

Incentives in Managerial Compensation: A Survey of Experimental Research*

Alessandro Rossi[†]

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Abstract

The issue of designing effective managerial incentives has recently gained considerable attention in both theoretical analysis and business practices. Despite the importance of the theoretical achievements, to date little attempt has been made to test empirically the major theoretical hypotheses underlying incentive theories. More recently, the debate has been fuelled by the development of economic experimental studies explicitly designed to investigate how real decision makers subject to economic incentives behave. The aim of this paper is to provide a comprehensive survey of experimental contributions to contract and incentive design issues and to offer some suggestions for future research.

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[†]Dipartimento di Informatica e Studi Aziendali, Università degli Studi di Trento, arossi@cs.unitn.it, <http://www.cs.unitn.it/rock>

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1 Introduction

In the past two decades the economic and management research community has paid increasingly close attention to the issue of designing incentives for managers (or, more in general, workers).

Numerous scholars, ranging from human resource scholars to social psychologists, have contributed to the debate from different angles and perspectives, and economic studies within the principal–agent framework and contract design literature have substantially developed comprehensive theoretical contributions.

This has been a striking phenomenon from the perspective of business practices and fads as well. By way of examples of the revolution brought about in corporate compensation policies, a recent survey based on a sample of roughly five hundred U.S. companies revealed that over 54% of those companies had restructured their pay systems in order to reflect changes in corporate culture, the aim being to cope with market pressure better. And most of the other companies agreed that change in pay systems was strategically essential (Flannery et al., 1996). Moreover, in the past years work group compensation and team incentive design have greatly increased in popularity.¹

¹Wellins et al. (1991) recently claimed that more than the 25% of U.S. firms had implemented work group reward schemes.

Numerous leading researchers agree that agency cost theory has brought substantial theoretical advances in recent years. On the one hand, for example, contract theory has shed considerable light on the nature of optimal contracts under alternative assumptions on the parties involved in the agency relationship, like the level and distribution of information between them and differences in attitudes towards risk (Hölmstrom, 1982). Tournament theory, on the other hand, has shown that when relative compensation mechanisms rather than absolute measurements are introduced, the results in terms of impact on workforce effort may be greatly affected by manipulating group size or by the spread between alternative payoffs (Lazear and Rosen, 1981).

The importance of these theoretical findings notwithstanding, some authors have recently suggested that empirical research in this field has still to gather momentum: not only are empirical studies seemingly underdeveloped, but topics more relevant from a theoretical perspective have been left largely untested by empirical studies. This is indeed true if we consider that the bulk of empirical work has focused, on the one hand, on econometric studies of the relationship between profit sharing or various forms of employee stock ownership and labour productivity (Weitzman and Kruse, 1990; of Labor, 1993) and, on the other, on surveys of corporate compensation policies and the determinants of executive pay, as well as on such related issues as the impact of executive turnover on company performance (Jensen and Murphy, 1990; Brunello et al., 1997; Murphy, forthcoming). This literature arose during the eighties as the joint result of growing interest in executive pay by the media and society and the dramatically increasing levels of executive pay in the same period: as Murphy pointed out “CEO pay research has grown even faster than CEO paychecks” (Murphy, forthcoming). Despite the close connections with principal-agent theory, the mainstream literature on incentives and pay has

mainly focused on descriptive analysis of trends and fads arising from business practices, analysing them with regard to firm's productivity and profitability, and using data from large databases on executive pay. Surprisingly enough, there has been only marginal concern to challenge the underlying theoretical framework. Little attempt has been made to understand, for instance, the extent to which the normative prescriptions arising from contract theory are robust. In short, most of the issues relevant to a firm's human resources manager and mechanisms designer seem to have been disregarded by "standard" empirical theory.

Among the more important issues ignored by empirical studies are the following: the relative effectiveness of alternative types of group and individual incentive systems; comparison between levels of effort enforceable by means of relative versus absolute mechanisms of performance evaluation (tournament); the intertemporal behavior and risk attitude of real decision makers and managers; resolving the trade-off between individual pay and motivation and work group cooperation; and so on.

On closer inspection there are sound reasons that justify, to some extent, the lack of empirical research on these topics. In particular, as pointed out by various authors (Walker, 1989; Nalbantian and Schotter, 1997), it should be borne in mind that:

- most of the information required to test agency propositions is difficult to observe and gather. Moreover, the majority of the problems that arise when empirically studying the main issues of agency theory and contract theory are due to a lack of natural data on the relevant parameters (e.g. employee pay and productivity, preference and production function parameters, individual utility and cost functions, monitoring systems, and so on), and to the difficulty of controlling these parameters;

- there are serious control problems, as well as the limits of endogeneity of statistical techniques (especially in highly idiosyncratic environments);
- experiments on the effects of incentives on the behavior of real decision makers are difficult to set up in field studies – for instance, legal difficulties and conflicts with trade unions are likely to arise – and it is difficult to isolate the effect of a single variable on productivity or performance measures, given that it is impossible to controlling all the other elements that may affect it (this is the well-known *ceteris paribus* issue).²

The inability of empirical research to address many underlying and interesting theoretical issues of agency, motivation and compensation is, to some extent, now diminishing. This is because data on compensation and performance measures, also far below the top executive level, have become increasingly available in recent years. Nevertheless, the arguments set out earlier in this section suggest that the “standard” empirical literature may be intrinsically limited when it tackles managerial incentives and motivation topics.

