Explicit and Implicit Incentives for Multiple Agents

Explicit and Implicit Incentives for Multiple Agents

Jonathan Glover

Carnegie Mellon University
USA
jglover@andrew.cmu.edu

the essence of knowledge

Boston – Delft

Foundations and Trends® in Accounting

Published, sold and distributed by:
now Publishers Inc.
PO Box 1024
Hanover, MA 02339
USA
Tel. +1-781-985-4510
www.nowpublishers.com
sales@nowpublishers.com

Outside North America:
now Publishers Inc.
PO Box 179
2600 AD Delft
The Netherlands
Tel. +31-6-51115274

The preferred citation for this publication is J. Glover, Explicit and Implicit Incentives for Multiple Agents, Foundation and Trends® in Accounting, vol 7, no 1, pp 1–71, 2012

ISBN: 978-1-60198-632-0

Foundations and Trends® in Accounting
Volume 7 Issue 1, 2012

Editorial Scope

Foundations and Trends® in Accounting will publish survey and tutorial articles in the following topics:

- Auditing
- Corporate Governance
- Cost Management
- Disclosure
- Event Studies/Market Efficiency Studies
- Executive Compensation
- Financial Reporting
- Financial Statement Analysis and Equity Valuation
- Management Control
- Performance Measurement
- Taxation

Information for Librarians

Foundations and Trends® in Accounting, 2012, Volume 7, 4 issues. ISSN paper version 1554-0642. ISSN online version 1554-0650. Also available as a combined paper and online subscription.

Foundations and Trends® in
Accounting
Vol. 7, No. 1 (2012) 1–71

DOI: 10.1561/1400000020

Explicit and Implicit Incentives for Multiple Agents

Jonathan Glover

Tepper School of Business, Carnegie Mellon University, Pittsburgh, PA 15213, USA, jglover@andrew.cmu.edu

Abstract

This monograph presents existing and new research on three approaches to multiagent incentives. The goal of all three approaches is to find theories that better explain observed institutions than the standard approach has.

Contents

1

Introduction

Mechanism design theory treats institutions as endogenous games. In accounting, research on mechanism design has focused largely on principal–agent models. In the standard principal–single agent model, the principal offers the agent an incentive contract and then leaves the agent with what is essentially a decision problem. Yet, even simple principal–agent models can produce complicated optimal contracts. For example, an important result from moral hazard models with a risk-averse agent is that all informative variables will be incorporated into the optimal contract (Holmstrom, 1979).[1] A performance measure is informative if its conditional probability distribution depends on the agent's action, where the conditioning is on all performance measures already incorporated into the contract. Holmstrom's result provided a theory of relative performance evaluation (Antle and Smith, 1986) and refined the accountant's traditional notion of controllability to "conditional controllability" (Antle and Demski, 1988). The broader information content school of accounting theory has developed a better

[1] Holmstrom's (1979) informativeness condition is both necessary and sufficient for it to be optimal to incorporate an additional performance measure into a contract when the agent is risk averse and the incentive compatibility constraint binds.

(more nuanced) understanding of a wide variety of managerial and financial accounting practices (e.g., Demski, 2010; Christensen and Demski, 2003).

With a large number of informative variables, which seem inevitable in practice, the optimal contract Holmstrom predicts would be overwhelmingly complex. Even when there is only a single variable to contract on, the optimal contact can be extremely sensitive to the underlying details of the environment. For example, with a risk-neutral agent, the optimal contract can have the principal making anextremely large payment to the agent with an extremely small probability. If the probabilities are different than assumed, the principal may end up paying the agent much more than is required or fail to motivate the agent to take the action she intends. Real-world incentive contracts seem less fine-tuned to the environment and more robust.

When a principal contracts with multiple agents, even more extreme results emerge. For example, in models of capital budgeting with multiple risk-neutral agents who operate in correlated cost environments, the optimal contract prescribes some payments that are arbitrarily large and others that are arbitrarily small (negative) as the correlation becomes small. These arbitrarily large and small payments allow the principal to extract all of the agents' information rents and obtain the first-best solution as long as there is any correlation in project returns. The ease of achieving first-best payoffs and the knife-edged nature of the optimal contract make it suspect as an explanation of anything we see in practice (Cremer and McLean, 1988).

