Relational Contracts and the Value of Loyalty

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Motivation

Holdup problem is pervasive

- Developing economies (McMillan and Woodruff, 99)
- Developed countries (Macaulay, 67)

Holdup explains forms of organisations

- Organisation of communities (Grief, 93)
- Make vs Buy decisions (Williamson, 85)

How does Holdup affect supply relationships?

- Holdup problem mitigated by ongoing relationships.
- Maintaining relationships can reduce the scope of trade.

Toyota vs. GM

General Motors in 1980s

- Competitive bidding each year.
- Use cheapest supplier.
- Outsource 30% of production.
- Check quality of part before installing.

Toyota in 1980s

- Automatically renew contracts for life of vehicle.
- Preferred supplier policy for new models.
- Outsource 70% of production.
- Trust suppliers to verify quality.

Government Procurement (Kelman, 1990)

Government Procurement in 1980s

- Full and open competition (e.g. competitive bidding).
- Could not use subjective information (e.g. prior performance)

Public vs. Private

- Government uses lowest bidder more often.
- Private firms more loyal to suppliers.
- Private firms more satisfied with performance.

Motivation

This paper will . . .

- Derive the optimal relational contract.
- Show relational contracts induce loyalty.
- Characterise distortions induced by ongoing relationships.

We will have predictions about

- Switching between suppliers.
- Time path of prices.
- When trade will take place at all.

The Theory

One principal and N agents.

- Each period, principal invests in one agent.
- Investment costs vary across agents and over time.
- Agent can then hold up principal.

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- Investment costs vary across agents and over time.
- Agent can then hold up principal.

Agents can garner rents through threat of holdup.

- Rents same if trade once or one hundred times.
- Rents acts like fixed cost of new relationship.

Principal divides agents into ‘insiders’ and ‘outsiders’.

- Trade with insiders efficiently.
- Trade is biased against outsiders.
- This is self–enforcing if parties are patient enough.

Literature

- Calzolari and Spagnolo (2006).
- Relational contracts with random hiring: Shapiro and Stiglitz (1984) and Greif (1993, 2003).
- Relational contracts with contractible transfers: MacLeod and Malcomson (1989), Levin (2002, 2003).
- Community enforcement: Kandori (1992), Ghosh and Ray (1996), Sobel (2006).

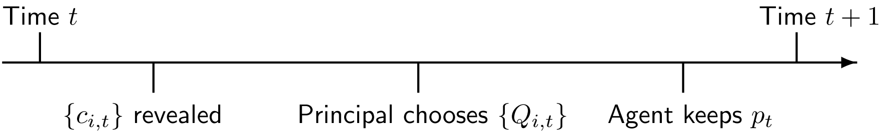
Outline

Model: Stage Game

One principal and N agents. Time $t \in \{1, 2, \ldots\}$.

1. Costs $\{c_{i,t}\}$ publicly revealed.
2. Principal chooses $Q_{i,t} \in \{0, 1\}$ s.t. $\sum_i Q_{i,t} \leq 1$.
   Winning agent produces and sells product worth v.
3. Agent keeps $p_t \in [0, v]$, and gives back $v - p_t$ to principal.

Investment $Q_{i,t}$ and prices p_t are noncontractible.



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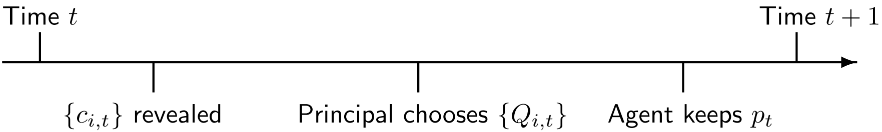
Holdup Problem: No investment in unique stage game equilibrium.



Model: Repeated Game

Relationships bilateral.

- Agent i observes costs $\{c_{i,t}\}$ and $Q_{i,t}$.

Relational contract $\langle Q_{i,t}, p_t \rangle$ specifies

- Investments: $Q_{i,t} : h^{t-1} \times [\underline{c}, \overline{c}]^N \rightarrow \{0,1\}$.
- Prices: $p_t : h_i^{t-1} \times [\underline{c}, \overline{c}]^N \rightarrow [0, v]$.

Equilibrium

- Contract is agent–self–enforcing (ASE) if agents' strategies form SPNE, taking principal's investment strategy as given.
- Contract is self–enforcing (SE) if both agents' and principal's strategies form SPNE.

One–Sided Commitment

Assumption

- Principal commits to (contingent) strategy, $Q_{i,t}$.
- Allows us to focus on agents' incentives.