As a result, an experimental approach seems reasonably able to shed light on these issues, to the extent it can:

- isolate the behavior of subjects in stylized markets;
- conduct systematic analysis of *ceteris paribus* changes in institutional variables;

²The study by Petty et al. (1992), for instance, analyses the effects of the introduction of an organizational incentive plan in a division of an electricity company: evidence of the success of the organizational incentive plan is presented, as well as episodes of conflict between the union and management which eventually led to cancellation of the experiment.

- assess whether the incentive properties pointed out in the theory still hold in actual behavior;

Moreover, this approach seems particularly suited to enhancing our understanding of agency theory from the behavioral perspective. One of the elements neglected in the game theoretical and mathematical adaptation of the transaction cost economics framework is the fact that principal–agent theory and contract theory develop their models without taking account of bounded rationality (which, on the contrary, plays a major role in transaction costs as one of the principal determinants of market failures and the rise of hierarchies as transaction governance mechanisms). In this respect, an experimental approach seems promising to the extent that it enables investigation of how the bounded rationality of real decision makers affects the outcome of numerous agency problems and issues traditionally analysed in the light of “standard” rational self–interest behavioral assumptions (Kreps, 1996).

In fact, as has been pointed out:

“...agency theory can be criticized from a behavioral perspective for its narrow view of rationality and its assumptions regarding economics agents’ cognitive ability. ... Despite its generality, agency models fail to capture many important aspects of behavior within organizations” (Levinthal, 1988)

Accordingly, laboratory experimentation seems to be the ideal instrument with which to investigate problem–solving by real decision makers in agency stylized settings, and their attitudes towards effort and risk.

The rest of this paper will seek to provide a comprehensive overview of existing experimental research on managerial pay and incentive design. The

paper is organized as follows: section 2 deals with tournament theory; section 3 discusses and compares group and individual incentive schemes, while section 4 investigates experimental laboratory markets issues.

Each section begins with a brief outline of the theoretical issues involved and short discussion of how “standard” empirical studies have challenged theory to date. There then follows a review of existing experimental studies, with particular care taken to explain why an experimental approach may yield further knowledge on the issue analyzed. Concluding remarks, including suggestions for future experimental research, will be made for each line of study.

2 Tournament Theory

Tournament theory is characterized by its focus on relative rather than absolute performance as the independent variable influencing retribution mechanisms. Relative compensation fosters a person’s motivation to the extent that a prize (monetary reward, promotion, benefit) is made contingent on the comparison of his/her performance with that of neighbours (competitors). From the the tournament administrator’s point of view, the advantages of employing evaluating procedures based on relative performance may be that the latter is easier to observe than absolute performance, and also that it is possible to eliminate (to some extent) common noise and variability beyond the control of workers (exogenous conditions) (Lazear and Rosen, 1981; Lazear, 1995).

One of the simplest possible instances of tournament, and one of the most pervasive in business practices, is the so-called *rank order tournament*, where the payment scheme depends only on the ranking of performance. This situation can be set up by defining a number of specific elements viz.:

- prizes: these are fixed in advance and made independent of absolute performance; they may consist in monetary prizes, promotion slots, etc.;
- comparison method: workers' performances are measured and compared. The best performer is awarded the highest prize, and so on. No importance is given to how much one worker outperforms the others: on the contrary, only the rank order matters.

Suppose that two workers are competing for a promotion. The tournament administrator, in designing the relative compensation scheme, has to choose the prizes carefully, taking into account that:

- the average prize money must be sufficiently high to attract workers to come and work in the firm in the first place (this principle is also known as *participation constraint*);
- the effort that a worker puts into his/her job depends both on the size of the two prizes and on the spread between them: the higher the winner prize and the salary spread, the more effort a worker will make;
- the salary spread connected to the promotion cannot be infinite, because of the firm's funds problem, but also because of the decreasing returns of compensation on effort costs;
- if the measured outcome of a worker's performance depends on contingencies beyond his/her control (e.g. luck), s/he will be less motivated to make more effort.

Tournament theory has yielded analytical understanding on how promotions and other compensation mechanisms may motivate worker

behavior. It has explained, at least qualitatively (comparative static analysis), how worker effort may be affected by design variables (for instance the prize spread, accuracy in monitoring performance) as well as external variables (risk level of the industry, luck).

Despite the importance of its achievements, the assertions of tournament theory have rarely been tested by empirical studies. A major explanation for the lack of empirical research is the difficulty of gathering natural data (for instance, worker cost functions). Some relevant exceptions do exist, however: Antle and Smith (1986), for instance, examined the pay of corporate executives using a large sample of corporations, finding that firms implicitly reward managers on the basis of personal performance relative to that of other managers, and on the basis of the firm's performance relative to that of other firms in the same industry. Lambert et al. (1993) found that hierarchical structures in some organizations are compatible with tournament theory. Many empirical studies both in the United States and European countries have found that both the remuneration of CEOs and their turnover, or probability of maintaining their position, depend on their performance relative to that of the industry (Gibbons and Murphy, 1990; Brunello et al., 1998).

All these studies provide evidence that relative performance is a recurrent pattern in compensation systems and may play an important role in determining promotions within firms. They are not directly concerned to test specific predictions arising from tournament theory or to validate the main assertions of that theory. Some exceptions do exist, even though the most striking evidence comes from settings different from business ones, like sporting events. Rosen (1984), for instance, analyses the distribution of prizes in sports matchplay tournaments; Ehrenberg and Bognanno examined the behavior of professional golfers and find evidence that richer tournaments yield better performances, although they were unable to

distinguish between the influence on motivation exerted by prize spreads or by higher prize levels (Ehrenberg and Bognanno, 1990*b,a*).

