a theory not only provides a more precise language for these concepts, it also provides some new empirical implications. These include implications for the form of optimal contract, either a bonus system or a fixed wage rate. The theory also helps us understand how changing expectations can lead to large declines in output. One question that is not answered satisfactorily in the literature is the dynamics of norm and expectation change. An objective of this conference is to understand how best to promote efficient behaviour in organizations. In this regard the best practical advice may be due to Koike (1994) who argues that education and adaptive learning are the keys to the Japanese system. That is, firms need to search out practices that have succeeded in the past, and adapt them through a process of experimentation. The market is the ultimate empirical test, providing rewards to successful innovators while weeding out less successful ideas and innovations.

## **2 The Nature of The Evidence**

Evidence about the world comes in a variety of forms. This is particularly true of the evidence used for the discussion and analysis of incentive based models. This section looks at the different types of evidence and asks what we are likely to learn from this work. I begin with the more tightly specified models and hypotheses that are studied using structural models. For each class of data I discuss what we have learned as well as some of the deficiencies in the data that may be addressed using other sources of information.

## 2.1 Structural Estimation.

The objective of a structural estimate is to recover the parameters of the underlying model that is generating the data. A nice example is the paper by Margiotta and Miller (1993), who estimate a structural model of executive compensation using a standard principal-agent framework. They are able to directly estimate the preferences of managers and agents. With such estimates one can make predictions on the precise form of compensation under different hypothetical conditions. One important implication of this work is that it enables us to measure directly the cost of changing individual behaviour. Jensen and Murphy (1988) find that CEOs receive only a small fraction of the returns they may create in a firm and suggest that compensation may be inefficient. Rosen (1992) observes that a \$1 billion variation in market value generates about a \$200,000 variation in CEO income. This can have a significant effect on CEO wealth, and consequently on CEO behaviour. The estimates of Margiotta and Miller (1993) suggest that the cost of ensuring efficient behaviour by CEOs is much lower than the benefits of such behavioural adjustments. In this respect the structural estimate has the advantage of using the observed trade-off between pay and performance to make precise statements about the preferences of the agents.

Despite its potential to increase the predictive power of the theory, there are only a very small number of structural estimates using incentive models. One reason is that incentive models tend to be rather complicated, with the results depending on many variables that are unlikely to be observed by the econometrician. Given that incentives often depend on the behaviour of other individuals within the organization, one also has what Manski (1993b) has called a “social reflection” problem, that may make identification impossible under a wide variety of conditions.<sup>1</sup>

An alternative estimation strategy is to use the restrictions implied by the theory to identify the model from the data. A clever example of this is the work of Ferrall (1994) who is able to estimate a Rosen (1982) hierarchy model by matching two data sets on the wages of engineers. In this case one cannot test the model based on cross equation restrictions because these restrictions are imposed *ex ante* to ensure that the model is identified. Therefore this approach must be combined with other data to test the theory. Once one has a good behavioural model, it can be used to generate restrictions on

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<sup>1</sup>See also Manski (1993a) for results on the identification of a dynamic choice problem.

unobservables that permit the estimation of incentive based models in a variety of circumstances. In section 2.3 we discuss the experimental work that has been done in this regard.

## **2.2 Reduced Form Estimates.**

An alternative to structural estimation is to test for the restrictions that the theory places upon the data. A nice example of this kind of work is the paper by Gibbons and Murphy (1992) on CEO compensation. They show that a standard agency model with asymmetric information on individual ability implies that the optimal contract has a time dependent performance/pay relationship. Early in their careers individuals work hard to signal their high ability, and consequently the pay-performance elasticity is smaller than later in their career. Gibbons and Murphy (1992) test this prediction with a sample using approximately 9,000 CEO years of observations over the period 1970-1988. The pay-performance elasticity is found to be in the range of 0.1 to 0.2, with a slight increasing trend as the individual nears retirement.

These results are consistent with the agency theory presented in their paper, however they do not constitute a test of the theory. Within this framework it is impossible to directly test for why a pay for performance system is used, or for the relative merits of this system compared to other compensation structures, such as a large severance package at retirement. In particular one would like to know to what extent asymmetric information about individual ability is important, or if risk aversion is an important ingredient in the determination of the compensation package. Another issue is whether pay for performance is used to increase individual effort, or to create incentives to choose the right project. In the latter case, pay for performance is to compensate the CEO for choosing projects that are in the shareholders' interest, and not projects from which the CEO may receive private perquisites, such as corporate jet expenditures.

In the former case it is the disutility of effort that is creating the need for incentive pay, and the level of incentive pay should depend on the individual and not on the job or level of responsibility. The fact that rewards increase greatly as one moves to the top of the hierarchy suggests that it is the second problem that needs to be solved. In this case there may be additional tests of the theory that use the relationship between pay and performance and the discretion a CEO has in deciding which projects the company should

pursue. Increased CEO discretion should be associated with a greater pay-performance elasticity.

Other papers in this literature include Jensen and Murphy (1990), and Lambert and Larcker (1987). The work by Antle and Smith (1986) and Gibbons and Murphy (1990) study the use of relative performance in CEO compensations. All these papers find evidence of a pay for performance relationship. However, due to the reduced form nature of the estimates it is difficult to know the precise reasons for such a relationship.

Knober and Thurman (1994) provide direct evidence on the consequences of piece rate and tournament contracts for behaviour in the market for broiler chickens. In this market one has a fairly homogeneous product that is supplied under a variety of contract forms, including piece rates and tournaments between producers. The evidence in this study is consistent with the theory in three cases. Performance in the tournaments is found to depend on the prize differences and not the level. More able producers choose less risky strategies and contracts are handicapped to avoid discouraging less able producers.

With more traditional labour market data providing only information on wages and socio-demographic variables it is much more difficult to find direct evidence for incentive effects. Moreover the competitive equilibrium model with human capital does a good job of explaining a large part of the variation in the data. For example, it is often suggested that wages rise with seniority to provide an incentive for agents to perform well early in their careers (Lazear (1979)). Yet the traditional work on wage structure explains this effect as a return to human capital (see Mincer (1958) and Becker(1975)). Lazear and Moore (1984) find support for the proposition that the age-earnings profile reflects an incentive effect rather than a return to human capital. More recently, Mincer and Higuchi (1988) argue that the observed wage growth in Japanese firms is due to a higher level of human capital, and not to the need to motivate workers. One of my students, Parent (1994), finds further support for the human capital model. His results are consistent with the earlier work of Abraham and Farber (1987) and Altonji and Shakato (1987), who find that tenure has a small impact on wage growth. Wages of workers are best explained by the value of the worker on the market, and not by some form of incentive contract that ex post may result in similar workers receiving very different incomes.

Incentive models have also been used to explain inter-industry wage dif-



ferences. Krueger and Summers (1988) find that some industries pay wages that are on average higher than those in other industries, even after all the appropriate controls for worker characteristics are added. They claim that this result may be explained by a version of efficiency wage theory in which high wages are paid to lower the cost of monitoring. A more direct test of the theory would be to compare the compensation policies of company owned fast food outlets with independent operators in the same chain. The cost of monitoring in company owned outlets is likely to be higher than in owner operated outlets; consequently wages should be higher. Krueger (1991) finds some evidence to support this hypothesis. A recent paper by Neal (1994) attempts a more direct test of the theory by studying the relationship between the number of supervisors and wages. He finds little support for the hypothesis that firms which use fewer supervisors compensate by paying higher wages.

These models regress endogenous variables upon endogenous variables, therefore it is very difficult to disentangle any potential incentive effect. Evidence for, say, efficiency wage type theories are at best indirect given that there are no measures of monitoring costs. Some of the survey data I discuss in subsequent sections more directly addresses the questions of incentives in the organization.

Abowd, Kramarz and Margolis (1994) have estimated firm and person specific effects in a wage equation using French administrative data. They found significant firm effects, though they were very much less important than person specific effects. The variance in wages due to person specific effects was about 100 times larger than for the firm specific effects. That is to say that the pay of an individual is mainly determined by his or her marketable skills, and to a far lesser degree by the firm to which he or she is attached. Thus, to the extent to which there is an incentive component in the pay level that varies by firm, it is of an order of magnitude less than the skill component, suggesting that it is very difficult to convincingly distinguish incentive effects from other causes of wage variation.

Over-all, the literature on compensation has found little direct evidence for the importance of incentives. Much stronger evidence can be found in the literature on job search (see the excellent survey by Devine and Kiefer (1991)). In this case there is a clean measure of performance, namely whether a person was able to find a job or not. Secondly, the underlying variation in the incentive system is due either to changes in government policy or part of

an experiment. In either case it is reasonable to suppose that the underlying variation in the incentive systems is exogenous. In contrast, CEO compensation is endogenous, making it more difficult to untangle the incentive effect from ability variation.

Work by Ham and Rae (1987) and Meyer (1990) find that the probability that an individual exits unemployment increases toward the end of his or her unemployment insurance entitlements. Woodbury and Spiegleman (1987) present evidence that providing a \$500 bonus to workers who find a job significantly decreases the spell of unemployment. More recently Lemieux and MacLeod (1994) have attempted to measure the potential for learning in a large Canadian sample of workers who have collected unemployment insurance. They find some evidence to suggest that individuals require some experience with an incentive system before changing their behaviour. They also find that a large number of individuals choose to collect a subsidy from the unemployment insurance system by working only the number of weeks needed to qualify for insurance, collecting payments until expiry, and then beginning the work/unemployment cycle again.

### **2.3 Experimental Data**

Laboratory experiments provide an opportunity to more precisely measure incentive effects. The typical experiment takes a group of individuals, usually undergraduate students, and asks them to carry out a set of tasks assigned to them. One is able to observe how behaviour responds as a consequence of different reward systems. Miller and Hamblin (1963), in an important review of the early work in sociology, observe that the success of group incentives depends on the interdependence of tasks. When groups were assigned tasks that could be divided up and measured individually, individual reward systems were more effective. However group reward systems were more effective in cases where individual contributions to group output was difficult to measure. A more up-to-date review by Schmitt (1981) confirms the findings reported in this earlier work. These results are consistent with the view that group incentives encourage free riding that can be alleviated by personalized incentive systems. An interesting result occurs when the success of a group outcome depends on inputs which are difficult to measure. Then group incentive systems outperform personalized incentive systems.

