# Delegation, Monitoring, and Relational Contracts

Susanne Goldlücke* and Sebastian Kranz†

February 21, 2012

**Abstract**

This paper analyzes in a relational contracting framework when a principal should fully delegate a task to a team of hired workers or only partially delegate the task and work herself in the team. It is shown that full delegation is more likely to be optimal under a less efficient monitoring technology, lower generated surplus, lower complementarity of efforts, or a larger team of workers.

JEL-Codes: D82, D21, L22, M54

Keywords: relational contracts; delegation; monitoring; job design; moral hazard in teams

## 1 Introduction

We consider a principal who repeatedly has projects that require a team of workers. The principal can fully delegate the work to $n$ hired agents, or she can also work on the project herself and hire just $n-1$ agents for the team (see Figure 1 for an illustration). We consider a setting in which incentives must be fully provided by relational contracting, i.e., no enforceable contracts can be written.

There are many possible factors that influence the decision whether to fully delegate a project, like different skill sets or possible valuable knowledge that is created by working on the task. In this study, we abstract from these context-specific factors and analyze the pure trade-offs that arise from different possibilities to provide incentives for high effort under the two delegation schemes via relational contracting. In all other respects, the schemes are assumed to be equivalent; in particular we assume that the principal can earn her reservation wage if she does not work, such that it does not matter that the full delegation scheme needs more individuals.

*Department of Economics, University of Mannheim, L7, 3-5, 68131 Mannheim, Germany. Phone: +49 621 181 3072 Email: goldluecke@uni-mannheim.de

†Institute of Energy Economics, University of Cologne. Email: skranz@uni-bonn.de.

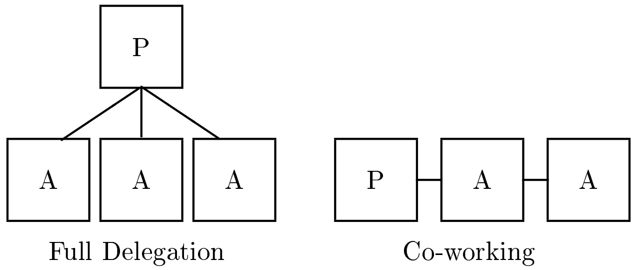


Figure 1: The two organizational forms for $n = 3$.

If the principal fully delegates the project, an optimal relational contract has essentially the same structure as in Levin (2003). If the project has been successful, the principal receives the return and pays each agent a bonus. If the principal refuses to pay a promised bonus, agents punish her by not exerting effort in future projects.

An advantage of the principal working herself is that she directly gains the benefits of a successful project and therefore has naturally higher incentives to exert effort than an agent. However, if the value of the project is low compared to the bonuses that have to be paid, the principal's incentives for effort are reduced since a success now becomes less attractive. Depending on the monitoring and production technology, it can be the case that full effort provision in every period can be achieved for a larger set of discount factors either for full delegation or for co-working. We find that full delegation is relatively more attractive than co-working if the monitoring technology is less precise, production costs are large compared to the value of a successful project, the size of the project is larger and effort levels are stronger substitutes.

That hierarchies arise as a response to agency problems is a familiar theme in the literature (Alchian and Demsetz (1972), Holmström (1982)). Our paper studies these issues in a repeated setting and finds that by varying the monitoring structure from perfect monitoring to pure imperfect monitoring, delegation becomes optimal. It is closely related to Doornik (2006) and Rayo (2007). While Doornik (2006) studies a partnership, Rayo (2007) studies a repeated moral hazard in teams problem and focuses on how incentives generated by explicit ownership shares interact with incentives generated by relational contracting. Our paper should be seen as complementing these papers: In a much simpler set-up with no formal contracts we study the well-defined question of how the organizational structure depends on available information and other parameters of the environment.

## 2 Basic model

We consider an infinitely repeated game with common discount factor $\delta$. In each period, a principal has a project that needs $n$ workers. She can hire $n$ agents as workers (delegation) or she can work herself and hire only $n-1$ agents (co-working). She makes this decision before the repeated interaction starts at $t = 0$. In every period, the following stage game is played: each worker $i$ can either exert effort $e_i = 1$ or shirk $e_i = 0$. Effort costs are $ce_i$ with $c > 0$. We denote by $\pi_m \in [0, 1]$ the success probability of the project if $m$ workers exert effort. The principal gets benefit $v$ from a successful project and zero benefit from a failure. The project has a positive expected surplus only if no worker shirks:

$$\pi_n v - nc > 0 > \pi_m v - mc \text{ for all } m < n.$$

We denote by

$$\Delta = \pi_n - \pi_{n-1}$$

the difference in the probability of success when $n$ individuals work and $n-1$ work. At the end of each period, the principal and all workers commonly observe the realized benefit $\tilde{v} \in \{0, v\}$. In addition, there is an imperfect technology to monitor individual efforts. Players observe a public signal $\tilde{e}$ that with probability $\alpha$ is equal to the current period's effort levels ($\tilde{e} = e$), and with probability $1-\alpha$ provides no information about efforts ($\tilde{e} = \emptyset$).