A nice test of tournament theory in recruitment decisions has been carried out by Ash (1990), whose analysis of navy recruiters showed that they behaved as if they were in a tournament, and that their behavior was influenced by the way in which performances were measured (for instance, they emphasized quantity over quality when the former variable was a key factor in comparison of relative performances). Finally, Knoeber and Thurman (1994) has validated three interesting assertions of tournament theory within a business framework (producers of broiler chickens): changes in the level of prizes which leave the prizes spread unaltered do not affect performances; more able players choose less risky strategies and tournament administrators attempt to reduce the disincentive effects of mixed tournaments by minimizing differences between players.

Overall, the empirical literature supportive of tournament theory seems at least to be narrow-focused. It gives the impression that many important theoretical issues have still to be investigated, and that the consequences of relative incentive schemes on the behavior of real decision makers are still far from being completely understood. For instance, how do different attitudes towards risk and towards cooperation affect the efforts of real workers and the performance of real firms? Which is more motivating: the prizes spread or the average level of prizes? What consequences arise if heterogeneous agents are introduced? Do real decision makers fail to recognize equivalent trade-offs among noise and prize spread, and do they exhibit well-know judgement biases in evaluating alternative tournaments? What performance and efficiency consequences derive from affirmative action programmes and equal opportunity laws in tournaments? These, just to name the few, are relevant empirical issues which, to date, have been neglected by empirical research.

The experimental literature on tournaments has been minimal: in the rest of this section I shall summarise the most notable studies on the matter.

2.1 An efficiency comparison between Tournament and Piece Rate schemes

Bull et al. (1987) were the first to examine in laboratory conditions of the properties of rank-order tournaments compared with piece rate reward schemes. They studied two-person, symmetric rank-order tournaments of the following form: there are two agents i and j , each of which has the following utility function:

$$u_k(p_k, e_k) = p_k - e_k^2/c, \quad \forall k = i, j$$

where p_k is agent k 's payment and the second term is agent k 's cost function, which increases with the square of effort e_k (normalized by c). Agent k 's payment is defined as:

$$p_i = \begin{cases} M & \text{if } y_i > y_j \\ m & \text{if } y_i < y_j \end{cases}$$

where $y_k = e_k + \epsilon_k$ is defined as the output of agent k . Direct observation of effort is not possible: only performances can be measured by the principal, and they are equal to the sum of effort and $\epsilon_k \sim U[-a, a]$ *i.i.d.*, which can be interpreted as a random shock. Consequently, the principal (the tournament administrator) has imperfect technology with which to measure the agents' performance; or alternatively, environmental noise somehow interferes with the effort and affects the performance of one agent.

Theoretical predictions affirm that equilibrium efforts will be as in the following formula:

$$\frac{(M - m)c}{4a} = e^*.$$

They will consequently increase proportionally with the spread between prizes ($M - m$) and will move inversely with the variance of ϵ and the cost of effort (multiplied by $1/c$).

From the business practices perspective this can be stated in the following terms: managers will be more motivated in their work if the payoff increase connected with a promotion is large, and if random elements do not overly affect the measurement (performance) of their effort.

Given this theoretical frame of reference, Bull and colleagues then tested some theoretical assumptions on the robustness of equilibrium predictions, on the absence of illusory effects, on the role of information in this class of games, and on the equivalence of tournaments with piece rate schemes.

They designed ten different experiments, in which subjects were paired at random and given information on all the parameters of the game except the identity of their matched player. Each tournament lasted 12 rounds. Even if in real contexts one shot tournaments are observed, the authors claimed that the complex decisions underlying the tournament game justified the repetition.

By way of summary, they found that:

- the theory holds on average, i.e. it correctly predicts the behavior of subjects in symmetric tournaments at an aggregate level, while single runs of the game display high levels of variance;
- there is no illusion effect: changes in the parameters of the game which leave the equilibrium unaffected do not result in a change in the behavior observed;

- information plays a major role in behavior: if players are told not only the rank order (whether they lose or win the tournament) but also the actual performance of the other player, they devote higher than optimal (from their perspective, not from that of the tournament administrator) effort to their work; or at least convergence to equilibrium levels is slower. By contrast, this was not the case when information about the other player's actual effort was given to subjects;
- in asymmetric tournaments³ disadvantaged contestants make a greater effort than predicted by the theory; and the theory also slightly underpredicts the effort of advantaged subjects. No disengagement effects are found: disadvantaged contestants do not completely shirk their work because they realize that they are handicapped and unlikely to win the tournament, compared with their advantaged opponents;
- tournament schemes are on average able to elicit the same level of effort as piece rate schemes, but they give rise to higher variance of behavior, since the game nature of the issue (conjectural variations) and the discontinuity of payoff functions result in greater difficulties in computing, or learning over time, the optimal strategy with respect to the difficulty of solving an individual decision making problem, as in the case of piece rate

From the firm's perspective, this higher variance can be viewed as a

³Asymmetric tournaments are tournaments in which the participants have different skills or different attitudes towards effort. One player with a higher (lower) effort cost than another is called the disadvantaged (advantaged) player'. Tournament theory predicts that in asymmetric tournaments subjects will, in equilibrium, display a level of effort inversely proportional to their effort cost (for formal analysis of the equilibrium see Bull et al. (1987)).

risk embedded in the institutional mechanism of relative pay, which is higher than other incentive scheme and must be taken into account when designing managerial incentives.

