

Institutional Design under Delegated Contracting and Auditing

Auditing the Contract Offer

Wolfgang Gick^{1,2}

¹Department of Economics
Dartmouth College

²Center for European Studies
Harvard University

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 - Hierarchies and Agency Costs
 - Vertical Hierarchies, Information, and Control (Auditing)
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Delegated Contracting as NIE Research Program

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- Hierarchy as a typical organizational form of business firms, non-for-profit organizations, governments, and centrally-planned economies
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 - Williamson (JPE 1967), Calvo and Wellisz (JPE 1978): Loss of control as a MH problem
 - Different: Arrow (1969) on transaction costs varying with the mode of resource allocation.
 - Marschak (AER 1968) on economics of information systems
→ Information and incentives should be analyzed together.

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- Endogenous determination of contract, information, and control
 - Melumad and Reichelstein (JET89) on communication and incentives in hierarchies
 - Hidden gaming in 3-player hierarchies (Laffont, JLEO1990).
- Delegated Contracting - Modeling the additional loss of control that arises in vertical hierarchies.
 - Particular assumption: Principal has no access to the agent located at the lowest tier (span of control).
 - McAfee and McMillan (JEMS 1995): second principal in the middle extends the ("hierarchical distance between the information source and the decision maker.")
- New view of Faure-Grimaud and Martimort (FGM) (EconLett 2001): Intermediary (middle principal) is hired to detect one extreme inefficient state of nature. If that does not occur he should induce production through offering a Baron-Myerson (1982) style subcontract.

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Players, Types and Prior beliefs

- **Players: Principal, Intermediary, Productive Agent**
 - Productive agent can be of three types, $\underline{\theta}$, $\hat{\theta}$ and $\bar{\theta}$, with $\Delta\theta \equiv \hat{\theta} - \underline{\theta} > 0$.
 - Type $\bar{\theta}$ has excessive marginal cost and should never be offered a contract according to the principal's will.
 - To avoid having the $\bar{\theta}$ -type in the regime, the principal hires the intermediary to costlessly observe type $\bar{\theta}$ with a known precision ρ .
 - Whenever she remains uninformed, the agent's type is either $\underline{\theta}$ (with a probability ν) or $\hat{\theta}$ (with a probability $1 - \nu$) at the subcontracting stage. The resulting priors are $(1 - \rho)\nu$, $(1 - \rho)(1 - \nu)$, and ρ , respectively.
 - Principal maximizes his expected net surplus $S(q) - s$, which includes the budget s paid to the intermediary to forward production transfers t to the productive agent.

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Transfers and Rents

- Transfers are designed to permit the offer of a BM style contract to the agent that includes the virtual costs $\Delta\theta\hat{q}$, which induces production by both types $\underline{\theta}$ and $\hat{\theta}$.
- $S(q)$ denotes the principal's gross surplus, with $S' > 0$, and $S'' < 0$.
- Intermediary's information rents (because of budgeting):
 $\underline{v} = \underline{s} - \underline{\theta}q$ and $\hat{v} = \hat{s} - \hat{\theta}\hat{q}$, respectively. These rents reflect the surplus of the intermediary-agent coalition.
- The intermediary is risk averse and has a VNM utility function of

$$V(s - t) = \frac{1 - e^{-r(s-t)}}{r}.$$

The Intermediary's Information Rent in FGM

- Hierarchy governed through a grand contract; delegation proofness is reached by satisfying the following constraints of the intermediary.
 - Downward IC constraints:

$$\underline{v} \geq \hat{v} + \Delta\theta\hat{q} \quad (1)$$

$$\nu V(\underline{v} - \Delta\theta\hat{q}) + (1 - \nu)V(\hat{v}) \geq \nu V(\underline{v}) + (1 - \nu)V(s(\bar{q})). \quad (2)$$

- Interim participation constraints:

$$V(\bar{s}) \geq 0 \quad (3)$$

$$\nu V(\underline{v} - \Delta\theta\hat{q}) + (1 - \nu)V(\hat{v}) \geq 0. \quad (4)$$

Agency Cost under Delegated Contracting

- Since the intermediary's contract offer is unobserved, she can require a rent that prevents her from offering a shutdown contract to the agent, which satisfies

$$V(\hat{v}) \geq \nu V(\hat{v} + \Delta\theta\hat{q}). \quad (5)$$

- If not observing a $\bar{\theta}$ -type agent, she could still offer a shutdown contract and reaping the virtual cost $\Delta\theta\hat{q}$ herself. To restore delegation proofness, a rent is paid to satisfy (5).

$$\hat{v} = \frac{1}{r} \ln \frac{1 - \nu e^{-r\Delta\theta\hat{q}}}{1 - \nu}. \quad (6)$$

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Timing of the contracting game under Auditing