The success of a project is commonly observed by all players, but not verifiable to a third party. It is not possible to write enforceable contracts that condition on $\tilde{v}$ or $\tilde{e}$. At the beginning and end of a period players can conduct voluntary monetary transfers to each other. Players are risk-neutral and there are no wealth constraints.

## 3 Method

We restrict attention to efficient equilibria in which all workers choose effort in every period on the equilibrium path. Further, we assume that transfers only depend on the signal in the current period and that any deviation from required transfers is punished by playing in all future the stage game Nash equilibrium (no effort and no transfers). That these assumptions are without loss of generality follows from Goldlücke and Kranz (2012). They develop tools to characterize the set of public perfect equilibrium payoffs in repeated games with transfers. The following analysis also uses their result that in order to find payoffs in the repeated game, one can first solve a specific static game.

In the static game, players play the stage game only once, but enforceable signal-dependent wage payments from the principal to the agents are possible. There is a restriction that the summed-up wages of all agents must not exceed an exogenous liquidity bound $L$ after any signal. For each delegation structure, we derive the minimum required liquidity to implement effort by all workers in this static game. We then find the minimum discount factor that allows the principal to promise such high payments by setting these liquidity requirements equal to

$$L(\delta) = \frac{\delta}{1-\delta}(\pi_n v - nc). \tag{1}$$

Intuitively, the variable $L(\delta)$ is an endogenous liquidity that is generated by the repeated game. It is defined as the joint surplus $\pi_n v - nc$ that is created in every period on the equilibrium path minus the punishment payoff of zero, adjusted for discounting. We refer the reader to Goldlücke and Kranz (2012) for details why this static game approach works.

# 4 Results

**Full Delegation** We first study full delegation using the approach described above. It is straightforward that in order to make the agents work, it is best to never pay an agent for a failure or for being caught shirking. Assume that all other workers exert effort and an agent gets a wage of $w_e$ if his positive effort is observed and $w_v$ for a successful project without effort being observed. The agent then exerts effort if and only if

$$\alpha w_e + (1-\alpha)\pi_n w_v - c \geq (1-\alpha)\pi_{n-1} w_v. \tag{2}$$

This condition can be easiest satisfied simultaneously for all agents by setting for each agent $w_e = w_v = L/n$. The liquidity therefore must satisfy

$$L \geq \frac{nc}{\alpha + (1-\alpha)\Delta} \equiv \mathcal{L}_D. \tag{3}$$

We find the critical discount factor under which mutual effort can be implemented under full delegation by setting this liquidity requirement $\mathcal{L}_D$ equal to the liquidity $L(\delta)$ that is generated in the repeated game. Solving for $\delta$ yields

$$\bar{\delta}_D = \frac{nc}{(\alpha + (1-\alpha)\Delta)(\pi_n v - nc)}. \tag{4}$$

The critical discount factor decreases in the benefit $v$, the probability of detecting effort $\alpha$ and the complementarity of efforts $\Delta$.

**Comparison with co-working** In the co-working set-up, the principal only has to pay out $n-1$ wages. Analogous to the delegation case, the principal can pay sufficiently large wages if

$$L \geq \frac{(n-1)c}{\alpha + (1-\alpha)\Delta} \equiv \mathcal{L}_C^A. \tag{5}$$

Because $\mathcal{L}_C^A < \mathcal{L}_D$, it depends on the principal's incentive constraint whether delegation or co-working can implement the efficient outcome for a larger range of discount factors. Again, it is straightforward to show that one can restrict attention to positive wages $w_e$ and $w_v$ as described above. If the principal is caught shirking, she clearly should pay all liquidity $L$ to the agents. The principal has no incentive to shirk whenever

$$\pi_n v - c - (n-1)\left(\alpha w_e + (1-\alpha)\pi_n w_v\right) \geq \pi_{n-1} v - \alpha L - (1-\alpha)(n-1)\pi_{n-1} w_v. \quad (6)$$