2.2 Asymmetrical tournaments, equal opportunity laws and affirmative actions

Despite the large body of literature on affirmative action programmes and equal opportunity laws, there is little empirical analysis of how these impact on firms' efficiency. Traditional views justify the existence or the imposition of these programmes and laws on firms on the ground that their net value should be non negative (the balance between the increased utility of the categories of workers benefiting from these instruments and the decreased utility of firms in terms of reduced efficiency). Schotter and Weigelt (1992) investigated these issues in an experimental tournament setting and found that in many situations the supposed trade-off between equity and efficiency does not arise; indeed, on the contrary, both workers and firms may benefit from the introduction of instruments regulating the internal labour market.

From the perspective of tournament theory, equal opportunity laws force tournament administrators to set up symmetric tournaments instead of the asymmetric ones that would naturally arise given the presence of differences in abilities, skills and effort costs among workers. On the other side, affirmative action programmes can be viewed as asymmetric tournaments where agents are identically skilled but some of them are discriminated against, while others (disadvantaged groups like minorities, women, and so on) are favoured.

The main findings of Schotter and Weigelt (1992) can be summarized as

follows:

- While the baseline experiment on symmetrical tournaments substantially replicated the previous results of Bull et al. (see the previous subsection), the experiments on asymmetrical tournaments told a different story: from the aggregate perspective, subjects behaved as the theory would have predicted (no oversupply of effort by disadvantaged subjects can be inferred from aggregate results). Closer inspection of the data revealed that, when the degree of asymmetry was large, disadvantaged subjects divided roughly into two groups: some of them oversupplied their effort while others dropped out, supplying zero effort. The authors claim that this was due to learning process from disadvantaged players in the early stages of the game conditioned to bad or good luck and to aggressive play of opponents.
- Equal opportunity laws were simulated in the experimental setting by comparing symmetrical tournament outcomes with that of 2-person *unfair tournaments* that is, tournaments in which subjects have identical cost functions and one of them is discriminated against in that he or she must produce an output that is greater than the opponent in order to assure himself to have equal probabilities to receive the winner's prize (M). The introduction of equal opportunity (eliminating rule asymmetries) results in increases in output and in the likelihood that previously disadvantaged individuals will win the tournament. Overall, the introduction of equal opportunity laws is beneficial to both managers and the firms administering the tournament.
- The role of affirmative actions programmes was investigated by comparing the outcomes of uneven tournaments (asymmetrical costs)

against the outcomes of uneven and unfair tournaments, when the affirmative action consisted in counterbalancing the degree of asymmetry by imposing an unfair supply rule (as described above) on the advantaged player. Affirmative action programmes had mixed effects in the experiment: when differences among advantaged and disadvantaged subjects were not severe, the introduction of such programmes increased both the probability of winning and the expected payoff for disadvantaged subjects, but they also resulted in losses for the tournament administrator (decrease in total output). By contrast, when asymmetries were severe, affirmative action programmes were beneficial both to disadvantaged subjects and to the firms implementing such programmes.

2.3 Tournaments in group incentives schemes

Nalbantian and Schotter (1997) have recently conducted experiments on a variety of group incentive schemes.

They show that relative performance schemes which compare among the productivities of different working groups are able to elicit higher levels of worker effort than many target-based group schemes. For a more complete analysis of their findings see also section 3 of this paper.

2.4 Further investigation

The literature surveyed in this section bears out many of the contentions of tournament theory, although it also highlights some discrepancies between the theory and behavior observed in laboratory conditions. Overall, it seems that much work still remains to be done in order to understand the

behavioral properties of these schemes more precisely. In particular, the following lines of research seem promising:

- What are the causes of high variance and path dependent behavior in the early stages of the game? While some explanations of high variance have already been given by previous research, it seems still puzzling with respect to learning process occurring in the early stages of the game.
- It seems that behavior in asymmetrical tournament games depends crucially on the goals pursued by the subjects. As noted in the experimental literature, some players may not be solely concerned to maximize their monetary reward minus the cost of effort; they may also be motivated by a desire to win the game. It would be interesting to elaborate these topics in order to understand whether defocusing instructions and changing the experimental environment results in behavior closer to the equilibrium prediction.
- No previous experiments have investigated the trade-off between efficiency and collaboration supposedly typical of tournaments and crucial in influencing the decision to implement a tournament within a firm. From the perspective of the tournament administrator, it would be interesting to investigate how this trade-off for workers could be lessened without resorting to traditional instrument devised by the theory, such as pay compression.
- When workers are allowed to choose which tournament to join (as is often the case in the professional job market), it would be interesting to investigate, from a behavioral standpoint, whether different criteria from those predicted by tournament theory are used to compare among the alternative contracts, and to what extent the heuristics and

biases in individual decision making problems may be transferred into these kind of decisions. For instance, rather than comparing among different tournaments using the participation constraint and average salary, workers may rely on heuristics similar to those employed in decision making under uncertainty, such as maximin or maximax.

3 Comparison between individual and group incentive schemes

Despite the greatly increased popularity of group incentive schemes in the past decades, few studies have empirically addressed their impact on corporate performance and the issue of whether they are truly effective devices in eliciting optimal (from the principal's perspective) worker effort levels.

The effectiveness of group and individual incentive schemes from the behavioral perspective were being analyzed in experimental settings by economists, sociologists and psychologists even prior to the development of agency theory. This was basically because of the already widespread use of incentive schemes, and the similarities of many of them to already well-known social dilemma games.

It is worth mentioning a number of pioneering works, which, though plagued by methodological limitations and flaws in the design of the laboratory experiments or quasi-experiments in field settings, began systematic examination of the behavioral properties of individual and group incentive schemes with respect to their ability to elicit high levels of worker effort, and as a result high levels of productivity for firms.