Agent i's utility at time t is

$$U_{i,t} := E_t\left[\sum_{s \geq t} \delta^{t-s} p_t Q_{i,t}\right]$$

Lemma 1.
Contract $\langle Q_{i,t}, p_t \rangle$ is agent–self–enforcing if and only if

$$(U_{i,t} - v)Q_{i,t} \geq 0 \qquad (\forall i)(\forall t) \qquad \text{(DEA)}$$

Dynamic Enforcement Constraint

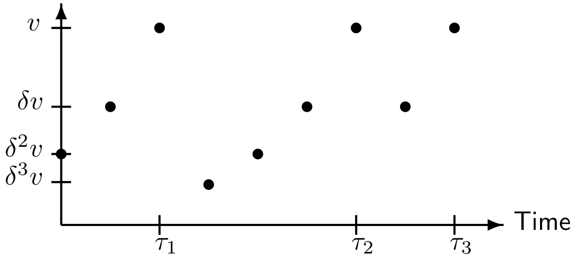
Lemma 2.

Contract $\langle Q_{i,t}, p_t \rangle$ is agent–self–enforcing if and only if

$$U_{i,t} \geq E_t[v\delta^{\tau_i(t)-t}] \qquad (\forall i)(\forall t) \qquad \text{(DEA}')$$

where $\tau_i(t) := \min\{s \geq t : Q_{i,s} = 1\}$ is time of next trade.

Proof.



□

Principal's Problem

The profit at time t from relationship i is

$$\Pi_{i,t} := E_t\left[\sum_{s\geq t} \delta^{t-s}(v - c_{i,t} - p_t)Q_{i,t}\right]$$

Total profit is $\Pi_t := \sum_i \Pi_{i,t}$.

Principal's problem is to maximise initial profit

$$\Pi_0 := E_0\left[\sum_{s\geq 1}\sum_{i} \delta^{t-s}(v - c_{i,t} - p_t)Q_{i,t}\right]$$

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$$\Pi_0 := E_0\Big[\sum_{s\geq 1}\sum_i \delta^{t-s}(v - c_{i,t})Q_{i,t}\Big] - \sum_i U_{i,0}$$

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Optimal ASE Contract

The set of insiders at time t is $\mathcal{I}_t := \{i : \tau_i(0) < t\}$

Property 1.

Trade with insiders is efficient. Suppose $i \in \mathcal{I}_t$. *Then* $Q_{i,t} = 1$ *if* $c_{i,t} < v$ *and* $c_{i,t} < c_{j,t}$ $(\forall j)$.

The Idea

- First time agent trades, they gets rents v.
- This payment can be delayed and used to stop future holdup.
- Thus rents act like fixed cost of new relationship

Optimal ASE Contract

Property 2.

Trade is biased against outsiders. Suppose $i \notin \mathcal{I}_t$. Then $Q_{i,t} = 0$ if either:

1. $(v - c_{i,t}) < v(1-\delta)$; *or*
2. $(c_{j,t} - c_{i,t}) < v(1-\delta)$ *for* $j \in \mathcal{I}_t$.

The Idea

- Abstain if profit less than rental value of rents.
- Prefer insider if profit gain less than rental value of rents.
- May prefer relatively inefficient outsider (if costs not IID).

Theory of endogenous switching costs

- Pay to switch to new agent, but not to revert back.

Prices

General prices

- Pick $U_{i,t}$ such that (DEA′) holds $(\forall t)$ and binds at $t = 0$.
- Prices can then backed out of utility:

$$p_{i,t} = U_{i,t} - E_t[\delta^{\tau_i(t+1)} U_{i,\tau_i(t+1)}]$$

Fastest prices

- These have property that (DEA′) binds $(\forall t)$,

$$p_{i,t} = vE_t[1 - \delta^{\tau_i(t+1)}]$$

- Fastest prices maximise continuation profits, $\Pi_{i,t}$.
- Full problem: Investment rule implementable only if it can be implemented by fastest prices.

Example: IID Costs

- Number of insiders, n_t, follows time–invariant markov chain.
- Stay inside if best insider cost $c_{1:n}$ falls below cutoff, c_n^*.

Insiders, n_t	Cutoff, c_n^*	Prob$(n_{t+1} = n_t)$	Value fn., $\Phi(n)$
0	0	0	83.6
1	0.358	0.358	85.3
2	0.398	0.637	87.0
3	0.454	0.837	88.6
4	0.549	0.959	90.2
5	0.834	0.999	91.7
6	1	1	92.9

Table: $v = 2$, $c_{i,t} \sim [0,1]$, $N = \infty$ and $\delta = 0.98$.

Predictions

1. More loyalty in countries with poorer legal systems.
   - Johnson et al (2002)
2. More loyalty where goods are more specific.
   - Johnson et al (2002)
3. Firms who are less loyal receive lower quality.
   - Kelman (1990), GM vs. Toyota.
4. Trade harder as end game approaches.
   - Bankruptcy of GM and suppliers.