Bull, Schotter and Weigelt (1987) carried out experiments comparing

tournaments and piece rates. They found that compared to piece rates, tournaments generated a greater level of variance in output than predicted by the theory. While the qualitative features of the data are consistent with the tournament model, there remains a great deal of unexplained variance.

There now exists a large literature concerned with testing various refinements of the Nash equilibrium concept.<sup>2</sup> A Nash equilibrium is a set of strategies from which no agent wishes to deviate. This implicitly requires agents to have correct expectations concerning the play of other players in addition to computing their best response. A difficulty with many of the experiments conducted in this literature is that one is testing the joint hypothesis of consistent expectations and self-interested behaviour.<sup>3</sup>

For example consider the following battle of the sexes game:

$$\begin{bmatrix} (1, 2) & (0, 0) \\ (0, 0) & (2, 1) \end{bmatrix}.$$

This game has three Nash equilibria: (1,2), (2,1) and a mixed strategy equilibrium. If individuals are presented with this game and asked to play with no pre-play communication, then the theory of rational behaviour makes no prediction on the distribution of strategies to be chosen. However if the two players meet before playing the game and agree to play (1,2), then neither player has an incentive to deviate. Thus testing incentives in game theory requires disentangling the expectations problem from the incentive issue. This theory is subject to experimental testing by Van Huyck, Gillette and Battalio (1992). They study how individuals play coordination games when they are given recommendations on how to play. The role of these recommendations is to coordinate expectations, and to see whether deviation from a Nash equilibrium occurs. It is found that even if a Nash equilibrium is recommended, significant deviation occurs when a unique efficient Nash equilibrium exists. Other work by Brandts and MacLeod (1994) also study the effect of recommendations on strategic choice. In the case of normal form games they find that players deviate from the recommendation if it is not a Nash equilibrium or it is an imperfect Nash equilibrium. This latter result seems to be motivated by the (rational) expectation that there is a probability that the other player may deviate.

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<sup>2</sup>For a comprehensive survey see Davis and Holt (1993).

<sup>3</sup>Schelling (1960) is a classic study of the expectations formation problem in the time of nuclear threat.

In general, this work finds that in clearly specified simple games players did choose strategies which were in their best interests. Results from experiments with two-stage games examining the subgame perfect equilibrium concept are much less clear-cut. In particular, it would appear that the higher level of non-equilibrium play in more complicated games suggest that agents did not fully understand the game. However, given that all we observe is behaviour and not the reasoning process, it is not clear why equilibrium play is less frequently observed in these games.

Further insights into strategic behaviour can be found in the very nice work of Binmore, Morgan, Shaked, and Sutton (1991) and Binmore, Swierzbinski, Hsu, and Proulx (1993). They find further evidence that individuals act in their own best interests. Once individuals are given sufficient time to understand the rules of the game they play strategies that are very close to the equilibrium outcome. This work also finds no evidence that social norms play an important role. In interviews carried out after the experiment most players felt that the outcome obtained was fair, even when the payoffs were very unequal. This experimental work tends to support the idea that social norms are primarily a coordination device, rather than a binding constraint on behaviour causing people to select sub-optimal strategies. However, these experiments also highlight the importance of giving individuals an opportunity to learn about the game. In more complicated situations social norms may be a way to pass on the form of optimal play. Given that learning takes time, this would also imply that in a changing environment social norms may seem to induce sub-optimal behaviour, but only because individuals have not yet had time to discover how to play optimally.

## **2.4 Case Studies and Industry Surveys.**

The essence of strategic play is that one's choice depends on expectations concerning the other player's choice. Laboratory experiments provide some evidence that agents think and behave strategically. The problem with standard economic data sets is that when expectations are important the evidence for incentives is at best indirect. A class of data that can be used to address this is an industry survey or case study.

An example is the group of studies by Kaufman (1984), Blinder and Choi (1990), Bewley (1993) and Hall (1993) that report the results of interviews with managers about their wage policies. These studies ask managers why

certain policies are not followed and what they would expect to be the consequence of a particular policy that was not chosen. The focus of this work is on the problem of wage setting and why firms do not cut wages in the face of excess demand.

An interesting and consistent observation from this work is the importance in the manager's mind of ensuring worker morale and effort. Policies that may be perceived as unfair are to be avoided. This is because workers can perform a large number of actions which reduce the productivity of the firm. Essentially, wage reductions are avoided due to the existence of a social norm requiring workers to reduce their cooperation in the event of a salary cutback. These issues have also arisen in discussions of down-sizing in firms. For example, Cameron (1994) in a survey of 30 organizations attempts to identify good practices for down-sizing. Central to all his observations is the importance of maintaining a corporate culture that ensures worker cooperation. These studies point to the fact that worker cooperation is not something that is obtained via a simple wage contract. Rather, actions taken after the relationship has started have an important impact on the continued cooperation and productivity of the worker. Furthermore, some actions such as wage cuts are not taken (and hence not observed) due to the effect they are expected to have on worker behaviour in the future.

Another fine source of case studies is the important work of Koike (1984, 1988, 1994). Over a period of several years he has gathered evidence about Japanese work practices and management. In Koike (1994), it is suggested that much of the cooperation observed in Japanese firms arises due to the special environment that is created in the firm. Koike finds that culture is not central to cooperation, but rather the encouragement of learning and on the job training. In particular, the high level of worker training in *problem solving* is key to the success of the Japanese system. An important aspect of the employment relationship is the ability of workers to respond and act upon unexpected events that cannot be contracted upon *ex ante*.

Ichinowski (1992) provides an interesting study of behavioural change in a steel mill. He followed the performance of one steel mill in a large company. Compared to other mills run by the same company, this mill faced difficult labour/management relationships characterized by high turnover rates for management, high absenteeism and grievances by workers. The union contract was very complicated, with a large number of clauses that were particular to this mill. In the early 1980s the management decided to radically

change the style of labour relations at the plant. Management insisted on a new contract that eliminated the special side deals in favour of a much simpler contract. Rather than threaten workers with a plant shutdown and layoffs, workers were offered job security and higher wages. Initially the workers resisted the new contract. However, after a short strike it was implemented, resulting in an immediate increase in labour costs to the firm. An unexpected consequence of this contract was that worker and plant productivity greatly increased within a couple of years of its introduction. In particular, the plant went from being one of the least productive to one of the most productive mills operated by the firm in question. In this case, the offer of job security and higher wages seems to have brought about a behavioural change in the workers that led to higher firm productivity and greater profits despite the increase in labour costs.

Finally, there are several interesting case studies that look at the structure of wages and promotion within a single firm. The book by Rosenbaum (1984) is a rich source of evidence concerning the career paths of individuals in a single firm. His main conclusion is that the career path of an individual, with its potential for promotion and higher salary, provides the incentive for high performance. In particular, he claims that the standard human capital model is unable to explain the pattern he observed in this firm. Baker, Gibbs and Holmström (1993) also study the career paths of individuals in a single firm, within which they find a fairly rigid hierarchy, with individuals promoted up the ladder facing few downward or lateral movements. Individuals who are not promoted eventually face declining real earnings.

A difficulty with this work is its restriction to a single organization. The econometrician may argue that one is studying a single data point from which it is impossible to make general statements. We cannot tell from such a study whether the characteristics of the firm in question hold in general, or whether they are likely to be observed in other firms. This work needs to be validated with further evidence from other firms in the same and other industries.

## **2.5 Non-quantitative historical evidence.**

Case studies provide detailed information on a limited number of firms over a short period. An alternative approach is to use historical evidence that is less detailed, but covers a larger period of time. Certainly the classical economists, most notably Adam Smith (1976), have used historical obser-

vation to provide insights for theoretical work in economics. North (1981) provides a detailed review of the role of institutions for economic growth in England. In a fascinating study, MacMullen (1988) documents that the decline of Rome was a result of corruption and a breakdown in the rule of law. The lack of contract enforcement created incentives for individuals to buy and sell power and led to excess investment in rent seeking activities. Chandler (1977) provides a rich description of the rise of mass production and the management class in America since the middle of the 19th century.

More recently there have been several papers that bring together the historical evidence and theoretical incentive based arguments. Milgrom, North and Weingast (1990) show how the institution of the law merchant can be understood as a mechanism for the enforcement of contracts.<sup>4</sup> Greif (1994a) looks at the potential for multiple equilibria to explain the variation in social institutions. In particular, he argues that the rise of Genoese traders relative to the Maghribis in North Africa was due to the use of “individualist” social norms in the former, while the latter depended on reputation forces for contract enforcement. In this case one has two societies surviving side by side for centuries using different sets of social norms.

This historical evidence also highlights the danger of using a static efficiency argument to explain a given organizational form. For example, the fact that a large organization in the US uses a particular personnel policy does not imply that it is optimal given the current market environment. It may have been optimal at some earlier period, yet its efficiency today depends on how it compares to others being used in the market place. Adjustment costs and slow selection in the market may result in inefficient organizations surviving for long periods of time. Historical analysis has the merit of studying institutions over sufficiently long periods so that one may observe the workings of market forces on them.

## **2.6 Introspection, personal observation and the impact of the evidence.**

In a subject such as economics, it is impossible for researchers to completely avoid using personal experience in the model formation process. Daily con-

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<sup>4</sup>See also Greif, Milgrom and Weingst (1994) for a similar argument applied to the case of merchant guilds.

tact with news media and other sources of information about the economy and its institutions does effect our judgments on the validity of theories. Arnold Zellner (1988) offers an antidote to this in the form of Bayesian econometrics. His approach enables one to combine personal beliefs and biases with evidence in a rigorous and scientific way. Formally, one may incorporate prior beliefs into prior probabilities on parameter values. These priors are updated using Bayes' rule as new evidence is obtained. This approach has great intellectual appeal, though it is not yet widely used. One possible reason is that there is at the moment no accepted way to parameterize the set of potential models. Without such a parameterization it is not possible to define prior beliefs over the set of potential models. As the set of potential models is refined, one can expect to observe an increase in the importance of Bayesian econometrics.

Despite the lack of a scientific basis upon which to form beliefs, I will use introspection to suggest that the evidence discussed above does allow us to draw some conclusions.