- Agent learns its type; Intermediary learns whether the agent is of the most inefficient type $\bar{\theta}$ or not. **(t=0)**
- Principal offers a grand contract to the Intermediary, designing transfers, output targets, and control. **(t=1)**
- If accepted, the Intermediary offers either a BM contract or a shutdown contract to the Agent. **(t=2)**
- The Agent accepts or rejects, production takes place, and the Intermediary reports the Agent's type to the Principal. **(t=3)**
- Outputs are observed, and the Principal performs an audit through controlling the existing subcontract between Intermediary and Agent, if the Intermediary reports $\tilde{\theta} = \bar{\theta}$. **(t=4)**

Principal audits after a favorable report

- **Case 1:** Intermediary reports $\tilde{\theta} = \bar{\theta}$. No sub-contract exists and the report can either be true or false. If the report is true, the intermediary did exactly her job to *not* offer a sub-contract when observing that $\theta = \bar{\theta}$.

If the report was false, the intermediary has offered a shutdown contract and lost her gamble. Although she did not act following the principal's intention, she was unable to reap any rent. The agent's true type is then $\theta = \hat{\theta}$.

- **Case 2:** Intermediary reports $\tilde{\theta} = \hat{\theta}$. This report is true: the sub-contract was accepted, which reveals that the intermediary has indeed offered a BM contract, otherwise the revealed $\hat{\theta}$ -type agent would have rejected.
- **Case 3:** Intermediary reports $\tilde{\theta} = \underline{\theta}$. The accepted sub-contract can be a shutdown contract, in which case the intermediary may have reaped the virtual costs $\Delta\theta\hat{q}$ included in the budget to permit a BM contract.

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How Auditing Reduces the Loss of Control

- Auditing the contract after a θ report reduces the intermediary's participation constraint to:

$$V(\hat{v}) \geq \nu[\underline{\varrho}V(\hat{v} + \Delta\theta\hat{q} - P^s) + (1 - \underline{\varrho})V(\hat{v} + \Delta\theta\hat{q})].$$

Under endogenous punishment this can be reduced to

$$V(\hat{v}) \geq \nu(1 - \underline{\varrho})V(\hat{v} + \Delta\theta\hat{q}).$$

- This constraint is binding in the optimum and can be satisfied by reducing the intermediary's rent to

$$\hat{v} = \frac{1}{r} \ln \frac{1 - \nu(1 - \underline{\varrho})e^{-r\Delta\theta\hat{q}}}{1 - \nu(1 - \underline{\varrho})}.$$

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Grand Contract under Internal Control

- Principal's program:

$$\max_{\{(\underline{s}, \underline{q}), (\hat{s}, \hat{q}), (\underline{\varphi}), (\bar{s})\}} (1 - p)[\nu(S(\underline{q}) - \underline{\theta}q - \frac{1}{r} \ln \frac{1 - \nu(1 - \underline{\varphi})e^{-r\Delta\theta\hat{q}}}{1 - \nu(1 - \underline{\varphi})} - \Delta\theta\hat{q} - c(\underline{\varphi}) + (1 - \nu)(S(\hat{q}) - \hat{\theta}\hat{q} - \frac{1}{r} \ln \frac{1 - \nu(1 - \underline{\varphi})e^{-r\Delta\theta\hat{q}}}{1 - \nu(1 - \underline{\varphi})})] - p\bar{s}$$

- Solution: No distortion at the top

$$(\underline{q}^C) = \underline{\theta}$$

- Reduced distortion for the $\hat{\theta}$ -agent, compared to the original FGM setting:

$$(\hat{q}^C) = \hat{\theta} + \frac{\nu}{1 - \nu} \Delta\theta + \frac{1}{1 - \nu} \frac{\nu\Delta\theta(1 - \underline{\varphi}^C)e^{-r\Delta\theta\hat{q}}}{1 - \nu(1 - \underline{\varphi}^C)e^{-r\Delta\theta\hat{q}}}$$

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Comparing Delegated Contracting with Centralization

- Auditing permits the principal to reduce distortion. The solution under delegation is closer to the second-best result.
- Compared with centralization, delegation performs better. Paper shows a choice rule for the principal when to contract the agent himself, and when using delegation with auditing.
- Results is robust. It also holds if the intermediary requires limits on punishments to accept the contract. This permits a concluding interpretation on how different legal settings influence the efficiency of different hierarchical forms of contracting: with no limits on punishments the loss of control is smallest.

Final Thoughts

- Delegated Contracting as a typical form of delegation in large hierarchies can be improved through an internal control scheme.
- Control schemes of this kind are pervasive in public bureaucracies.
- Novelty lies in auditing a contract instead of auditing production: no access to productive agent is needed.
- Possible extensions:
 - (1) Comparison with hiring an external auditor to examine the productive agent's type (carried out contingent on $\hat{\nu}$)
 - (2) Extending the setting toward a richer action and information space of the intermediary (see e.g. Melumad, Mookherjee and Reichelstein (RJE 1995)).

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