With risk-averse agents, the contract is less knife-edged in response to the risk premium associated with imposing risk on the agents but presents another problem. The optimal Bayes–Nash incentive compatible contract (the second-best solution) typically creates multiple equilibria in the agents' subgame, and the agents may find tacitly colluding on an equilibrium other than the one the principal intends them to play appealing (Demski and Sappington, 1984; Mookherjee, 1984). That is, the second-best solution may induce excessive (from the principal's perspective) coordination.

This monograph presents research on three themes related to multiagent incentives, taking the view that developing a better understanding of multiagent incentives is central to developing a better understanding of observed institutions. The organizing theme is multiple equilibria created by the use of the Bayes–Nash solution to the multiagent contracting problem. First, in preventing tacit collusion, confession is an alternative to ratting that allows for less demanding behavioral assumptions than Bayes–Nash, while approximately implementing the second-best solution (Glover, 1994). Second, optimal robust contracts designed to deal with a variety of settings are qualitatively similar to the standard optimal contracts when the variety is small and qualitatively different than the standard ones when the variety is large. When the variety is large, individual rather than relative performance evaluation is optimal in moral hazard settings, and procurement contracts similar to observed second-price procurement auctions emerge as optimal in adverse selection (Arya et al., 2009). Such contracts are not subject to the tacit collusion problem by virtue of providing dominant strategy incentives. Third, in repeated settings, collusion can be turned into cooperation (implicit contracting between the agents that benefits the principal) by using aggregate performance measures to motivate mutual monitoring by the agents (Arya et al., 1997a). The monograph surveys existing research on these three themes (with a fairly narrow focus on my own research) and presents a few new results. Rather than presenting each of the models employed in the existing papers, two basic models are used — one for adverse selection and one for moral hazard. The goal is to present the results as simply as possible.

One approach to dealing with unwanted coordination is to make obedient behavior a dominant strategy (e.g., Demski and Sappington, 1984). Using a two-agent model of moral hazard, I expand on this approach, allowing for the production of additional (monitoring) information that provides information about individual efforts. The additional information can be thought of as produced by an audit of each agent's action. The second-best solution, which motivates each agent to "work" rather than "shirk" given the other agent is playing "work," itself incorporates this additional information. Under the revised second-best solution, each agent's pay now also depends on the audit of his own effort but not on the audit of the other agent's effort, since the audit of the other agent's effort is not informative in the sense of Holmstrom (1979).

If instead the optimal contract has to eliminate an equilibrium that has both agents playing "shirk" instead of both playing "work" by making "work" a dominant strategy, the optimal contract incorporates all information. In particular, each agent's pay is highest when the audit of his own effort indicates he has played "work" and the audit of the other agent's effort indicates he has played "shirk." This is a way of turning up the power of incentives when the audit of the other agent's effort indicates the agents may be playing the bad equilibrium. It is optimal to use an uninformative signal, because doing so is the optimal way to prevent collusion (without adding self-reporting). As far as I know, this is a new result. Put differently, although the individual signals are uncorrelated, the possibility of tacit collusion creates an endogenous correlation that optimal dominant strategy contracts incorporate but the standard optimal second-best Nash contracts ignore.

The mechanism design literature points us in a different direction: we augment the second-best solution by adding (costless) self-reporting. This new self-reporting is used to eliminate unwanted equilibria without creating new equilibria or changing the equilibrium payoffs (e.g., Ma, 1988; Ma et al., 1988; Mookherjee and Reichelstein, 1990). These augmented mechanisms are typically complex, for example, employing infinite message spaces when the underlying type space is binary. The typical "tail-chasing" mechanisms also exploit a weakness of the Nash equilibrium concept — that best responses are not always well defined. Arguably, these mechanisms without well-defined best responses are of limited use in understanding actual institutions (Jackson, 1992). The focus of the implementation literature has been on what can and cannot be implemented, not the form of the implementing mechanisms.