1. Individuals do respond to incentives. Though this has formed the basis of economics for centuries, only recently do we have a substantial body of quantitative evidence, including laboratory experiments and the evidence from search activities in labour markets, that support the hypothesis that individuals adjust their behaviour in the direction of maximizing wealth/income/utility. However this is an error prone activity, with the consequence that individuals may often take sub-optimal decisions in the short run. More research is needed to better understand learning in economic environments.
2. The organizational environment is complex, characterized by a wide variety of institutions. Surveys of managers consistently find that morale and the control of non-contractual aspects of the employment relationship is an important problem. In particular, managers are reluctant to cut wages due to the potential negative effect on future performance. Case studies consistently report the importance of trying to find ways to motivate individuals to perform well at complex, difficult to define tasks. In addition, the laboratory evidence discussed by Miller and Hamblin (1963) indicates that performance pay is effective only when well defined measures of individual performance exist. When cooper-



ation is important, incentive systems which are independent of individuals' performance, but reward team performance, are likely to be superior.

### 3 Complexity, Creativity and Incomplete Contracts

Jensen and Meckling (1976) have emphasized: "It is important to recognize that most organizations are simply legal fictions which serve as a nexus for a set of contracting relationships among individuals."<sup>5</sup> The contracting approach has come to dominate the study of incentive and organization problems. It is motivated by the idea that markets are necessarily incomplete, and consequently firms and other institutions are needed to supplement market allocations. These ideas have their origins in Coase (1937), with Williamson (1975) initiating the modern revival of these issues.

The purpose of contracting relationships among individuals in a firm is to provide incentives for efficient behaviour. A fundamental issue which is not yet resolved is the best way to model and think about contractual incompleteness, with the empirical literature reviewed above providing little guidance on the form that incentive contracts should take. In this section I review the notion of contractual incompleteness in preparation for the subsequent sections that discuss some empirical implications of the model.

To help fix ideas consider the following simple contractual relationship between two agents,  $i \in \{0, 1\}$ . Individual 0 is assumed to be the principal or employer who has been allocated the residual rights to the organization, while agent 1 is the agent or employee. Each agent has a per period utility function of the form:  $U_i(w, \hat{e}, \theta)$ , where  $w$  is net income,  $\hat{e} = (e_0, e_1)$ , and  $e_i$  is the action selected by agent  $i$ . If either agent terminates the relationship they obtain a flow utility of  $\bar{U}_i$ . If complete contracts were possible then an efficient allocation would solve:

$$\begin{aligned} (w^*(R, \theta), \hat{e}^*(R, \theta)) &= \arg \max_{w, \hat{e}} U_0(-w, \hat{e}, \theta) \\ &\text{subject to } U_1(w, \hat{e}, \theta) \geq \bar{U}_1(\theta) + R, \end{aligned} \tag{1}$$

where  $R > 0$  is the amount of rent the employer gives to the employee, and  $\theta$  represents the state of nature.

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<sup>5</sup>Jensen and Meckling (1976) page 310.

Let us assume that for each agent and for each  $R$  and  $\theta$ , the optimal level of effort  $e_i^*$  is not an optimal response to the other's optimal action, that is

$$e_i^* \neq \arg \max_{e_i} U_i(w_i^*, e_i, e_{-i}^*, \theta), \quad (2)$$

where  $w_0^* = -w^*(R, \theta)$  and  $w_1^* = w^*(R, \theta)$ . Under complete contracts each agent would be required to carry out the stipulated actions and transfers. If an agent were to deviate it is assumed that a third party, such as the courts of law, would punish the defecting individual.

With complete contracts it is not possible to identify incentive effects, rather the observed variation in effort and income is explained by optimal risk sharing and allocation of effort. But, as the recent work of Townsend (1994) illustrates, the complete contracts framework is usually rejected by the data. Williamson (1975, 1985) and other modern organization economists emphasize the importance of transactions and information costs that make it impossible to write complete contingent contracts, so institutions arise to provide solutions to the problem of contract creation and enforcement.

The issue is how should one introduce contractual incompleteness. In the standard agency model one supposes that the principal has a contractible signal as a function of the underlying parameters, say  $y = f(e, \theta)$ . In this case one can study the solution to (1) assuming that the only enforceable contract is payment as a function of  $y$ , say  $w(y)$ .

There is a large theoretical literature discussing the form of contracts under different informational assumptions (see Hart and Holmstrom (1985) for a survey and Milgrom and Roberts (1992) for more recent overview with applications). For many specific performance/pay issues the agency model yields useful insights, however it is not a complete model. Many, if not most, economic relationships in organizations are not mediated only by explicit contracts. Issues such as promotion policies, office politics, morale and reputation effects are all reported by managers to be important for the operation of the firm. In these cases there are actions and events that are important to the relationship, but are not explicitly contracted upon.

These phenomena have led to a class of models which suppose that contracts are incomplete, but that information is symmetric. In this context incomplete means that there are events that are important to the relationship, but which cannot be explicitly contracted on.<sup>6</sup> The idea here is that ex

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<sup>6</sup>Pioneering articles include Grout (1984) and Grossman and Hart (1986).

ante it is not possible to write a contract conditional upon the information  $e$  or  $\theta$ , yet *ex post* this information is observable to both parties, and hence the final allocations can be made conditional upon this information.

Grossman and Hart (1986) use this approach to construct a theory of the firm based on the allocation of residual rights. For example, suppose that in our contract problem agent 0 has no action to take, and that there is no uncertainty. In this case Grossman and Hart observe that a transfer of ownership to the agent causes her to internalize all costs and benefits from any action taken; thereby ensuring efficiency. Though this approach has resulted in a rich and interesting theory of the firm, the assumption that no conditional clauses can be written into a contract is extreme, and certainly not consistent with the variety and complexity of the contracts we observe in practice.

Moreover, the literature on incomplete contracts typically assumes that *ex post* both parties can observe all the information relevant to the contract. There is now a large literature in the theory of implementation demonstrating that under quite general conditions agents can design mechanisms or institutions which result in the first best (see the excellent survey by John Moore (1992) on these issues). Tirole (1994), relating joint work with Eric Maskin, extends these arguments to suggest that the usual justifications for incomplete contract models: unforeseen contingencies, costs of writing and enforcing contracts, are not good motivations for the models of incomplete contracts as they stand. He observes that if payoffs are observable, then even though the states of nature are not contractible, the set of allocations under complete contracts is equal to the set of allocations under incomplete contracts.

Despite this result, and the important work in implementation theory, there seem to be few examples of where application of the theory has helped us understand organizations.<sup>7</sup> I would like to argue that there are some important insights to be gained from the literature on incomplete contracting. However, I will also argue that the theory is more compelling as a basis for understanding organizations once we move beyond the one or two period framework that is most popular in the implementation and incomplete contracting literature. First I will consider the problem of contract complex-

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<sup>7</sup>Implementation theory has however revolutionized the area of auctions and non-linear pricing, where there are many fruitful applications.

ity and unforeseen contingencies. Then I discuss the role of innovation and contracts, and how this complicates the notion of authority.

### 3.1 Complexity

Unforeseen contingencies are often cited as one reason for contract incompleteness. The fact that contracting agents cannot anticipate all possible outcomes of nature that are relevant to their contract is well recognized in the common law.<sup>8</sup> With experience, precedents are added to the law that deal with new circumstances for which the contracting parties have no explicit clauses in their contract.

In confronting this problem economists often talk in terms of “bounded rationality”.<sup>9</sup> However, as Simon (1956) has observed, the fact that individuals may not optimize in a given situation does not imply that they are not rational or goal seeking. What is needed is some way to think about and model the complexity of the decisions faced by individuals. To begin it is useful to consider a simple example to see the magnitude of the complexity problem. Consider a trader who receives just one piece of information each day, either good or bad. After receiving this information, she must make a buy or sell decision based on the information received during the past seven days. Suppose we wish to open up a market for each decision that she might take. That is, for each history and each buy or sell decision, we wish to establish a price or value. How many cases are involved?

Each day the trader has observed a sequence of 7 good or bad signals. For each sequence of signals a different buy or sell decision may be made. A decision function at that time is a map from the history to either buy or sell. The number possible histories is  $2^7$ , thus the total number of possible decisions is  $n = 2^{2^7} = 2^{128}$ . This is a truly large number. To get a better

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<sup>8</sup>As an example consider the following extract from a waiver that I was recently required to sign for a Colorado River Trip with O.A.R.S.: “I am aware that white water boating entails risk of injury or death to myself. I understand that the description of these risks is not complete, and that other unknown or unanticipated risks may result in injury or death.”

<sup>9</sup>There is a growing literature on endogenously incomplete contracts, examples include Anderlini and Felli (1994), and Lipman (1993). This literature focuses on issues of computability and rationality. The argument used here is much simpler, it is a matter of counting the number of contingencies that one might wish to include in a contract.

intuitive feel, observe that over two days the total number of possible decisions is  $n^2 = 2^{256}$ . By way of contrast the number of protons, neutrons and electrons in the earth is roughly  $2^{160}$ . It would not even be physically possible in *principle*, let alone in practice, to write down a complete contingent contract.

A contract is a set of conditional statements; that is, if A occurs the parties agree to execute B. The simple example illustrates how quickly the number of possible cases increases in a simple dynamic framework. This kind of example is not new. The game of chess is another well cited example illustrating the bounds on “rationality” (see the insightful discussion by Simon (1972)). However it is not clear what it means to have a bound on “rationality” in this case. The game is finite, with well defined rules for winning. If it were possible to write down the complete extensive form, a simple application of dynamic programming would yield the optimal strategy for each agent for any given position. Individuals who play chess are rational in the sense that they try to follow strategies that result in winning.

Now suppose that one were writing a contract for a risk averse agent to play chess on one’s behalf. Given that the game is finite and that each play is public information, we know there exists a first best contract that pays the agent a fixed fee equal to her reservation wage as well as a penalty clause that reduces the payment if the agent ever chooses a sub-optimal strategy. In equilibrium the agent will not deviate and will win every game for which winning is a subgame perfect equilibrium (it is not known whether white has a sure winning strategy). This example satisfies all the necessary conditions a theorist needs to confidently assert the existence of a solution. The number of states of nature is finite, and there is complete and symmetric information.