A distinction should be drawn between, on the one hand, studies on how

individual variable pay versus fixed pay affects productivity, and on the other, studies which investigate the role of group incentive schemes. While the former have been carried out in experimental and field study settings, providing clear evidence of the effectiveness of individual incentives in enhancing productivity⁴, the latter have shown that group incentive schemes may have a different impact on productivity.

For instance, many early studies discovered that when so-called egalitarian revenue sharing was implemented (where group output is equally divided among participants, regardless of differences among individual contributions), some robust results were obtained. For instance, it was found that workers had less control over their individual earnings because they depended on the group's productivity. As a result, the better performers were likely to reduce the amount of effort they put into their work, while poorer performers were likely to shirk in order to benefit from the labour of the other members of the group (the so-called free-riding effect). It was also found that the size of the group had a strong effect on effort, since as the group size increased the individual worker lost control over his or her payoff.

The first studies on the impact of simple group reward schemes on workers' productivity date back at least to Marriott (1949), who was the first to report evidence that workers paid on an individual basis are slightly more productive than those paid according to group incentive schemes. Moreover, in his seminal field study Marriott found an inverse correlation between group size and the performance of workers in large factories (with group sizes ranging from 0–10 to over 50 people). Some years later, Campbell (1952) obtained similar results using 20–40-person groups. Schwab (1973), finally, reached similar conclusions using compared

⁴Dickinson and Gillette (1993) gives a large review on this topic.

performance–pay instrumentality scores.

Laboratory analysis of the matter has focused mainly on smaller groups. Farr (1976) analyzed the effectiveness of fixed hourly pay, individual variable pay, egalitarian revenue sharing, and tournament pay in 3–person groups. He found no difference among variable pay schemes: all of them performed better than the fixed scheme. London and Oldham (1977) compared fixed hourly pay, the individual incentive system (piece-rate) and three different group reward schemes (egalitarian revenue sharing, high performer pay, low performer pay for all the players involved) in 2–person teams.⁵ The laboratory implementation was a card sorting task (a design that typically does not control for the subjects’ effort cost). The main results were as follows: individual and high performer treatments performed better than other ones; being the top performer in a 2–person team reinforced achievement and motivation in treatments where the other participant did not benefit from it, or did not reduce the payment to the first player; in the higher performer treatment, over time the lower performer felt obliged to counterbalance the top performer’s action by improving his or her performance, which suggests that equity considerations may be at work. Moreover, it is significant that this did not happen in the egalitarian revenue sharing treatment, where the lower performer took advantage of the higher effort levels of the top worker. Finally Stoneman and Dickinson (1989) compared the behavior of workers in a simulated check–entering task without pecuniary payments and found no difference among the performances of groups of different size (2–4–5–9–person groups) with respect to the performance level under individual incentive schemes.

It is evident from this short survey of the literature that findings in laboratory and field settings diverge. The discrepancies stem from the fact

⁵This reflects a conceptualization of group tasks originally proposed by Steiner (1972).

that the first attempts to model group incentive mechanisms in laboratory conditions were poor in design quality and failed to control for the utility functions of the subjects involved in the experiment (as in the card sorting task experiment). Another reason may be that most field studies, unlike experiments, focused on different group sizes: whilst most of the experiments involved very small groups (ranging from 2 or 3-person teams to 9-person groups), the field studies typically investigated larger groups.⁶

As a result, the remainder of this section will focus on two recent papers: the first concerns a card sorting task experiment where group size was increased in order to compare the results with field studies; the second focused on 6-person groups using a game theoretical framework which made it possible to control for utility function and effort cost.

3.1 Group Productivity in a Card Sorting Task

Honeywell et al. (1990) sought to compare experimental findings with the results of field studies. They set up a card sorting task game, and contrasted productivity under individual incentive conditions (a base pay for sorting a fixed minimum of cards and a piece rate if the performance exceeded 25% of the target) with a group incentive condition (where the same mixed scheme – target based and piece rate – was computed with respect to the group’s average performance). Within subjects experimentation was used (i.e. the same subjects were used to test individual and group schemes) in order to assess whether a social loafing phenomenon existed (people tend to decrease their productivity in groups), and public feedback (common knowledge of payoffs) was provided in order to simulate an actual work environment.

⁶For instance, a recent survey has claimed that organizations employing small group incentives had work groups with a modal value of 10 persons (Peck, 1990).

It was found that individual performance was comparable under individual and group incentives: the top performers under individual schemes were also top performers under group schemes, and vice versa. This was consistent with previous findings (Farr, 1976; Stoneman and Dickinson, 1989), but it conflicted with other experimental and field studies (London and Oldham, 1977). The social loafing effect ⁷ was only observed among low performers (they continued to perform below the average in order to benefit from the performance of the other members), while it was not found among high performers (they did not decrease their performance in reaction to opportunistic behavior by lower performers). The authors' interpretation, following Stoneman and Dickinson (1989), was that high performers in small groups realize that lowering their performance may further reduce their earnings.

A tentative explanation of these results may be that, although a card sorting task provides a setting more similar to a real working environment, and although it permits observation of the subjects' real attitudes toward effort levels (rather than simply assuming effort disutility at increasing rates, as in the paper summarized in next subsection), it may yield outcomes that are difficult to analyse. Moreover, the alternating treatment (subjects were rewarded in even sessions under individual schemes, and in odd ones under group schemes) may not be the ideal way to investigate the emergence of differing behaviors in group and individual incentive schemes: the subjects may learn to avoid effort and to free ride under group incentive schemes only over a longer period of time. Moreover, the experimental instructions were, in my view, too informative of the aim of the research:

“You are being invited to participate in a research study
investigating the effects of monetary incentives on work

⁷See Dierks and McNally (1987) for thorough treatment.

performance...The information obtained from this study may allow businesses to better design pay systems that satisfy both the organization and the employee.” (Honeywell et al., 1990).