The monograph presents simpler mechanisms than those usually used to eliminate unwanted equilibria (e.g., Glover, 1994). These simpler mechanisms assume less demanding behavioral assumptions — two rounds of iteratively removing strictly dominated strategies — and employ smaller message spaces than the standard ones but achieve only approximate implementation of the second-best solution. Hence, the approach represents an arbitrarily small deviation from the standard approach of searching for institutions in optimality. As examples of practices that resemble the mechanisms, budgeting (and budget padding in particular) in adverse selection (Arya and Glover, 1996) and management forecasts in moral hazard (Arya and Glover, 1995) can be viewed as providing opportunities for off-equilibrium confessions.[2] If the agents have complete information, even the first-best solution can be exactly implemented via two rounds of iteratively removing strictly dominated strategies in a general principal–multiagent model of adverse selection (Arya et al., 2000b). The approach relies on the reports of other agents in determining any one agent's equilibrium allocation, while providing each agent with the opportunity to challenge what others say about him. A challenge is appealing to an agent if and only if other agents are lying about him. Put in terms familiar to accountants, when two managers or a manager and an auditor can both verify something (e.g., the historical cost of an asset), the mechanism design literature suggests that information should be relatively easy to elicit in principal–multiagent models.[3]

The principal may also be a player in the game, beyond her role in designing incentive contracts. For example, the principal may be able to bail the agents out when the outcome would otherwise be disastrous for her. Arya and Glover (2006) study a potential bailout by a principal that is more likely to occur when early signals indicate both agents' projects are likely to fail. A familiar idea in banking regulation is that bailouts create moral hazard.

> Repeated intervention subverts the incentives that are the moving force of market behavior. Bailouts obviate the hard choices — default or reform for troubled borrowers; sound lending judgments or failure for investors — and substitute a free ride on taxpayers in the Group of Seven leading industrial nations. Capital markets have learned that there is an implicit

[2] The principal commits not to punish an agent who confesses. To quote Bassanio from Shakespeare's *Merchant of Venice*, "Promise me life, and I'll confess the truth."

[3] An important caveat is that most of the mechanism design literature (including Arya et al., 2000b) confines attention to single-period settings.

> International Monetary Fund guarantee for large emerging market borrowers and that risk premium can be collected while avoiding the risk (Lerrick and Meltzer, 2001).

Similar arguments against bailouts were made in the wake of the more recent subprime mortgage crisis. The point here is related but different: a bailout that is more likely when multiple institutions are likely to fail leads to *coordinated* moral hazard. The potential of a bailout creates an endogenous correlation in the agents' environments. Even if taking desirable actions (working, diversifying, due diligence in credit evaluations, etc.) is a Nash equilibrium, the possibility of a bailout may lead the managers to take on coordinated undesirable actions in order to make it more likely they will be bailed out.

Relative performance evaluation is a natural solution. In the case of the banking crisis, one version of relative performance evaluation has the surviving banks receiving the assets of the failed banks at a bargain price (Acharya and Yorulmazer, 2007). In an earlier paper, Arya and Glover (2006) study a principal–two-agent model of moral hazard subject to a bailout by the principal and explore the role of information system design as a commitment device designed to limit bailouts and, hence, unwanted coordination.[4]

Returning to the critique that the traditional optimal mechanisms seem overly fine-tuned to the environment:

> This brings me to a point I wish to emphasize: The optimal trading rule for a direct revelation game is specialized to a particular environment. For example, the rule generally depends on the agents' probability assessments about each other's private information. If left in this form, therefore, the theory is mute on one of the most basic problems challenging theory. I refer to the problem of explaining the prevalence of a few simple trading rules in most of the commerce

[4] The working paper version from 2001 provides a more general, although still highly stylized, analysis and is available online.

> conducted ... The rules of these markets are not changed daily as the environment changes; rather they persist as stable, viable institutions. As a believer that practice advances before theory, and that the task of theory is to explain how it is that practitioners are (usually) right, I see a plausible conjecture: These institutions survive because they employ trading rules that are efficient for a wide class of environments (Wilson, 1987, pp. 36–37).

The second approach the monograph takes is to focus on the simplicity of the second-best solution itself by requiring the mechanism be designed early, before a particular application (environment) arises. The optimal robust mechanism is found taking expectations over the potential environments. The early design assumption is equivalent to blocked communication — the mechanism is not allowed to be a menu of mechanisms that are later fine-tuned to the actual environment based on the agents' communication about the environment once the particular environment arises. Optimal robust mechanisms help rationalize, for example, second-price auctions (Arya et al., 2009). The auction model can be converted into a capital budgeting setting with mutually exclusive projects by changing signs. In the capital budgeting version of the model, the second-price auction can be reinterpreted as relative project ranking, which is a common means of rationing resources in organizations. Second-price auctions provide dominant strategy incentives. Hence, the result provides a Bayes–Nash foundation for dominant strategy mechanisms. Other approaches to the robustness problem (e.g., Bergemann and Morris, 2005, 2008) take larger departures from the Bayesian framework, focusing on, for example, robustness to higher order beliefs.[5]

[5] Many of the implementing mechanisms used to prove sufficiency results in the recent literature on robust mechanisms are subject to the Jackson critique, which calls into question the notions of robustness being employed. Studying specific settings and robust mechanisms for those settings seems more likely to yield fruitful positive results and insights into observed institutions. So far, the robustness literature's most interesting results are negative ones.