Though such a contract is efficient, it clearly cannot be implemented. The sheer complexity of the game implies that even the most skilled players sometimes choose sub-optimal strategies. In this case the reason that the contract is incomplete is not because there is asymmetric information between the principal and agent, nor because third parties cannot observe the outcome. It is incomplete because of the complexity of the environment. This simple example highlights the way bounds on information processing can naturally make implementing a complete contract impossible. Even though we do not have a complete model of how individuals play chess, this does not limit our ability to write models of contracting with chess. In this case we simply assume that the reward system cannot depend on play, only on

the outcome. Incentives to play well are provided by paying a prize to the winner. Assuming that complexity makes it impossible to write a contract on the quality of play allows us to suggest the contract form one observes in practice.

I used chess as an example because it highlights the interaction between efficient contracting and complexity. However, the game of life is at least as complex as chess, thus I would submit that contractual incompleteness of this type is unavoidable. Holmstrom and Milgrom (1991), and Baker (1992) provide theories on how to construct reward systems when observed measures of performance are not perfectly correlated with effort. In practice, every performance based system creates an incentive for individuals to maximize the performance measure at the lowest cost. The work environment, like the chess game, has many possibilities that simply cannot be anticipated by the creators of the reward system. Baker quotes Lawler (1990, pg. 58):

“The literature on incentive plans is full of vivid descriptions of the counterproductive behaviors that ... incentive plans produce. One of the first books I read in compensation provided story after story about how employees were outsmarting and defeating the piece-rate systems (Whyte, 1955). Indeed, as I read this classic book, I marveled at the ingenuity of the worker.”

This quote highlights the innovative nature of human effort, and the essentially non-contractual aspect of “good” work. By definition, an innovative technique cannot be anticipated before hand. Incentive systems that recognize and reward innovative, output enhancing behaviour are to be preferred to ones that rigidly set a minimum quality level *ex ante*. Piece rate systems create an incentive to find innovative ways to increase the measured output, and not necessarily ways to increase the output desired by the employer. Holmström and Milgrom (1991) incorporate “complexity” into a formal model by supposing effort is multi-dimensional. They study an example of a building contractor who must decide on the trade-off between speed and quality, where the speed of work can be observed and contracted upon, but not the quality. Holmström and Milgrom (1991) show that in an agency framework the optimal contract is one that pays a fixed rate that is independent of the speed. The reason is that any contract that creates an incentive for speedy completion results in too little effort on quality.

Even in the absence of explicit performance criteria the buyer can always resort to a lawsuit and argue that the contractor did not satisfactorily complete the work. If this is the case then the contract is not a simple fixed wage contract, rather there are a set of default conditions that will be filled in by the court in the case of a dispute. It is well recognized in contract law that one of its roles is to complete otherwise incomplete contracts.<sup>10</sup> This ensures that the buyer has some contractual protection in certain states, even if these states were not anticipated in the written agreement between the buyer and seller.

This is not always efficient. Use of the courts is a very expensive solution that most parties would prefer to avoid. Therefore it is the threat of court action, rather than the court enforced rule, that is likely providing the necessary incentives. Secondly, the threat of court action provides no incentive for above average quality. A cheaper market solution, as suggested by Klein and Leffler (1981), is the use of reputations.<sup>11</sup> In that case the contractor carries out a “high quality” job to ensure future business through references from satisfied customers. When there are reputations the contract consists of two parts, the explicit conditions that are written down by the two parties, and the implicit conditions that are associated with the contractor’s reputation. With reputations the form of the contract between the contractor and the client is much more complicated than the written contract. Not only does the threat of losing ones reputation help maintain quality, such an informal arrangement also rewards innovation. Above average quality creates an incentive for individuals to actively recommend a contractor to friends and relatives. In this way an informal arrangement creates the incentive for the contractor to do a good job, and in some states of nature an exceptional job.

Tirole (1994), reporting joint work with Eric Maskin, observes that even if one cannot contract over actions, the ability to contract over payoffs can, under the appropriate conditions, result in the outcome (this result does not apply to the chess example where the discreteness of the final outcome makes it impossible to obtain good risk sharing). That is the existence of transactions costs by themselves cannot justify incomplete contracts. However, in

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<sup>10</sup>See Cooter and Ulen (1988). They also point out that US courts view the setting of default conditions as their prerogative, and in many cases disallow clearly specified liquidation damages specific by contract.

<sup>11</sup>See also the insightful work of Ben-Porath (1980) who looks at F-connects (families, friend and firms) as an alternative to formal contract enforcement.

the contractor example, I would also argue that many aspects of the payoff are not contractible, but the buyer can form a judgment as to the quality of the work. A similar case arises in chess. Though formally measuring the quality of play is difficult, chess experts can agree in general whether play in a given game is of high quality. Similarly, inspection of the contractor's work in comparison with others does generate an opinion that is correlated with overall quality.

It may seem unusual to suppose that a principal and an agent can form judgments about the quality of output, but that these judgments cannot be formally contracted upon. If anything, I would submit that this is the norm, rather than the exception, in economic life. If a city commissions a work of art or building, it is impossible to write a contract specifying the quality of the work in advance, though once it has been created many people feel competent to comment on and judge its quality. The employment relationship is very similar. Many tasks are assigned with rather vague conditions, such as "be friendly to clients!" What does this mean exactly? If the employer begins receiving complaints concerning service she knows that there is something wrong. However, one would not write an explicit contract specifying what "friendly" means.

In these cases the rewards and punishments for the level of quality are necessarily separated over time, and not explicitly contracted upon. We shall denote situations in which quality of effort is maintained by an understanding or long term informal agreement as an implicit contract. The essential assumption that we make is that parties to the agreement understand what is meant by good quality, but cannot write an explicit contract based on the level of quality. At the root of the problem is not asymmetric information per se, but rather that every task involves a large number of unforeseen contingencies upon which the agent may take appropriate actions, and that specifying these actions in advance is simply impossible. Before taking up the theory of implicit contracts I wish to discuss one solution to the problem of this kind of contractual incompleteness, and its relationship to implicit contracts.

## **3.2 Property Rights and Influence Activities**

An alternative to the use of a formal performance/pay contract is a reallocation of property rights. This idea has been fruitfully applied to the theory



of the firm by Grossman and Hart (1986) and Hart and Moore (1990). The recent work of Holmström and Milgrom (1994) integrates the theory of property right allocation with the standard agency model. This model provides a framework that is consistent with the empirical work of Anderson and Schmittlein (1984). Formally, a property right gives the owner the residual rights of control. In each state of nature, once the set of contractual obligations are met, any further decisions that need to be taken, or any residual revenue, are the domain of the owner. In an organizational context one may replicate the incentives provided by an allocation of property rights by creating profit centers or using compensation packages that formally allocate the residual rights of control. Ownership of an asset allocates the right to contract out employment with the asset. This residual right of control is formally modeled in agency theory by giving the principal all the bargaining power (the optimal contract is found by maximizing the principal's objective function subject to incentive and individual rationality constraints for the agent).

In practice such an allocation of rights is never as clear-cut as it may seem. Possession of the residual rights of control do not necessarily mean that one has control. Taiishi Ohno, the inventor of the just-in-time system at Toyota, observes:

“It was not at all easy to overcome the conservatism of a factory where the work habits were set, where a lathe operator would only operate a lathe, where a welder would weld...Actually, it was my own struggle against these outmoded structures which marked the beginning of the Toyota production system.”<sup>12</sup>

In this case Ohno as the owner had the right to dismiss workers, and allocate workers to different tasks. Even though the just-in-time system, and the associated multi-tasking of workers, eventually proved to be a very effective employment system, the owner did not have the right *in practice* to bring about the necessary change. Change came about slowly as it was demonstrated that the new system was better. The work of Lindbeck and Snower (1989) has emphasized the role of unions in exactly this context. Union members can carry out actions that raise the cost of hiring non-union workers, even when the firm has the legal right to do so.

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<sup>12</sup>Ohno (1984), p. 210.

The work of Milgrom (1988) and Lazear (1989) also highlights the role of influence activities inside the firm. They observe that there are many actions that workers can take to influence the decisions of superiors. Milgrom (1988) observes that optimal allocation of tasks may involve ex post rents that employees may attempt to extract by allocating time to influence activities. He also observes that firms will try to limit such activities by delegating to workers decisions which are important to them, but which do not affect the firm's payoff. Lazear (1989) emphasizes the importance of individual characteristics that may affect the utility employees receive during sabotage activities. Lazear observes that there is an important connection between the structure of wages and the employment policy of the firm. Firms that wish to use more incentive pay involving a higher level of ex post rents will carry out more screening of employees to eliminate "hawks" that will engage in sabotage activities that undermine the incentive properties of the compensation system.

This work highlights the existence of non-contractible actions by workers that can increase the cost of reallocating property rights. A consequence is that the predictive power of agency models is reduced. The standard agency model supposes that one party with all the bargaining power offers an optimal contract to the agent, who either accepts or rejects the offer. In such a model the wage of the worker reflects the alternative opportunities. MacLeod and Malcomson (1993b) formally show that the existence of non-contractible actions by the worker and firm imply that any division of the rents may occur, even when the firm has the right to make all the offers. The mechanics of this result is discussed in the next section.

## **4 Incomplete Contracts, Social Norms and Organizations in Markets**

Schotter (1984) has argued that one role of institutions is to facilitate the creation of long term relationships that can overcome the problems of contractual incompleteness through the use of reputations. Bull (1987) makes a similar observation in an explicit repeated contracting framework. This work uses the concept of a self-enforcing contract defined as an agreement for which some of the terms and conditions are not enforced in a court of

law, but by the potential loss of cooperation between the two parties. When self-enforcing contracts are an important part of a relationship, then the standard agency model no longer forms a good benchmark for empirical work. Furthermore the existence of self-enforcing contracts depends on the use of social norms to coordinate the actions of individuals.

## 4.1 Self-Enforcing Incomplete Contracts

To illustrate a self-enforcing contract we return to the simple model of a bilateral relationship between two agents,  $i \in \{0, 1\}$ , where individual 0 is assumed to be the principal or employer who has been allocated the residual rights to the organization, while agent 1 is the agent or employee. For simplicity I suppress dependence on the state of nature and suppose each agent has a per period utility function of the form:  $U_i(w, \hat{e})$ , where  $w$  is net income,  $\hat{e} = (e_0, e_1)$ , and  $e_i$  is the action selected by agent  $i$ . Assume that these actions are observed by both parties, but in the spirit of the complexity arguments above they cannot be explicitly contracted upon. In the words of Williamson (1975) a high level of effort by the agent represents “consummate” cooperation.<sup>13</sup> Actions by the employer may also include the way employees are treated, or the way the working environment is organized. Employee behaviour, on the other hand, may include sabotage behaviour as in the case of Lazear (1989), or helping/training actions as considered by Itoh (1991).