The subjects may very well have been biased by this information. Finally, it seems that interactions among subjects between the end of one session and the beginning of the next (the experimenters needed 10 minutes to compute the results) were not controlled, and idle talk or other interactions among the subjects may have affected experimental outcome.

3.2 Productivity Under Various Group Incentives

In a recent paper, Nalbantian and Schotter (1997) describe an experimental investigation of group moral hazard performance in several common group incentive schemes. They focus their analysis on the behavioral and operational mechanisms enacted by incentive structures, and they compare the outcomes of experiments on performance under group incentive systems with the theoretical predictions and with experiments on performance under individual incentive systems with probabilistic monitoring and efficiency wages.

For this purpose they used a basic principal–agent framework, summarized as follows: there is a principal running a firm with six agents. Each agent i chooses an effort level $e_i \in [0, 100]$. Effort is costly for agent i and is represented by function $C(e_i) = e_i^2/100$. Firm output depends on the agents’ individual effort levels as well as on a stochastic variable ϵ (which can be interpreted as luck or as the existence of an imperfect technology in monitoring the agents’ performance), as in the following formula:

$$Y = \sum_1^6 e_i + \epsilon \quad \epsilon \sim U[-40, 40];$$

There is excess demand in the market, so that all the output produced by agents is placed at the fixed price $p = 1.5$ per unit. As a consequence the firm's revenue function is as follows:

$$R = 1.5Y = 1.5 \left(\sum_1^6 e_i + \epsilon \right).$$

The Pareto-Optimal effort levels for each agent can then be straightforwardly derived as follows:

$$\max \pi = 1.5 \left(\sum_1^6 e_i + \epsilon \right) - \sum_1^6 e_i^2/100;$$

$$\Rightarrow (\text{f.o.c.}) \quad \partial \pi_i / \partial e_i = 1.5 - 2e_i/100 = 0, \quad i = 1, 2, \dots, 6, \quad \Rightarrow e_i = 75.$$

Thus, the principal's problem is to design an incentive scheme that will implement these Pareto-Optimal effort levels as Nash equilibrium for the agents.

Nalbantian and Schotter compare the following group and individual incentive schemes:

Partnership Schemes: Egalitarian Revenue Sharing This has been the first group decision scheme traditionally investigated in early experiments and field studies. The scheme is comparable to the voluntary contribution mechanism of public good theory and shares with social dilemmas the problem that free riding is a dominating strategy, since all the revenue generated by the firm is shared equally among members and each worker's final payoff is simply his/her revenue share minus his/her cost of effort. In fact, although everyone would be better off if everyone else contributed to the firm's output

with optimal effort, each agent has a personal interest in shirking or free riding in order to benefit in revenue generated by other agents without incurring effort costs. Formally we have:

$$\pi_i = 1.5 \left(\sum_1^6 e_i + \epsilon \right) / 6 - \epsilon_i^2 / 100.$$

Target Based Schemes Forcing Contracts Within this scheme a revenue target is set by the principal. If it is achieved, the workers share all the revenue generated; if it is not, a relatively low penalty wage is assigned to each worker. Hölmstrom (1982) originally devised this scheme in order to avoid free riding effects in team compensation. In their paper the scheme takes the following form:

$$\pi_i = \begin{cases} 1.5 (\sum e_i + \epsilon) / 6 - e_i^2 / 100 & \text{if } 1.5 (\sum e_i + \epsilon) \geq R^* \\ B & \text{otherwise.} \end{cases}$$

Tournament-Based Schemes: Competitive Teams Relative rather than absolute performance measurements are implemented by the authors by dividing the firm into two 6-person teams (T_1 and T_2) and having these two teams compete for prizes. The team producing the highest output receives the big prize, the loser receives the small one. The payoff for any worker i on Team 1 is defined in the following formula, where TR is a transfer made from the winning team to the losing one.

$$\pi_i(Y_1, Y_2, e_i) = \begin{cases} \frac{R_i + TR}{6} - \frac{e_i^2}{100} & \text{if } Y_1 > Y_2 \\ \frac{R_i - TR}{6} - \frac{e_i^2}{100} & \text{if } Y_1 < Y_2 \end{cases}$$

Individualistic Schemes: Monitoring Absolute and relative group mechanisms are compared to individual wage schemes with

supervision mechanisms: in the latter case the firm offers its workers an individual wage W greater than their opportunity wage w should they make a given effort of e^* set by the principal. In each period there is a probability of p that the firm will check the worker's effort level: if s/he is caught free riding s/he will be fired. Formally:

$$\pi_i = \begin{cases} W & \text{if } rnd > p \\ \text{fired} & \text{if } rnd < p \end{cases}$$

The experimental design consisted in the random and anonymous division of a large sample of college undergraduates (408) into groups of 6 persons. During the experiment, each subject was told only his/her own effort level and the group output level (no individual information on the performance of other players was given), and s/he performed two different experiments based on different incentive schemes. Each experiment lasted 25 rounds. The order of the two experiments was reversed for half of the population in order to analyze how history and past experience with different incentive schemes affected group performance.

The main results of the paper can be thus summarized:

- When free riding is the dominant strategy (as in egalitarian revenue sharing), subjects gradually take advantage of shirking opportunities, and levels of effort drop; this outcome closely resembles well-known results in voluntary contribution mechanisms in public goods (Ledyard, 1995) and highlights the social dilemma of workers' performance in team production: a finding that dates back at least to Marschak and Radner (1972).
- Relative schemes elicit the higher mean effort: none of the schemes induce near-to-equilibrium effort levels from the subjects, although

competitive tournaments clearly predominate over any other mechanisms.