The important point in Arya et al. (2009) is that the optimal mechanisms are qualitatively similar to the standard ones when robustness is a small concern but are qualitatively different from the standard ones when robustness is a large concern, although even a small robustness concern can convert a nonunique solution into a unique one.

I present a new result on robust contracts for moral hazard. Robust contracts designed by two principals of two different firms do not use relative performance evaluation when the standard optimal contracts would. The principals each understand the production technology their own agent operates but have less information about the technology operated in the competing firm.

Casting the firm as a principal–multiagent model in which the principal provides all incentives via explicit contracts is, at best, an abstraction of a broader relationship. As Sunder (1997) writes, the firm is "an arena in which self-motivated economic agents play by mutually agreed upon or implied rules to achieve their respective objectives." The comparative advantage of a firm over other institutional arrangements is in enforcing implicit contracts, since the courts can enforce explicit contracts. Repeated relationships and multiple equilibria (in the continuation game) are an essential part of implicit contracts, since self-enforcing punishments agents can impose on each other are needed to make their implicit promises credible. That is, instead of viewing multiple equilibria as undesirable, the principal can use multiple equilibria to her advantage.

The third approach this monograph studies is to incorporate repeated play and implicit (relational) contracting among the agents and between the agents and principal. Relational contracting and mutual monitoring among the agents create a role for joint performance evaluation, even when the joint performance measure is an aggregation of individual performances measures that could be contracted on individually (Arya et al., 1997a; Che and Yoo, 2001).

When the relationship is repeated indefinitely, whether the agents' actions are strategic complements or strategic substitutes is important. The agents' actions are strategic complements if each agent's marginal benefit of increasing his own action is increasing in each other agent's action. An example of a setting in which individual efforts are strategic complements is an interdisciplinary project — individual effort is most productive when the other team members are also working hard. An example of a setting in which actions are strategic substitutes is a project for which the agents' actions are interchangeable and there are decreasing returns to total effort. A strategic substitutability limits the gains to mutual monitoring and cooperation, because the agents are tempted to collude on taking turns doing the work (think of group projects in a classroom setting) unless the incentives are high powered.

Under a twofold repetition of the relationship, mutual monitoring is always optimal in the first period. Multiple equilibria are created in the second period that the agents use to enforce cooperation in the first period. If individual performance measures are available, only the sum is used in determining compensation in the first period, since this is the most efficient way to provide group incentives for joint working over joint shirking. In the second period, a mix of aggregate and individual performance evaluation is used. Aggregation is inefficient in providing second-period incentives, so just enough aggregation is used to provide the punishment needed to enforce first-period cooperation. In the two-period setting, the turn-taking collusion problem does not arise. The second-period incentives must be high powered enough to provide individual incentives for working, since the second period is the final period.

Mutual monitoring can be viewed as an alternative to the confession (and other self-reporting) mechanisms discussed earlier. The implicit contracting approach casts accounting and explicit contracting as means of setting the stage for (decentralized) implicit contracting rather than an all-encompassing (centralized) source of information and contracting. Earlier approaches to mutual monitoring (e.g., Itoh, 1993; Tirole, 1986) assumed agents could write explicit side contracts with each other, often describing explicit side contracting as an abstraction of a repeated relationship with implicit side contracting. The implicit side contracting approach is relatively underexplored (particularly finitely repeated implicit contracting) and has the potential to yield new insights into observed practices (e.g., the evolution of incentives over a manager's tenure).

> Enforcement is a more serious issue for side contracts than for ordinary contracts. If collusion poses a threat to an organization, the latter may stipulate in its grand contract among members that side contracts or some forms of potentially verifiable side transfers are prohibited. Indeed, organizations routinely do so . . . If, as is often the case, repeated interaction is indeed what enforces side contracts, the second approach [of modeling repeated interactions] is clearly preferable because it is more fundamentalist; it takes a more agnostic view of whether gains from trade are realized within groups, and in doing so, it unveils an important control variable affecting the realization of collusion (Tirole, 1992, pp. 155–156).