Suppose that the relationship is repeated over time and that each agent discounts utility at the rate  $\delta$ . Each period we have the following sequence of moves. First agents simultaneously choose effort, then side payments are made. These side payments consist of two components. The first is a payment that is contracted upon and is independent of effort, while the second is a voluntary (and hence not explicitly enforceable) bonus payment. After the payments have been made the agents simultaneously decide to stay together or separate. At each point all past plays are fully observable. If at the end of a period either agent terminates the relationship they each obtain a flow utility of  $\bar{U}_i$  in the future. If complete contracts were possible then an efficient allocation would solve (1). It is also assumed that the efficient action is not a best reply to a choice of efficient actions by the other agent as given by (2).

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<sup>13</sup>Williamson (1975), page 68.

Within this framework there are only three kinds of decisions: effort, payments, and separation. Though complete explicit contracts are not possible, any of the decisions can be made conditional upon what has happened in the relationship. Consequently we have the following set of potential incentive mechanisms:

1. Pay an end of the period bonus in the event of good behaviour.
2. Choose “uncooperative” behaviour in the future. That is, select a suboptimal action  $e_i$  in the future in the event of bad behaviour.
3. Use the threat of termination in the event of bad behaviour.

Formally, income can be made conditional upon effort by supposing that at the end of the period the employer promises to pay the employee a bonus of  $b \geq 0$  if the performance is acceptable. This is an implicit contract or agreement because the payment of  $b$  cannot be legally enforced. Similarly, the employee could in principle pay the employer a rebate on her salary of the amount  $\rho \geq 0$ . Enforcement of these payments requires the worker or the firm to threaten to quit the relationship or to produce low effort in the future. Without loss of generality we restrict analysis to stationary contracts of the form  $c^* = \{\bar{w}, b, \rho, e^*\}$  where  $\bar{w}$  is a fixed payment that is independent of the actions, while  $b$  and  $\rho$  are the bonus payments by the employer and employee. The total compensation to the employee, if the agreement is fulfilled, is given by  $w_1 = \bar{w} + b - \rho$ . It will become clear why we need to include the potential for side payments. It is assumed that these payments are made simultaneously at the end of the period, just before the termination decision. For notational simplicity  $U_0(c^*)$  denotes  $U_0(-(\bar{w} + b - \rho), e^*)$  and similarly for  $U_1(c^*)$ . We implicitly assume that all contracts considered provide a payoff that is at least as great as the individual’s market alternative.

MacLeod and Malcomson (1989), using the insights of Abreu (1988), show that the set of self-enforcing contracts in an infinitely repeated relationship are completely characterized by those allocations that use the threat of separation to enforce the contract<sup>14</sup>. The reason is that the market alternative gives the minimum utility each agent can receive. Abreu (1988) observes

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<sup>14</sup>In practice relationships cannot last forever. From experimental results on repeated games we know that agents can and do cooperate early in the relationship. Osborne and Rubinstein (1990) observe that what is important in the application of repeated games is that individuals analyze or think about the game as if there is always a tomorrow.

that in a repeated game the set of perfect equilibrium allocations are completely characterized by those self-enforcing allocations for which deviations are followed by reversion to the worst perfect equilibrium for the deviating player. In the case of this contracting game, MacLeod and Malcomson (1989) show that separation defines the worst perfect equilibrium outcome for each player in the game.

For the threat to separate to be an equilibrium, it must be accompanied by a set of self-enforcing beliefs or social norms. When defection occurs, separation is an optimal strategy because both parties believe that shirking will continue in the future. If the relationship were to continue after shirking occurs, continued shirking would be an equilibrium strategy because of both agents' belief that the relationship will terminate at the end of the current period. Together these beliefs and strategies form a subgame perfect Nash equilibrium. Given these threat strategies, the set of self-enforcing contracts are characterized by the following proposition.

The contract  $c^*$  is a self-enforcing agreement if and only if it satisfies:

$$\begin{aligned} U_0(c^*) &\geq (1 - \delta) \max_{e_0} U_0(-\bar{w}, (e_0, e_1^*)) + \delta \bar{U}_0, \\ U_1(c^*) &\geq (1 - \delta) \max_{e_1} U_1(\bar{w}, (e_0^*, e_1)) + \delta \bar{U}_1 \end{aligned} \quad (3)$$

$$\begin{aligned} U_0(c^*) &\geq (1 - \delta) U_0(-\bar{w} + \rho, (e_0^*, e_1^*)) + \delta \bar{U}_0, \\ U_1(c^*) &\geq (1 - \delta) U_1(\bar{w} + b, (e_0^*, e_1^*)) + \delta \bar{U}_1 \end{aligned} \quad (4)$$

The first set of equations correspond to the conditions that if an individual produces sub-optimal effort, then no end of the period bonus is paid, and the relationship is terminated. The second set of conditions are the incentive constraints which ensure that side payments are made. If a party does not make a payment the relationship is immediately terminated. This result has some important implications for the nature of compensation in the presence of incomplete contracts. The first is the necessity of a quasi-rent for the enforcement of the contract. The incentive constraints (3) can be rewritten as follows:

$$\begin{aligned} \delta \{U_0(c^*) - \bar{U}_0\} &\geq (1 - \delta) \{ \max_{e_0} U_0(-\bar{w}, (e_0, e_1^*)) - U_0(c^*) \}, \\ \delta \{U_1(c^*) - \bar{U}_1\} &\geq (1 - \delta) \{ \max_{e_1} U_1(\bar{w}, (e_0^*, e_1)) - U_1(c^*) \}. \end{aligned} \quad (5)$$

The term on the right is the one period gain from cheating, while the term on the left is the future difference between the market alternative and the

gain from the relationship. If the market were perfectly competitive then the utility of agents would be the same in the current relationship as in the next best alternative. That is, one would have  $U_i(c^*) = \bar{U}_i$  for  $i = 0, 1$ . Substituting this into these incentive constraints one has for  $i = 0, 1$ :

$$\bar{U}_i \geq \max_{e_i} U_i(w_i^{defect}, (e_i, e_{-i}^*)), \quad (6)$$

where  $w_i^{defect}$  is the payment for agent  $i$  if he or she defects. From condition (2) this is impossible. Therefore the enforcement of incomplete contracts requires the existence of rents from continuing the relationship.

The origin of this idea can be found in the work of Hirschman (1971), who emphasized the importance of not being able to leave a relationship too easily. Easy exit creates too little incentive for individuals to improve the operation of the organization when things go wrong. The notion that exit costs can bring about an efficient relationship in a group is formally analyzed in MacLeod (1988). That paper shows that a combination of exit costs and a repeated relationship can result in efficient team production in a revenue sharing team.<sup>15</sup>

There are a variety of ways that markets can create such quasi-rents. In the case of Japanese firms Nakane (1970) documents how workers who change jobs face a great deal of discrimination in their new work place. Such a social norm creates an exit cost that can encourage cooperation and the enforcement of incomplete contractual relations.<sup>16</sup> This idea is extended by Ben-Porath (1980) to argue that F-connections (families, friends and firms) can in general improve the operation of the market by providing more information about individuals through the creation of reputations.

In the context of bilateral relationships Klein and Leffler (1981) show how advertising can be used to dissipate the quasi-rents needed to ensure that firms develop a reputation to produce high quality goods. Fama (1980) similarly argues that managers can earn reputational rents for good performance. The interaction between reputation and contract enforcement when there are heterogeneous workers is investigated by MacLeod and Malcomson (1988). Beginning with Waldman's (1984) idea that the allocation of workers

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<sup>15</sup>Holmström (1982) provides a general result demonstrating that efficiency is not possible in a revenue sharing cooperative. See Legros and Mathews (1993) for necessary and sufficient conditions for efficiency in the static team model.

<sup>16</sup>This argument is explicitly made in Kanemoto and MacLeod (1989).

to jobs provides information to the market about the worker's ability, they show that there exists an equilibrium hierarchy of jobs that efficiently match workers to tasks. Contracts are enforced by the threat of a reputation loss leading to the worker being allocated to a lower paying job. Shapiro and Stiglitz (1984) argue that unemployment creates a rent that can be used to enforce the employment contract, an idea that has its roots in a 1923 NBER volume on unemployment and business cycles.<sup>17</sup>

Lazear and Rosen (1981) show how the creation of ex post rents in tournaments provides a way to ensure worker incentives. Carmichael (1983) and Malcomson (1984) both show how this work can be extended to two-sided incomplete contract problems. They show that the tournament solves the problem of getting the employer to commit to providing a reward for good performance. This can be achieved naturally in hierarchical firms in which the firm has already committed itself to paying more money to workers higher up on the ladder. To create the incentives for performance the employer need only ensure that promotions are limited to the best performing workers.

These works demonstrate how the need to enforce implicit contracts provides a basis for the theory of organizations. As Schotter (1984) has emphasized, an important role of the institution is not simply to set up monitoring and control procedures, but also to safeguard the set of social norms which ensure that efficient behaviour persists over time<sup>18</sup>. Observe that the incentive constraint (5) requires there to be a rent in the *future*. In repeated relationships this rent is created by the agreement to punish when defection occurs. Observe that there is no physical relationship between current and future payoffs, therefore it is only the social norm, or implicit agreement between the parties, that can enforce the relationship.

## 4.2 Empirical Implications

The existence of self-enforcing incomplete contracts implies the need for a quasi-rent from the relationship. Once there are rents, then there are a wide variety of contracts that will result in efficient levels of effort. Moreover MacLeod and Malcomson (1993) show that the existence of self-enforcing contracts implies that the division of bargaining power between the two con-

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<sup>17</sup>Rice (1923) discusses how unemployment improves worker performance.