- History matters: the previous experience of subjects with revenue sharing schemes leads to lower outputs in subsequent non revenue sharing experiments (lower than when the non revenue experiment is performed first). It seems that workers show inertial behavior and that past experience modifies the experimental subjects' perception of trust and fairness.
- Comparison with individual schemes based on monitoring shows that they are able, like group tournaments, to elicit higher levels of effort, but that they are also more costly for the firm (only high detection levels in monitoring lead to high effort levels, while low detection levels lead to free riding).

The study of Nalbantian and Schotter provides a clear benchmark on the theme of group incentive design and open the way to a rich agenda of additional research. Their analysis treats firm performance as the sole outcome of a non-cooperative game: it focuses only on the behavioral properties of incentive schemes in eliciting the Pareto-optimal levels of effort, while making little or no attempt to understand how elements such as social norms and different regimes of communication may affect the outcome of the experimental interaction. Moreover, the role of group size is not investigated, and one may consider the treatment of effort not as common information as too narrow, given that in naturally occurring work situations workers may check the level of effort put into the job by their colleagues (so as to detect and sanction free riding), and principals may be able to enforce the desired level of effort by their agents not solely by giving them incentive schemes but also by explicitly communicating the target desired (in terms of effort levels).

3.3 Suggestion for further research

The literature surveyed in this section confirms that the experimental approach may be a valuable instrument with which to test, in controlled conditions, interesting theoretical issues concerning the properties of incentive schemes. Overall, it seems that much work is still required to understand more precisely the behavioral properties of these schemes and how they interact with environmental conditions. In addition to the suggestions and criticisms already introduced while surveying the papers in this section, the following lines of research should be pursued further:

- The group incentive scheme framework displays many similarities with the public good literature. As Table 1 shows, many incentive schemes can be matched to an analogous public good feature, while other elements are peculiar to one framework. Despite the similarities, very little has been done to compare and understand whether the large body of findings and regularities yielded by public good experimentation still hold in the incentive framework, and whether different outcomes may arise in the latter frame as the result of specific elements, or merely as the result of simple semantic differences over the same underlying formal problem.⁸;
- The information given to players may be a variable that importantly affects motivation to effort, as well as the different opportunities for communication given to agents.
- Some major issues seem still underestimated from the perspective of the principal interested in the design of efficient incentive mechanisms. For instance, to what extent does history matter when a change in

⁸There are, however, some important exceptions: see for instance the paper by Croson (1995).

Table 1: A comparison between the features of group incentive schemes and public good schemes (adapted from Nalbantian and Schotter (1997))

group incentive schemes	public goods schemes
revenue sharing	voluntary contribution
forcing contract	threshold
?	“money-back” threshold
competitive teams	?
gainsharing / profit sharing	?

the incentive scheme is implemented, and what instruments may be introduced in order to reduce the problem of a lock-in to free-riding strategy and to diffuse trust and cooperative behavior among agents?

- As pointed out by Welbourne and Cable (1995), very little is known about how agents interpret these incentive programmes, and how different dispositions towards an incentive scheme may result in different outcomes (increases in productivity). The coherence between the firm’s and workers’ views of group incentive plans are not always controlled by the incentive designer: whilst firms may implement group incentive plans in an endeavour to encourage employees to identify with the specific needs of a particular business, or to promote organizational membership roles, workers may evaluate these schemes differently. Given that group incentives may have different motivational values because they can be understood in different ways by workers, laboratory investigation techniques such as protocol analysis and post-experiment interviews may shed light on how group incentives give rise to identity processes affecting workers saliency of work related roles (organization member or team partner versus individual job holder) and may ultimately result in different

behavior. This may lead to test in laboratory conditions more realistic and complete accounts of worker motivation. An example may be Frank's status theory, which suggests that status considerations may be more motivating than monetary reward in shaping employee behavior (Frank, 1984, 1985).

- Finally, it seems crucially important to understand the extent to which first move outcomes may result in path dependency, and which elements may be successfully controlled in order to direct interaction among the agents towards the desired outcome.

4 Experimental labour markets and reciprocity

Research on experimental markets was first conducted by Fehr and colleagues, and it has acquired major importance in the many agency debates on labour markets, contract incompleteness and enforcement issues.

The aim of these studies is to test, in the context of competitive experimental markets, whether contract enforcement and bargaining among principals and agents may be affected by their attitude towards reciprocal and fair behavior.

Within the framework of the experimental labour market, a first group of studies have investigate the existence of the so-called fair wage-effort hypothesis' (Akerlof, 1982; Akerlof and Yellen, 1990), which states that wage increases raise workers' effort levels, and that, as a result, involuntary employment may result because firms may have the incentive to pay wages above the competitive level. Fehr jointly with other scholars (Fehr et al., 1993; Fehr, Kirchsteiger and Riedl, 1998; Fehr and Falk, forthcoming; Fehr,

Kirchler, Weichbold and Gächter, 1998; Fehr and Tougareva, 1995) has conducted experiments based on the so-called Gift Exchange Game: that is, a two-stage game which can be summarized as follows: the first-stage is a wage determination game in which workers (agents) and firms (principals) trade for stipulating job contracts with each other; in the second-stage, workers who have concluded a contract with a firm must choose an effort level.