It is an empirical question whether various groups of managers are best modeled using models of individual incentives (e.g., Holmstrom, 1979) or models of group incentives (e.g., Itoh, 1993; Arya et al., 1997a; Che and Yoo, 2001). In studying the impact of pay-for-performance dispersion on top executives' incentives, Bushman et al. (2012) use the Arya et al. (1997a) and Che and Yoo (2001) models to motivate studying the role team tenure has in mitigating poor performance. They speculate that the poor performance they observe is caused by individual free-riding. Their results are consistent with team tenure reducing free-riding.

In another recent paper, Li (2012) studies structural models of the incentives provided to top executives, using the consistency of the risk-aversion estimates to evaluate the ability of the models to explain observed incentives. She finds the most consistent estimates for a group incentive model similar to Arya et al. (1997a) with less consistent estimates from an individual incentive model similar to the Holmstrom (1979) model. Both of these models perform better than another team-based model that allows for explicit side contracts and transferable utility (similar to one of the models in Itoh, 1993).

Li (2012) raises intriguing questions about the existing literature on executive compensation, which criticizes executive compensation practice for not being more consistent with models of optimal individual incentives (e.g., Jensen and Murphy, 1990; Bebchuk and Fried, 2006). Perhaps, it is time for the executive compensation literature to devote more attention to models of group incentives.

If contracting is limited to non-verifiable variables (e.g., subjective assessments of agents' actions), then the principal's contract with the agents is also an implicit one. If the agents observe each other's actions, then there is room for implicit contracting with and between agents. With only non-verifiable performance measures, bonus pools emerge as an optimal response to the principal's limited ability to make commitments but only as an extreme form of the optimal relational contract when the discount rate becomes extremely large and the model is essentially of a single-period setting (Glover and Xue, 2012). When the discount rate is small, the optimal contract is a group-based one that fosters implicit contracting and mutual monitoring among the agents as in Arya et al. (1997a). As the discount rate is increased, group-based pay becomes infeasible, and the principal uses a mix of individual and relative performance evaluation. The feature of bonus pools that has the principal rewarding the agents for poor performance emerges sooner than one might expect. The reason is that relative performance evaluation encourages the agents to collude on taking turns working. Pay for bad performance is used to mitigate this effect of relative performance evaluation — to make the agents' payoffs strategically independent instead of creating a strategic substitutability. (In one-shot games, strategic independence is a particular form of dominant strategy incentives.)

Baldenius and Glover (2012) study exogenous bonus pools in an indefinitely repeated setting in which there are non-verifiable individual measures that cannot be explicitly contracted on and a verifiable (objective) measure of team performance (e.g., firm-wide earnings) that can be contracted on. The strategic complementarity or substitutability of the agents' actions is again key, this time in the team performance. Bonus pools perform at their best when the agents' actions are closest to strategically independent. With a large strategic complementarity, it can be better to make the bonus pool independent of the team performance measure instead of having the bonus pool be increasing in the team performance measure.[6]

The remainder of the monograph is organized into four sections. Sections 2 and 3 study explicit contracting. I begin with adverse selection in Section 2 and turn to moral hazard in Section 3. Section 4 studies implicit contracting. Section 5 concludes by discussing additional managerial and financial reporting (regulation) applications and potential extensions.

[6] In fact, in the case of a large strategic complementarity, it is optimal to make the bonus pool a decreasing function of the team performance measure, but this may not be a practical solution, since understating performance (or destroying output) is often possible.

References

Abreu, D. and H. Mastushima (1992), 'Virtual implementation in iteratively undominated strategies: Complete information'. *Econometrica* **60**, 993–1008.

Acharya, V. and T. Yorulmazer (2007), 'Too many to fail — an analysis of time-inconsistency in bank closure policies'. *Journal of Financial Intermediation* **16**, 1–31.

Adams, R. and D. Ferreira (2007), 'A theory of friendly boards'. *The Journal of Finance* **62**, 217–250.

Aggarwal, R. and A. Samwick (1999), 'Executive compensation, strategic competition, and relative performance evaluation: Theory and evidence'. *The Journal of Finance* **54**, 1999–2043.

American Institute of Certified Public Accountants (1934), *Audits of Corporate Accounts*. New York, NY.