<sup>18</sup>See also the important work of Coleman (1990) on the enforcement of social norms.

tracting parties is indeterminate:

**Proposition 1** *Suppose that, when a new match starts in period  $\tau$ , contract negotiation consists of one agent making a “take it or leave it” offer that the agent can either accept or reject. If the offer is rejected, the worker and the firm receive their respective default payoffs  $\bar{U}_0$  and  $\bar{U}_1$ . If the offer is accepted, the relation proceeds as described above. Then, whichever party makes the offer, the set of wage profiles consistent with the worker never shirking is the set given by (5).*

The essence of the proof is based on the existence of a self-enforcing social norm determining the division of the rent. Suppose that the social norm requires the agent to receive half the rent from the relationship. Then the principal will offer half of the rent if he believes that the agent will reject any smaller offer. The difficult point is to explain how rejecting any offer that gives some rent above the market alternative is an equilibrium play for the agent. This can be an equilibrium in exactly the same way the threat to terminate is an equilibrium for self-enforcing contracts. Whenever the principal offers a contract that gives the worker less than half the surplus, both parties believe that shirking followed by separation will ensue should the contract be accepted and the relationship continued.

Notice that this social norm is consistent with the survey evidence concerning managers’ reasons for not lowering wages. Ex post a self-enforcing contract requires the existence of a rent. In the employment context, if the worker is receiving part of this rent, then the firm has an incentive to lower wages in every period. This rent is not necessarily a reputation rent, but may be a rent due to search costs, as discussed by Cahuc and Zylberberg (1994). To ensure that workers are not held up *ex post*, the social norm of not cooperating or shirking in the event of a wage cut can ensure the existence of an equilibrium.

These equilibria pose some serious problems for empirical work. In particular, there are many different self-enforcing contracts that may yield equilibria. This may generate a great deal of indeterminacy in contract form over a large sample of firms and workers. It also illustrates theoretically why the allocation of property rights does not necessarily result in an allocation of bargaining power. As the example with Toyota demonstrates, workers must agree to cooperate with the allocation of authority if it is to be effective.



Aghion, Dewatripont and Rey (1994) demonstrate that one practical way to implement an efficient contract is to have the ability to allocate all the bargaining power to one agent or the other. The potential for agents to take unforeseen and non-contractible actions makes such an assumption stronger than it may seem at first glance. Even if we agree *ex ante* to allocate all the power to, say, agent 0, agent 1 still has a large set of potential courses of action that she may take *ex post*, and which may undermine this allocation of bargaining power. These include: initiating litigation, refusing to pay bills, providing low quality goods, etc. Agents may agree to allocate power to one side, but this action is not mechanical and requires the implicit agreement of both parties *ex ante* and *ex post*.

The theory does make some predictions about the form of the contract if the allocation of rents is such that one party is indifferent between accepting the contract or separating. Suppose that the employee receives a payoff that is equal to his or her market alternative. In this case the employee is indifferent between staying and leaving, and hence the threat of termination does not provide incentives. This immediately implies that to obtain the cooperation of the employee the employer must supply an end of period bonus  $b$ . Similarly, there is no way to enforce a rebate from the employee to the employer, and consequently  $\rho = 0$ . To provide her with an incentive to stay, this contract must provide the employee with a utility which exceeds the payoff in the market. Should the employer either fail to provide the necessary effort or bonus payment, the employee must separate. A similar argument applies when the roles are reversed. In general; the bonus payment should be made to the agent who is indifferent between staying and leaving.

In markets for workers in short supply, their utility in the current job will be equal to their alternative because competing firms are always willing to match the current offer. This implies that their alternative is equal to their current payoff and hence the optimal contract must include a bonus component. A substitute to a bonus would be the use of a tournament that provides *ex post* rewards to good performers. Avner Greif has pointed out to me that in the case of the Genovese agents, the highly valued ones could expect to receive future rewards such as the right of marriage into a merchant's family. My own informal polling of employers in the computer industry finds that good programmers are offered some sort of bonus package, including profit sharing and stock options. (Due to the complexity of modern software, there is a continual demand for good programmers. The employment of several

mediocre programmers is not an adequate substitute.)

Conversely, suppose that the employer has valuable capital for which efficiency dictates that it be fully employed. Further suppose that there are many equally skilled workers that may operate this equipment. In this case, should a worker leave, the firm is immediately able to replace her. Therefore the market alternative with another worker is equal to the return with the current worker. This implies that the firm suffers no loss should a worker leave, and there is therefore no way to enforce a bonus pay contract and the compensation system must take the form of a fixed wage payment. MacLeod and Malcomson (1993) observe that this is the sort of contract that explains the \$5 per day provided by Ford. In that case the assembly line capital was a scarce resource (an entrepreneurial input from Ford), implying that it was efficient to have the capital fully utilized. If a worker left, efficient requires that he be immediately replaced. As Raff (1988) has pointed out, the cost of replacing a worker was relatively low, consequently one may assume that the firm's market alternative to any given worker was equal to the return from keeping the worker. Furthermore, he finds no evidence that high wages were used to economize on monitoring. Assembly line work requires the worker to execute care which is likely to be non-contractible, thus there must be a rent in the relationship. In the case of Ford the rent was dissipated by the introduction of high wages and the creation of queues for the high wage jobs. These queues ensured that Ford could enforce a high standard of work and keep the capital fully utilized.

This model also helps us understand the survey results discussed above on wage rigidity. Managers are generally reluctant to lower wages in the face of a decline in a worker's reservation wage due to the potential effect on morale. *Ex post* there is always an element of rent sharing between the worker and the firm. Consequently, in many cases the firm could lower wages and workers would still prefer to stay on with the firm. However, if the wage is compensation for specific investments being made by the worker, then a reduction would contravene an explicit agreement. The one tactic that workers have to enforce the contract is to reduce the quality of their work should the firm try to lower the wage. Of course, in the case of a severe adverse shock it is often possible for firms to lower wages with the explicit agreement of workers. In those cases the firm needs some form of verifiable information to convince the workers that such a wage cut is necessary.

## 5 Implications for Organizations in Markets

The empirical work discussed at the beginning of this paper provides a great deal of evidence to support the hypothesis that individuals respond to incentives, however it has been much less successful in providing consistent evidence on the form of optimal contracts in firms. Nor is there a consistent body of evidence that quantitatively measures the size of the incentive effect in a way that is reproducible in any new organization. The second part of the paper suggests that a reason for this is the necessarily incomplete nature of contracts between individuals. Furthermore, the efficient governance of such contracts requires the existence of rents which weaken the predictive power of market constraints on the form of contracts.

The work on incentives and self-enforcing contracts provides a language and framework within which we can understand why certain kinds of practices work, as well illustrated in the surveys by Itoh (1992) and Milgrom and Roberts (1992). In particular the notion of contractual incompleteness implies that one should be very reticent to recommend an “optimal” contract. As the environment changes, and individuals learn, one is likely to observe new and better contract forms and relationships. The theory of self-enforcing contracts is based on the notion that one cannot identify *a priori* the notion of good effort every period. Rather, output that was considered acceptable in one period, may in fact be considered inadequate in the next. An obvious example of this is the tenure review process at universities. The standards for good quality research tend to rise over time, with the consequence that work acceptable for tenure in the 1970’s may not be considered acceptable in the 1990’s. It should also be emphasized that the tenure decision is itself a self-enforcing contract (see Carmichael (1988)). The precise criteria for promotion are never agreed upon in advance. Rather, after a review of the candidate’s work, a committee decides whether to grant tenure or not, based on past experience and individual judgment.

The incomplete contracting approach also highlights the danger of trying to make predictions or recommendations for efficient organizations. The need for contract enforcement requires the existence of rent. As Hirschman (1971) has emphasized, low mobility costs may lead to a breakdown of cooperation. However, from this it is impossible to conclude that raising mobility

costs is likely to improve performance.<sup>19</sup> Cooperation is only one of many possible equilibria when people are forced to live together. There is plenty of evidence to support the hypothesis that with high exit costs we may get inefficient equilibria. An important open question is understand how to bring about cooperative behaviour and efficient equilibria. The results on profit sharing presented in the conference paper of Weitzman (1994) is in terms of equilibrium selection are suggestive in this regard. The direct incentive effects of profit sharing are likely to be very small. However, if workers interpret profit sharing as some form of gift or indication of good will it may encourage more cooperative behaviour.<sup>20</sup>

This problem of incomplete contracts can also help us understand why it is so difficult to construct a good empirical incentive model that can be used for policy purposes. A productive relationship depends on a long-term understanding between individuals and a flexibility with regards to the evaluation of individuals. In particular, performance systems and organizational behaviour that are optimal for a given environment may not remain optimal in the future. Therefore, the notion of an optimal contract as used in the agency literature is a backward looking concept. Once we have understood the environment and have observed that a particular reward system works well, the theory is usually capable of explain why it is successful. However this does not imply that one can predict the form of an optimal contract in some future, untried environment.

Therefore I would tend to view those contract forms that we observe and call optimal as good starting points for the form of efficient relationships we will observe in the future. What seems important is that entrepreneurs are willing to experiment with new and better contract forms. A potential direction for contract theory is to adopt Schumpeter's (1951) view of economic development. If one views new and better organizational forms in terms of innovation, then his theory suggests that entrepreneurs create new reward systems that generate rents. As we have seen, these rents are often necessary to enforce implicit agreements between agents.

Over time new organizational forms are adopted by other firms. Evidence for this process can be seen in the success of management consulting firms.

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<sup>19</sup>See MacLeod (1993) for a discussion of the costly effect of mobility costs in Chinese cooperatives in the 1950's.

<sup>20</sup>Carmicheal and MacLeod (1993) illustrate how, in a dynamic model, gift exchange can help bring about cooperation.

Companies hire these firms to give advice based on their experience with a wide variety of compensation practices.<sup>21</sup> These various inputs provide ideas that can be tested by a firm. Those contracts and organizational innovations that help a firm survive in the market will flourish and eventually be adopted by other firms. It is interesting to note that the management consulting business is dominated by a relatively small number of large international firms. These firms collect data on management practices and compensation on an on-going basis. Their success seems to spring from their role as market makers for organizational innovations which ensure the widespread dissemination of good practices.

Some of the research presented at the conference is clearly moving towards a more dynamic view of incentives and organizational innovation, and is consistent with the incomplete contracting approach presented here. Aoki's (1994) paper discusses the nature of diversity and why there may be several, rather than one, locally optimal solution. Milgrom and Robert (1994) observe that there may be a great deal of path dependency resulting in the optimizing process getting stuck away from the best solution. Finally, Lazear (1994) provides a formal model of the evolution of corporate culture. One can interpret the corporate values discussed by Lazear as incorporating a set of norms that can be internalized by the firm, but cannot be explicitly contracted upon. This work will hopefully lead to a new class of empirical models that will enrich our understanding of incentives and organizations.