Predictions based on the standard rational and selfish hypothesis suggest that workers will make minimal effort (because efforts above that level are increasingly costly) no matter what wage they receive. because firms are aware of this, they will respond by paying the competitive (zero rent) wage corresponding to the minimum effort level. The experimental findings, however, show that average wages are substantially above the competitive wage corresponding to the minimum effort level, and that firm's wage payments contain substantial amounts of rent (wages are much higher than the competitive wage corresponding to the workers' actual effort choices). There is much evidence to suggest that this result may be exceptionally robust: in particular Fehr's papers show that the positive wage-effort relationship is very robust across different institutions, such as one-sided oral bid auctions (Fehr et al., 1993; Fehr, Kirchsteiger and Riedl, 1998), double auctions (Fehr and Falk, forthcoming), bilateral bargaining (Fehr, Kirchler, Weichbold and Gächter, 1998), and across different stake sizes (Fehr and Tougareva, 1995). Moreover, in competitive treatments (such as one-sided oral bid auctions and double auctions), there was an exogenous excess supply of workers (so that firms were playing the game from a strong position, since they had the power to enforce rather unfair contracts). Nevertheless, fair contracting emerged and no learning effects toward equilibrium over time were observed. Finally, it is surprising that even in double action markets (the most competitive market institutions) wages are

roughly similar to those in the bilateral institution: which confirms that competition among workers even in the double auction has a negligible impact on wage formation, and that fairness and reciprocity seemingly play a dominant role.

A critique of these studies might centre on their analysis of certain implementation elements. For instance, firms payoff functions were designed so to avoid the possibility of losses, although this does not seem entirely reasonable.

A second line of research comprises experiments that deepen inquiry into whether and to what extent reciprocity is able to mitigate the so-called *contract enforcement problem*. This problem is typical of agency relationships because many employment contracts are incomplete and workers have some effort discretion; thus whenever firms have limited enforcement technology and deal with rational and purely selfish workers, they are unable to enforce the efficient effort level, and can only achieve a minimal effort level below the efficient one. On the other hand, a subject is said to behave in a reciprocal manner if s/he is willing to forgo some money in order to punish behavior that he or she considers unfair, or to reward behavior that he or she considers fair. It is argued that the reciprocal behavior of principals and agents may drive the outcome of a typical contract enforcement game far from the shirking equilibrium, and that it is a successful device with which to raise effort levels above the minimum.

Fehr and Gächter contrasted a two-stage treatment (where only workers could respond reciprocally to firms' offer) with a three-stage one (where, conversely, both workers and firms could respond reciprocally) (Fehr and Gächter, 1998). Subsequently, Fehr et al. (1997) studied both these settings and also introduced, as a treatment variable, the absence or presence of an imperfect monitoring technology (fines that a third party, such as a court,

may impose on the shirking worker with some probabilities). The main findings of these studies are as follows: in the 2-stage setting firms cannot completely enforce their desired effort level. Workers reciprocate to firms offering wage levels higher than the minimum. In the 3-stage treatment the contract enforcement problem is further reduced: now also firms can reciprocate to workers behavior, rewarding or punishing behavior considered unfair (note that this action is costly for the firm and is consequently not rational from an equilibrium perspective). Finally, the introduction of external monitoring and fines undermines, at least in the 2-stage treatment, reciprocal responses and reduces the average efforts of workers.

These findings suggest that reciprocity (and especially double reciprocity) generates a significant increase in effort levels, compared with the prediction based on selfish preference assumptions, and that it considerably mitigates the contract enforcement problem. Thus reciprocity may be viewed, at least from a behavioral perspective, as a viable solution to the problem of contract enforcement, and as even more effective than such traditional responses as the explicit threat of fines for workers undersupplying efforts. Gächter and Falk have elaborated further on this observation, showing that incentive contracting, fines and monitoring, as well as other explicit enforcement instruments, may result in lower levels of effort, since they may crowd out implicit reciprocity attitudes of principals and agents. They also suggest that, in the case of repeated interaction, reciprocity plays a major role in reputation formation, which in itself mitigates the contract enforcement problem (Gächter and Falk, 1998).

This line of inquiry has shed considerably light on how experimental labour market outcomes may be affected by reciprocal behavior, an element traditionally ruled out in the analysis of standard economic theory. It would be interesting to develop this analysis in the following directions:

- Reciprocity motives have been observed in many ultimatum game experiments⁹. These are bargaining games where two subjects must agree on sharing a certain amount of money: one party makes an offer which the other may accept (in this case the amount of money is divided as agreed by the parties) or reject (in this case neither gets nothing). Although the theory predicts that the party making the offer will be advantaged and will ask for anything up to the entire amount, since it is rational for the responder to accept any positive amount, laboratory experimentation shows that the majority of offering parties propose a fair split of the amount. It may be interesting to compare whether, in the setting of experimental markets, rents are shared between principals and agents in a manner that differs from ultimatum games. These, to my knowledge, are matters still to be investigated experimentally.
- It would also be interesting to investigate how the learning process interacts with reciprocity outcomes. For instance, whereas in the 2-stage treatment outlined above workers learn over time to respond reciprocally to fair offers made by firms, in the 3-stage treatment they start reciprocating from the outset and no learning effects can be detected.

5 Final remarks

The past sections have roughly sketched the contribution of the experimental economics literature to analysis of issues related to managerial incentive design. Despite the incompleteness of the survey, it should be evident that an experimental approach may be a valuable instrument with

⁹See Roth for an extensive review (Roth, 1995).

which to test and challenge, under controlled conditions, a wide variety of interesting theoretical issues, such as the behavioral properties of various types of incentive scheme, and how the real behavior of agents and principals is affected by reciprocity considerations. First results of experimental studies are particularly useful and interesting to incentive designers in organizations, and they emphasise the need for further laboratory investigation.

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