Antle, R. (1984), 'Auditor independence'. *Journal of Accounting Research* **22**, 1–20.

Antle, R. and J. Demski (1988), 'The controllability principle in responsibility accounting'. *The Accounting Review* **63**, 700–718.

Antle, R. and G. Eppen (1985), 'Capital rationing and organizational slack in capital budgeting'. *Management Science* **31**, 163–174.

Antle, R. and J. Fellingham (1990), 'Resource rationing and organizational slack in a two-period model'. *Journal of Accounting Research* **28**, 1–24.

Antle, R. and J. Fellingham (1997), 'Models of capital investments with private information and incentives: A selective review'. *Journal of Business Finance and Accounting* **24**, 887–908.

Antle, R. and A. Smith (1986), 'An empirical investigation of the relative performance evaluation of corporate executives'. *Journal of Accounting Research* **24**, 1–39.

Arya, A., J. Demski, J. Glover, and P. Liang (2009), 'Quasi-robust multi-agent contracts'. *Management Science* **55**(5), 752–762.

Arya, A., J. Fellingham, and J. Glover (1997a), 'Teams, repeated tasks, and implicit incentives'. *Journal of Accounting and Economics* **23**, 7–30.

Arya, A., J. Fellingham, J. Glover, and K. Sivaramakrishnan (2000a), 'Capital budgeting, the hold-up problem, and information system design'. *Management Science* **46**, 205–216.

Arya, A. and J. Glover (1995), 'A simple forecasting mechanism for moral hazard settings'. *Journal of Economic Theory* **66**, 507–521.

Arya, A. and J. Glover (1996), 'The role of budgeting in eliminating tacit collusion'. *Review of Accounting Studies* **1**, 191–205.

Arya, A. and J. Glover (1997), 'Maintaining auditor independence'. Working Paper, Carnegie Mellon University.

Arya, A. and J. Glover (2001), 'Option value to waiting created by a control problem'. *Journal of Accounting Research* **39**, 405–415.

Arya, A. and J. Glover (2006), 'Bailouts and unwanted coordination'. *Journal of Accounting, Auditing, and Finance* **21**, 109–117.

Arya, A., J. Glover, and J. Hughes (1997b), 'Implementing coordinated team play'. *Journal of Economic Theory* **74**, 218–232.

Arya, A., J. Glover, and U. Rajan (2000b), 'Implementation in principal-agent models of adverse selection'. *Journal of Economic Theory* **93**, 87–109.

Arya, A., J. Glover, and S. Sivaramakrishnan (1997c), 'The interaction between decision and control problems'. *The Accounting Review* **72**, 561–574.

Arya, A., J. Glover, and S. Sunder (1998), 'Earnings management and the Revelation Principle'. *Review of Accounting Studies* **3**, 7–34.

Arya, A., J. Glover, and R. Young (1995), 'Virtual implementation in separable Bayesian environments using simple mechanisms'. *Games and Economic Behavior* **9**, 127–138.

Arya, A., J. Glover, and R. Young (1996), 'Capital budgeting in a multidivisional firm'. *Journal of Accounting Auditing and Finance* **11**, 519–534.

Baiman, S. (1975), 'The evaluation and choice of internal information systems within a multiperson world'. *Journal of Accounting Research* **13**, 1–15.

Baiman, S., P. Fischer, M. Rajan, and R. Saouma (2007), 'Resource allocation auctions within firms'. *Journal of Accounting Research* **45**, 915–946.

Baiman, S. and M. Rajan (1995), 'The informational advantages of discretionary bonus schemes'. *The Accounting Review* **70**(October), 557–579.

Baker, G., R. Gibbons, and K. Murphy (1994), 'Subjective performance measures in optimal incentive contracts'. *Quarterly Journal of Economics* **109**(November), 1125–1156.

Baldenius, T., S. Dutta, and S. Reichelstein (2007), 'Cost allocation for capital budgeting decisions'. *The Accounting Review* **82**, 837–867.

Baldenius, T. and J. Glover (2012), 'Relational contracts with and between agents'. Working paper, Carnegie Mellon University and Columbia University.

Bebchuk, L. and J. Fried (2006), *Pay Without Performance*. Boston, MA: Harvard University Press.

Benoit, J. and V. Krishna (1985), 'Finitely repeated games'. *Econometrica* **53**, 905–922.