## References

- [1] Abowd, John M., Francis Kramarz and David N. Margolis (1994). "High Wage Workers and High Wage Firms." Mimeo, CREST, Paris.
- [2] Abraham, K. G. and H. S. Farber (1987). "Job Duration, Seniority, and Earnings." *American Economic Review*, 77, 278-297.
- [3] Aghion, P., M. Dewatripont, and P. Rey, (1994). "Renegotiation Design with Unverifiable Information." *Econometrica*, 62, pp. 257-283.

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<sup>21</sup>As an example of the kind of advice given by these firms see the book by Hewitt Associates (1991).

- [4] Alchian, Armen A. and Harold Demsetz, (1972). "Production, Information Costs, and Economic Organizations." *American Economic Review*, 62: 777-795.
- [5] Altonji, J.G. and R. A. Shakoto, (1987). "Do wages rise with seniority?" *American Economic Review*, 54, pp. 437-460.
- [6] Anderlini, L. and L. Felli, (1993). "Incomplete Written Contracts." LSE working paper.
- [7] Anderson, Erin and David C. Shmittlein (1984). "Integration of the Sales Force: An Empirical Examination." *Rand Journal of Economics*, 15, pp. 385-95.
- [8] Antle, Rick and Abbie Smith, (1986). "An Empirical Investigation in the Relative Performance of Corporate Executives." *Journal of Accounting Research*, 24, pp. 1-39.
- [9] Aoki, M., (1990). "Toward an Economic Model of the Japanese Firm." *Journal of Economic Literature* vol. XXVIII, pp. 1-27.
- [10] Aoki, M., (1994). "Why diverse organizational conventions exist and how we can benefit from diversity: An evolutionary game parable." This conference volume.
- [11] Baker, G., Micheal Gibbs, and Bengt Holmström, (1993). "A Study of an Internal Labor Market." *European Economic Review*, Vol. 37.
- [12] Baker, George P., (1992). "Incentive Contracts and Performance Measurement." *Journal of Political Economy*, 100, pp. 598-614.
- [13] Becker, G. S., (1975). *Human Capital*. The University of Chicago Press, Chicago.
- [14] Ben-Porath, Yoram, (1980). "The F-Connection: Families, Friends and Firms and the Organization of Exchange." *Population and Development Review*, 6, pp. 1-30.
- [15] Bewley, T. F., (1993). "A Depressed Labor Market, as Explained by Participants." Unpublished manuscript, Yale University.

- [16] Binmore, K., Morgan, P., Shaked, A. and J. Sutton, (1991). "Do People Exploit Their Bargaining Power? An Experimental Study." *Games and Economic Behavior*, 3, pp. 295-322.
- [17] Binmore, Ken, Swierzbinski, J., Hsu, S. and C. Proulx, (1993). "Focal Points and Bargaining." *International Journal of Game Theory*, 22, pp. 381-409.
- [18] Boyd, Robert and Peter J. Richerson, (1985). *Culture and the Evolutionary Process*. The University of Chicago Press, Chicago.
- [19] Blinder, A. S. and D. H. Choi, (1990). "A Shred of Evidence on Theories of Wage Stickiness." *Quarterly Journal of Economics*, vol. 105, pp. 1003-1015.
- [20] Brandts, Jordi and W. Bentley Macleod, (1993). "Equilibrium Selection in Experimental Games with Recommended Play." forthcoming in *Games and Economic Behavior*.
- [21] Bull, Clive, (1987). "The Existence of Self-Enforcing Contracts Implicit Contracts." *Quarterly Journal of Economics*, 102, pp. 147-159.
- [22] Bull, Clive, Andrew Schotter, and Keith Weigelt, (1987). "Tournaments and Piece Rates: An Experimental Study." *Journal of Political Economy*, 95, pp. 1-33.
- [23] Cahuc, Pierre and André Zylbergberg, (1994). "Moral Hazard and Involuntary Unemployment." Mimeo, Université de Paris 1.
- [24] Cameron, Kim S., (1994). "Strategies for Successful Organizational Downsizing." Forthcoming in *Human Resources Management Journal*.
- [25] Carmichael, Lorne, (1983). "The Agents-agents problem: Payment by relative output." *Journal of Labor Economics*, 1, pp. 50-65.
- [26] Carmichael, Lorne, (1988). "Incentives in Academics: Why is there tenure?" *Journal of Political Economy*, 96, pp. 453-72.
- [27] Carmichael, Lorne and W. Bentley MacLeod, (1993). "Gift Giving and the Evolution of Cooperation." Mimeo Queen's University.

- [28] Chandler, Alfred D., (1977). *The Visible Hand: The Managerial Revolution in American Business*. Harvard University Press, Cambridge, Mass.
- [29] Coleman, J., (1990). *Foundations of Social Theory*. Harvard University Press, Cambridge Mass.
- [30] Cooter, Robert and Thomas Ulen, (1988). *Law and Economics*. Scott, Foresman and Company, Glenview, Illinois.
- [31] Davis, Douglas and Charles A. Holt, (1993). *Experimental Economics*. Princeton University Press, Princeton, New Jersey.
- [32] Devine, T. J. and N. M. Kiefer, (1991). *Empirical Labor Economics*. Oxford University Press, Oxford.
- [33] Fama, G., (1980). "Agency problems and the theory of the firm," *Journal of Political Economy*, 88, pp. 288-307.
- [34] Ferrall, Chris, (1994). "Emprical Analysis of Occupational Hierarchies." Mimeo Queen's University, Kingston Canada.
- [35] Gibbons, R. and K. J. Murphy, (1990). "Relative Performance Evaluation For Chief Executive Officers." *Industrial and Labor Review*, 43, Special Issue, pp. 30-51.
- [36] Gibbons, R. and K. J. Murphy, (1992). "Optimal Incentive Contracts in the Presence of Career Concerns: Theory and Evidence." *Journal of Political Economy*, 100, pp. 468-505.
- [37] Grossman, S. J. and O. Hart, (1986). "The costs and benefits of ownership: A theory of vertical and lateral integration." *Journal of Political Economy*, 94, pp. 691-719.
- [38] Greif, A., (1994a). "Cultural Beliefs and the Organization of Society." Forthcoming in the *Journal of Political Economy*.
- [39] Greif, A., P. Milgrom, and B. Weingast, (1994b). "Coordination, Commitment and Enforcement: The Case of the Merchant Guild." Forthcoming in *Journal of Political Economy*.



- [40] Grout, P., (1984). "Investment and wages in the absence of binding contracts: A Nash Bargaining Approach." *Econometrica*. 52, pp. 449-460.
- [41] Hall, J., (1993). "The Wage Setters Guide to Wage Rigidity." MSc dissertation, University of Southampton.
- [42] Ham, John, and Samuel Rea, (1987). "Unemployment Insurance and Male Unemployment Duration in Canada." *Journal of Labor Economics* 5, pp. 325-351.
- [43] Hart, O. and J. Moore, (1988). "Incomplete Contracts and Renegotiation." *Econometrica*, 56, pp. 755-785.
- [44] Hart, O. and B. Holmström, (1985). "The Theory of Contracts." In *Advances in Economic Theory: Fifth World Congress* (T. Bewley ed.). Cambridge University Press, Cambridge.
- [45] Hewitt Associates, (1991). *Total Compensation Management*. Blackwell Business, Cambridge Mass.
- [46] Hirschman, A., (1971). *Exit, Voice and Loyalty*. Harvard University Press.
- [47] Holmström, Bengt, (1979). "Moral Hazard and Observability." *Bell Journal of Economics*, 10, pp. 74-91.
- [48] Holmström, B. R., (1982). "Moral Hazard in Teams." *The Bell Journal of Economics*, 13, pp. 324-40.
- [49] Holmström, Bengt and Paul Migrom, (1991). "Multi-task Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design." *Journal of Law, Economics, and Organizations*, 7, pp. 24-52.
- [50] Holmström, Bengt and Paul Migrom, (1994). "The Firm as an Incentive System." forthcoming in the *American Economic Review*.
- [51] Ichinowski, C., (1992). "Human Resource Practices and Productive Labor-Management Relations." Draft, Columbia Univ. NBER.

- [52] Itoh, H., (1992). "Cooperation in Hierarchical Organizations: An Incentive Perspective." *Journal of Law, Economics, and Organization*, 8, pp. 321-345.
- [53] Jensen, M. C. and W. H. Meckling, (1976). "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure." *Journal of Financial Economics*, 3, pp. 305-360.
- [54] Jensen, Micheal and Kevin Murphy, (1990). "Performance Pay and Top Management Incentives." *Journal of Political Economy*, 98.
- [55] Kanemoto, Y. and W. B. MacLeod, (1992). "The Ratchet Effect and the Market of Secondhand Workers." *Journal of Labor Economics*. 10, pp. 85-98.
- [56] Kaufman, Roger T., (1984). "On Wage Stickiness in Britain's Competitive Sector." *British Journal of Industrial Relations*, 22, pp. 101-112.
- [57] Klein, B. and K. Leffler, (1981). "The Role of Market Forces in Assuring Contractual Performance," *Journal of Political Economy*, 89, pp. 615-641.
- [58] Koike, K., (1984), "Skill Formation Systems in the U.S. and Japan: A Comparative study." In: M. Aoki ed., *The Economic Analysis of the Japanese Firm*, North Holland, pp. 47-75.
- [59] Koike, Kazuo, (1988). *Understanding Industrial Relations in Modern Japan*. MacMillan, London.
- [60] Koike, K., (1994). "Learning and Incentive Systems in Japanese Industry." In: *The Japanese Firm: Sources of Competitive Strength*, (M. Aoki and R. Dore eds). Oxford University Press.
- [61] Knober, Charles and Walter N. Thurman, (1994). "Testing the Theory of Tournaments : An Empirical Analysis of Broiler Production." *Journal of Labor Economics*, 12, pp. 155-179.
- [62] Krueger, A. B. (1991). "Ownership, Agency and Wages: En Examination of Franchising in the Fast Food Industry." *Quarterly Journal of Economics*, 104, pp. 75-102.