Expected payments enter the incentive constraints of agent and principal in a diametrical way: if increasing a payment relaxes an agent's constraint, it tightens the principal's constraint. To find the minimal liquidity to satisfy the principal's incentive constraint, we can therefore assume that wages are chosen such that each agent's incentive constraint (2) binds. Adding these binding constraints to the principal's constraint yields

$$\Delta v - 2c \geq -\alpha L. \quad (7)$$

Rearranging yields

$$L \geq \frac{2c - \Delta v}{\alpha} \equiv \mathcal{L}_C^P, \quad (8)$$

which means that the efficient outcome can be implemented if and only if

$$L(\delta) \geq \max(\mathcal{L}_C^A, \mathcal{L}_C^P). \quad (9)$$

Comparing this to the condition $L(\delta) \geq \mathcal{L}_{\mathcal{D}}$ for delegation, one can see that the first best outcome can be implemented for a larger range of discount factors under co-working if and only if

$$\mathcal{L}_C^P \leq \mathcal{L}_D. \quad (10)$$

Rearranging yields the following result.

**Proposition 1.** *The first best outcome can be implemented for lower discount factors under co-working than under full delegation if and only if*

$$nc \leq v\left(\frac{\alpha}{1-\alpha} + \Delta\right); \quad (11)$$

*the attractiveness of co-working attractiveness compared to full delegation increases if ceteris-paribus i) costs $c$ are lower, ii) the value of the project $v$ is larger, iii) the probability to observe effort $\alpha$ increases, iv) the effort complementarity $\Delta$ increases, and iv) the team size $n$ is smaller.*

Co-working has the advantage that the principal is motivated to work because he owns the project. This advantage is very clear for $n = 1$, the degenerate case in which the principal chooses between doing the work herself and delegating it to an agent, thereby creating a moral hazard problem. This advantage becomes less important the larger the size of the organization $n$ is. Since the principal's incentives come from the fact that she is residual claimant on the project's profits, the greater these profits are, the easier it is to incentivize the principal. The disadvantage of co-working is that the incentives of the principal and the agents are not aligned: an agent has greater incentives to work if a bonus becomes larger, while if bonuses for a success become too large, the principal loses his incentives to work. Because the bonus that directly rewards for effort does not have this problem, co-working is superior if individual performance measures are available with high probability.

# 5 Discussion

The model was framed in an abstract way, but if set in a specific application, it can be augmented in various ways. In an application to management, it would be important to study how incentives generated by the relational contract interact with contractible but imprecise performance measures. Such questions are analyzed in Gürtler (2008), and Schöttner (2008), who study the problem of optimal job design that was raised by Itoh (1994) in a repeated setting.

For an application to the theory of the firm, full delegation can be interpreted as separation of labor and ownership, while co-working in a team is reminiscent of partnerships that one can see in the service industries (e.g. law firms). In a recent paper, Li, Ye and Yu (2012) analyze the incentive effects of a producer-owned firm vs. an investor-owned firm in a static model. They show that producer-owned firms are less efficient when the input quality is unobservable and the size of the organization is large. This resonates well with our finding for the repeated game, where delegation (=producer-owned firm) is less efficient when monitoring quality becomes worse and the size of the organization is large.

# References

**Alchian, Armen A. and Harold Demsetz**, "Production, Information Costs, and Economic Organization," *The American Economic Review*, December 1972, *62* (5), 777–795.

**Doornik, Katherine**, "Relational Contracting in Partnerships," *Journal of Economics & Management Strategy*, June 2006, *15* (2), 517–548.

**Goldlücke, Susanne and Sebastian Kranz**, "Infinitely repeated games with public monitoring and monetary transfers," *Journal of Economic Theory*, 2012.

**Gürtler, Oliver**, "On Delegation under Relational Contracts," *International Journal of the Economics of Business*, 2008, *15* (1), 85–98.

**Holmstrom, Bengt**, "Moral Hazard in Teams," *The Bell Journal of Economics*, October 1982, *13* (2), 324–340.

**Itoh, Hideshi**, "Job design, delegation and cooperation: A principal-agent analysis," *European Economic Review*, April 1994, *38*, 691–700.

**Levin, Jonathan**, "Relational Incentive Contracts," *The American Economic Review*, 2003, *93* (3), 835–857.

**Li, Sanxi, Bing Ye, and Jianyu Yu**, "Observability and incentive in organizations," *Economics Letters*, February 2012, *114* (2), 205–207.

**Rayo, Luis**, "Relational Incentives and Moral Hazard in Teams," *The Review of Economic Studies*, July 2007, *74* (3), 937 –963.

**Schöttner, Anja**, "Relational Contracts, Multitasking, and Job Design," *Journal of Law, Economics, and Organization*, May 2008, *24* (1), 138 –162.