Bergemann, D. and S. Morris (2005), 'Robust mechanism design'. *Econometrica* **73**, 1521–1534.

Bergemann, D. and S. Morris (2008), 'Ex post implementation'. *Games and Economic Behavior* **63**, 527–566.

Bernheim, B. D. and M. D. Whinston (1998), 'Incomplete contracts and strategic ambiguity'. *American Economic Review* **88**, 902–932.

Bull, C. (1987), 'The existence of self-enforcing implicit contracts'. *The Quarterly Journal ofEconomics* **102**(February), 147–159.

Bushman, R., Z. Dai, and W. Zhang (2012), 'Management team incentive alignment and firm value'. Working Paper, University of North Carolina at Chapel Hill.

Che, Y. and S. Yoo (2001), 'Optimal incentives for teams'. *American Economic Review* pp. 525–541.

Christensen, J. A. and J. S. Demski (2003), *Accounting Theory: An Information Content Perspective*. New York, NY: McGraw-Hill.

Chung, K. and J. Ely (2007), 'Foundations of dominant strategy mechanisms'. *Review of Economic Studies* **74**, 447–476.

Cremer, J. and R. P. McLean (1988), 'Full extraction of the surplus in Bayesian and dominant strategy auctions'. *Econometrica* **56**, 1247–1257.

Demski, J. (2010), *Managerial Uses of Accounting Information*. New York, NY: Springer Verlag.

Demski, J. and D. Sappington (1984), 'Optimal incentive contracts with multiple agents'. *Journal of Economic Theory* **33**(June), 152–171.

Dutta, S. and X. Fan (2012), 'Incentives for innovation and centralized versus delegated capital budgeting'. *Journal of Accounting and Economics* **53**, 592–611.

Dutta, S. and S. Reichelstein (2002), 'Controlling investment decisions: Depreciation and capital charges'. *Review of Accounting Studies* **7**, 253–281.

Ederhof, M., M. Rajan, and S. Reichelstein (2010), 'Discretion in managerial bonus pools'. *Foundations and Trends in Accounting* **5**(4), 243–316.

Gibbard, A. (1973), 'Manipulation of voting schemes: A general result'. *Econometrica* **41**, 587–602.

Gibbons, R. and K. Murphy (1992), 'Optimal incentive contracts in the presence of career concerns: Theory and evidence'. *Journal of Political Economy* **100**, 468–505.

Gibbs, M., K. Merchant, W. Van der Stede, and M. Vargus (2004), 'Determinants and effects of subjectivity in incentives'. *The Accounting Review* **79**(April), 409–436.

Glover, J. (1994), 'A simpler mechanism that stops agents from cheating'. *Journal of Economic Theory* **62**, 221–229.

Glover, J. (2004), 'A discussion of 'a model of auditing under bright-line accounting standards''. *Journal of Accounting, Auditing and Finance* **19**, 561–564.

Glover, J. (2012), 'Disclosure and incentives'. *Accounting Horizons* **26**, 371–380.

Glover, J., Y. Ijiri, C. Levine, and P. Liang (2005), 'Verifiability and manipulability vs. information asymmetries about verifiability and manipulability'. Working Paper, Carnegie Mellon University.

Glover, J. and H. Xue (2012), 'A multi-period foundation for bonus pools'. Working Paper, Carnegie Mellon University.

Hearn, L. (1924), *Interpretations of Literature*. New York, NY: Dodd, Mead and Company.

Holmstrom, B. (1979), 'Moral hazard and observability'. *Bell Journal of Economics* **10**(Spring), 74–91.

Ichiishi, T. (1993), *The Cooperative Nature of the Firm*. Cambridge: Cambridge University Press.

Ijiri, Y. (1975), *Theory of Accounting Measurement*. Sarasota, FL: American Accounting Association.

Itoh, H. (1993), 'Coalitions, incentives, and risk sharing'. *Journal of Economic Theory* **60**, 410–427.

Jackson, M. (1992), 'Implementation in undominated strategies: A look at bounded mechanisms'. *Review of Economic Studies* **59**, 757–775.

Jackson, M. and T. Palfrey (2001), 'Voluntary implementation'. *Journal of Economic Theory* **98**, 1–25.

Janakiraman, S., R. Lambert, and D. Larcker (1992), 'An empirical investigation of the relative performance evaluation hypothesis'. *Journal of Accounting Research* **30**, 53–69.