- [63] Krueger, Alan B. and Lawrence Summers, (1988). "Efficiency Wages and the Inter-Industry Wage Structure." *Econometrica*, 56, pp. 259-293.
- [64] Lambert, R. and D. Larcker, (1987) "An Analysis of the Use of Accounting and Market Measures in Executive Compensation." *Journal of Accounting Research*, 25, pp. 85-125.
- [65] Lawler, Edward E. II, (1990). *Strategic Pay: Aligning Organizational Strategies and Pay Systems*, San Francisco: Josey-Bass.
- [66] Lazear, Edward, (1979). "Why is there Mandatory Retirement?" *Journal of Political Economy*, 77, pp. 1261-84.
- [67] Lazear, Edward, (1989). "Pay Equality and Industrial Politics." *Journal of Political Economy*, pp. 561-580.
- [68] Lazear, Edward P., (1992). "The Job as a Concept." In: *Performance Measurement, Evaluation, and Incentives*, edited by William J. Bruns, Boston: Harvard Business School.
- [69] Lazear, Edward P., (1994). "Corporate Culture and the Diffusion of Values." In this volume.
- [70] Lazear, Edward and Robert Moore, (1984). "Incentives, Productivity, and Labor Contracts." *Quarterly Journal of Economics*, 99, pp. 275-95.
- [71] Lazear, Edward and Sherwin Rosen, (1981). "Rank Order Tournaments as Optimum Labor Contracts." *Journal of Political Economy*, 89, pp. 841-64.
- [72] Legros, Patrick and Steve Mathews, (1993). "Efficient and Nearly Efficient Partnerships." *Review of Economics Studies*, 60, pp. 599-612.
- [73] Lemieux, Thomas and W. Bentley MacLeod, (1994). "A Longitudinal Analysis of Unemployment Insurance Reciprocity in Canada, 1972 to 1992." Mimeo Université de Montréal.
- [74] Lindbeck, A. and Snower, D. (1988) "Cooperation, Harassment, and Involuntary Unemployment: An Insider-Outsider Approach." *American Economic Review*, vol. 78, pp. 167-188.

- [75] Lipman, Bart, (1992). "Limited Rationality and Endogenously Incomplete Contracts," Queen's University Working paper.
- [76] MacLeod, W. B., (1988). "Equity, Efficiency and Incentives in Cooperative Teams." In: *Advances in the Economic Analysis of Participatory and Labor Managed Firms*, Volume 3, 5-23, J.A.I.
- [77] Macleod, W.B., (1993). "The Role of Exit Costs in the Theory of Cooperative Teams: A Theoretical Perspective." *Journal of Comparative Economics* 17, pp. 521-29.
- [78] MacLeod, W. Bentley and James M. Malcomson, (1988). "Reputation and Hierarchy in Dynamic Models of Employment." *Journal of Political Economy*, vol. 96, pp. 832-854.
- [79] MacLeod, W. Bentley and James M. Malcomson, (1989). "Implicit Contracts, Incentive Compatibility, and Involuntary Unemployment." *Econometrica*, vol. 57, pp. 447-480.
- [80] MacLeod, W. Bentley and James M. Malcomson, (1993a). "Investments, Holdup, and the Form of Market Contracts." *American Economic Review*, 83(4), pp. 811-837.
- [81] MacLeod, W. Bentley and James M. Malcomson, (1993b). "Motivation, Markets, and Dual Economies." Discussion Paper in Economics and Econometrics No. 9319, University of Southampton.
- [82] Malcomson, J. M., (1984). "Work Incentives, Hierarchy, and Internal Labor Markets." *Journal of Political Economy*, vol. 92, pp. 486-507.
- [83] MacMullen, Ramsay, (1988). *Corruption and the Decline of Rome*. Yale University Press, New Haven.
- [84] Manski, Charles F., (1993a). "Dynamic choice in social settings." *Journal of Econometrics*, 58, pp. 121-136.
- [85] Manski, Charles, (1993b). "Identification of Endogenous Social Effects: The Reflection Problem." *Review of Economic Studies*, 60, pp. 531-543.

- [86] Margiotta, Mary M. and Robert A. Miller, (1993). "Managerial Compensation and the Cost of Moral Hazard." GSIA working paper 1993-19.
- [87] Meyer, Bruce, (1990). "Unemployment Insurance and Unemployment Spells." *Econometrica* 58, pp. 757-782.
- [88] Milgrom, P., D. C. North, and B. R. Weingast, (1990). "The Role of Institutions in the Revival of Trade: the Law Merchant, Private Judges, and the Champagne Fairs." *Economics and Politics*, 2, pp. 1- 23.
- [89] Milgrom, Paul and John Roberts, (1992). *Economics, Organizations and Management*, Prentice Hall, Englewood Cliffs.
- [90] Milgrom, Paul, (1988). "Employment Contracts, Influence Activity and Efficient Organization." *Journal of Political Economy*, pp. 42- 60.
- [91] Miller, Keith and Robert L. Hamblin,, (1963). "Interpedence, Differential Rewarding, and Productivity", *American Sociological Journal*, vol. 28, no. 5, pp. 768-778.
- [92] Mincer, Jacob and Y. Higuchi, (1988). "Wage Structure and Labor Turnover in the United States and Japan." *Journal of Japanese and International Economics*, 2, pp. 97-133.
- [93] Mincer, Jacob, (1958). "Investment in human capital and personal income distribution." *Journal of Political Economy*, 66, pp. 281-302.
- [94] Moore, John, (1994). "Implementation, contracts and renegotiation in environments with complete information." In *Advances in Economic Theory: Sixth World Congress* (J.-J. Laffont ed.). Cambridge University Press.
- [95] Nakane, Chie, (1970). *Japanese Society*, University of California Press, Berkeley.
- [96] Neal, Derek, (1993). "Supervision and Wages across Industries." forthcoming in *Review of Economics and Statistics*.
- [97] North, D., (1981). *Structure and Change in Economic History*, Norton, New York.

- [98] Ohno, Taiishi, (1984). "How the Toyota production system was created." In: *The Anatomy of Japanese Business* (ed. Kazuo Sato and Yasuo Hoshino), pp. 197-215, New York: Basic Books.
- [99] Osborne, M. J. and A. Rubinstein, (1990). *Bargaining and Markets*, San Diego: Academic Press.
- [100] Parent, Daniel, (1994). "Competitive Wages: The Effect of Training and Industry-Specific Capital." Mimeo Université de Montréal.
- [101] Pearce, D., (1993). "Repeated Games: Cooperation and Rationality." In *Advances in economic theory Sixth World Congress*, J.-J. Laffont, ed., Cambridge University Press, U.K..
- [102] Radner, R., (1992). "Hierarchy: The Economics of Managing." *Journal of Economic Literature*, vol. XXX , pp. 1382-1415.
- [103] Raff, D., (1988). "Wage Determination and the Five-Dollar Day at Ford." *Journal of Economic History*, 48m pp. 387-399.
- [104] Rice, Stuart A., (1923). "The Effect of Unemployment upon the Worker and His Family." In: *Business Cycles and Unemployment*, The National Bureau of Economic Research, pp. 99-112.
- [105] Rosen, Sherwin, (1982). "Authority, control and the distribution of earning." *Bell Journal of Economics*, pp. 311-323.
- [106] Rosen, Sherwin, (1988). "Transactions Costs and Internal Labour Markets." *Journal of Law, Economics and Organization*, 4(1) pp. 49-64.
- [107] Rosen, Sherwin, (1992). "Contracts and the Market for Executives." In *Contract Economics*, (Werin, L. and H. Wijkander, eds), Basil Blackwell, Cambridge, Mass.
- [108] Rosenbaum, James E., (1984). *Career Mobility in a Corporate Hierarchy*. Academic Press, New York.
- [109] Schelling, Thomas, (1960). *The Strategy of Conflict*, Harvard University Press, Cambridge Mass.

- [110] Schmitt, D. R., (1981). "Performance Under Cooperation or Competition." *American Behavioral Scientist*, vol. 24 No. 5, pp. 649-679.
- [111] Schotter, A., (1984). *The economic theory of social institutions*. Cambridge University Press.
- [112] Schumpeter, J. (1951). *The Theory of Economic Development*. Cambridge, Mass: Harvard University Press.
- [113] Shapiro, C. and J. Stiglitz, (1984). "Equilibrium Unemployment as a Discipline Device." *American Economic Review*, 74, pp. 433-44.
- [114] Simon, H. (1956). "A Comparison of Game Theory and Learning theory." *Psychometrika* 21, pp. 267-272.
- [115] Simon, H. (1972). "Theories of Bounded Rationality." In *Decision and Organization*, edited by C. B. Radner and R. Radner, pp. 161-176. Amsterdam: North-Holland Publishing Company.
- [116] Smith, Adam, (1976). *The Wealth of Nations*. University of Chicago Press, Chicago.
- [117] Tirole, J. (1992). "Collusion and The Theory of Organizations." In: *Advances in Economic Theory*, J-J. Laffont (ed.), Cambridge University Press, Cambridge.
- [118] Tirole, J. (1994). "Incomplete Contracts: Where do we stand?" Walras-Bowley Lecture, Econometric Society Meetings, Quebec.
- [119] Townsend, R. M., (1994). "Risk and Insurance in Village India," *Econometrica*. 62, pp. 539-593.
- [120] Van Huyck, J. B., A. B. Gillette and R. C. Battalio, (1992). "Credible Assignments in Coordination Games." *Games and Economic Behavior*, 4, pp. 606-626.
- [121] Waldman, Michael, (1984). "Worker Allocation, Hierarchies and the Wage Distribution." *Review of Economic Studies*, 51, pp. 95-109.
- [122] Weitzman, Martin L. (1994). "Incentive Effects of Profit Sharing." In this volume.

- [123] Williamson, Oliver, (1975). *Markets and Hierarchies: Analysis and Antitrust Implications*. Free Press, New York.
- [124] Williamson. O. (1985). *The Economic Institutions of Capitalism*. N.Y., Free Press.
- [125] Woodbury, Stephen A. and Robert B. Spiegleman, (1987). “Bonuses to Workers and Employers to Reduce Unemployment: Randomized Trials in Illinois.” *American Economic Review*, 77, pp. 513-531.
- [126] Young, H. Peyton, (1993). “The Evolution of Conventions.” *Econometrica*, 61, pp. 57-84.
- [127] Zellner, Arnold, (1988). “Bayesian Analysis in Econometrics.” *Journal of Econometrics*, 37, pp. 27-50.