Jensen, M. and K. Murphy (1990), 'Performance pay and top-management incentives'. *Journal of Political Economy* **98**, 225–264.

Laffont, J. and D. Martimort (2001), *The Theory of Incentives: The Principal-Agent Model*. Princeton, NJ: Princeton University Press.

Lerrick, A. and A. Meltzer (2001), 'Beyond IMF bailouts: Default without disruption'. *Quarterly International Economics Report* **May 2001**.

Levin, J. (2003), 'Relational incentive contracts'. *American Economic Review* **93**(June), 835–847.

Li, C. (2012), 'Mutual monitoring within top management teams: A structural model investigation'. Working Paper, Carnegie Mellon University.

Ma, C. (1988), 'Unique implementation of incentive contracts with many agents'. *Review of Economic Studies* **55**, 555–572.

Ma, C., J. Moore, and S. Turnbull (1988), 'Stopping agents from 'cheating''. *Journal of Economic Theory* **46**, 355–372.

MacLeod, W. (2003), 'Optimal contracting with subjective evaluation'. *American Economic Review* **93**(March), 216–240.

Mautz, R. and H. Sharaf (1961), *The Philosophy of Auditing*. Sarasota, FL: American Accounting Association.

May, G. O. (1958), 'Generally accepted principles of accounting'. *Journal of Accountancy* **105**(1), 23–27.

Milgrom, P. and J. Roberts (1992), *Economics, Organizations and Management*. Englewood Cliffs, NJ: Prentice Hall.

Mookherjee, D. (1984), 'Optimal incentive schemes with many agents'. *Review of Economic Studies* **51**, 433–446.

Mookherjee, D. and S. Reichelstein (1990), 'Implementation via augmented revelation mechanisms'. *Review of Economic Studies* **57**, 453–475.

Mookherjee, D. and S. Reichelstein (1992), 'Dominant strategy implementation of Bayesian incentive compatible rules'. *Journal of Economic Theory* **56**, 378–399.

Murphy, K. and P. Oyer (2003), 'Discretion in executive incentive contracts'. Working Paper, University of Southern California and Stanford University.

Myerson, R. (1979), 'Incentive compatibility and the bargaining problem'. *Econometrica* **47**, 61–74.

Rajan, M. (1992), 'Cost allocation in multiagent settings'. *The Accounting Review* **67**, 527–545.

Rajan, M. and S. Reichelstein (2006), 'Subjective performance indicators and discretionary bonus pools'. *Journal of Accounting Research* **44**(June), 585–618.

Rajan, M. and S. Reichelstein (2009), 'Objective versus subjective indicators of managerial performance'. *The Accounting Review* **84**(January), 209–237.

Reichelstein, S. (1997), 'Investment decisions and managerial performance evaluation'. *Review of Accounting Studies* **2**, 157–180.

Riordan, M. and D. Sappington (1988), 'Optimal contracts with public ex post information'. *Journal of Economic Theory* **45**, 189–199.

Ross, S. (1995), 'Uses, abuses, and alternatives to the net-present-value rule'. *Financial Management* (Autumn), 96–102.

Satterthwaite, M. (1975), 'Strategy-proofness and Arrow's conditions: Existence and correspondence theorems'. *Journal of Economic Theory* **10**, 187–217.

Schmeidler, D. (1980), 'Walrasian analysis via strategic outcome functions'. *Econometrica* **48**, 1585–1593.

Sunder, S. (1997), *Theory of Accounting and Control*. Cincinnati, OH: South-Western Publishing.

Tirole, J. (1986), 'Hierarchies and bureaucracies: On the role of collusion in organizations'. *Journal of Law, Economics and Organization* **2**, 181–214.

Tirole, J. (1992), 'Collusion and the theory of organizations'. In: J.-J. Laffont (ed.): *Advances in Economic Theory: Invited Papers for the Sixth World Congress of the Econometric Society 2*. Cambridge: Cambridge University Press.

Towry, K. (2003), 'Control in a teamwork environment — the impact of social ties on the effect of mutual monitoring contracts'. *The Accounting Review* **78**, 1069–1095.

Wilson, R. (1987), 'Game-theoretic analysis of trading processes'. In: T. Bewley (ed.): *Advances in Economic Theory (Fifth World Congress)*.

Zimmerman, J. (2000), *Accounting for Decision Making and Control*. New York, NY: McGraw-Hill.