Full Problem

Principal's problem is to maximise profits

$$\Pi_0 = E_0\left[\sum_{s\geq 1}\sum_i \delta^{t-s}(v - c_{i,t} - p_t)Q_{i,t}\right]$$

$$\begin{aligned} \text{s.t.} \quad & \Pi_{i,t}Q_{i,t} \geq 0 \quad (\forall i)(\forall t) \qquad \text{(DEP)} \\ & (U_{i,t} - v)Q_{i,t} \geq 0 \quad (\forall i)(\forall t) \qquad \text{(DEA)} \end{aligned}$$

Question

- Can we implement optimal ASE contract?

Full Problem

Principal's problem is to maximise profits

$$\Pi_0 = E_0\left[\sum_{s\geq 1}\sum_i \delta^{t-s}(v-c_{i,t})Q_{i,t}\right] - E_0\left[\sum_i v\delta^{\tau_i(0)}\right]$$

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$$\text{s.t.} \qquad (W_{i,t} - v)Q_{i,t} \geq 0 \quad (\forall i)(\forall t) \qquad \text{(DEP}'\text{)}$$

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Time Inconsistency

Example 1

- Suppose $N = 1$, $v = 1$ and $\delta = 3/4$.
- Costs: $c_t = 1/2$ for $t \leq 10$, and $c_t = 0.99$ for $t > 10$.

What goes wrong:

- Optimal ASE contract has $Q_{i,t} = 1$ $(\forall t)$.
- By backwards induction, $Q_{i,t} = 0$ $(\forall t)$.

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Optimal ASE contract is not time consistent.

- Rents of insiders are sunk, so agent used efficiently.
- But payment of rents is delayed to prevent future holdup.
- Principal may later regret promising to use agent efficiently.

IID Costs

Proposition 3.

Suppose that costs are IID and $\underline{c} > 0$. *Then* $\exists\hat{\delta}$, *independent of* N, *such that the optimal ASE contract satisfies (DEP) when* $\delta > \hat{\delta}$.

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Suppose that costs are IID and $\underline{c} > 0$. Then $\exists \hat{\delta}$, independent of N, such that the optimal ASE contract satisfies (DEP) when $\delta > \hat{\delta}$.

- For fixed N, result is trivial.
  - $W_{i,t} \to \infty$ as $\delta \to 1$.
- Problem: If $N = \infty$, then $\sup_t n_t \to \infty$ as $\delta \to 1$.
  - Marginal welfare, $E[c_{1:n} - c_{1:n+1}]$, falls quickly in n.
  - Average welfare, $E[v - c_{1:n}]/n$, falls more slowly in n.
  - Thus $W_{i,t} \to \infty$ as $\delta \to 1$.

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Example 2

- Suppose $c_{i,t} \sim U[0,1]$ and $v > 1$.
- Then (DEP) satisfied when $\delta \geq \hat{\delta} = (1 + (v-1)^3)^{-1}$.

More

Private Cost Information

Suppose $\{c_{i,t}\}$ are privately known by principal.

Problem

- The optimal ASE contract is not incentive compatible.
- Principal lies about costs because of time inconsistency.

Example 3

- Suppose $N = 1$, $v = 1$, $c \sim U[0, 2]$, and $\delta = 9/10$
- Optimal ASE contract: Outsiders trade if $c \leq 0.80$;
  Insiders trade if $c \leq 1$.
- This contract is self–enforcing and generates prices, $p_t = 0.18$.
- Principal will overstate cost if $c \in [0.82, 1]$.
- Similarly, she may lie to use outsider over insider.

Maintenance Contracts

A maintenance contract has payments:

$$
\begin{aligned}
p_{i,t} &= (1-\delta)v && \text{if } i \in \mathcal{I}_t \\
p_{i,t} &= 0 && \text{if } i \notin \mathcal{I}_t
\end{aligned}
$$

Investments $Q_{i,t}$ chosen to maximise profits Π_0 as in optimal ASE contract.

More formally

1. Principal observes her costs.
2. Principal makes public cost reports, determining $\langle Q_{i,t}, p_{i,t} \rangle$.
3. Principal chooses in whom to invest.
4. Winning agent chooses whether to hold up principal.

Maintenance Contracts

Proposition 5.

The maintenance contract is an optimal ASE contract, and is incentive compatible for principal. It is self–enforcing if

$$W_{i,t} \geq v \qquad \textit{for all } i \in \mathcal{I}_t. \tag{DEP$^{\text{MC}}$}$$

Benefit of MC

- Incentive Compatibility

Cost of MC

- (DEP$^{\text{MC}}$) is stricter than (DEP).
- However, under IID costs (DEP$^{\text{MC}}$) holds if $\delta > \hat{\delta}$.

Agents' Rents

Agents' obtain rents.

- Crucial to this paper.
- But principal may be able to fully extract.

1. Up–front payments.

- At time 0, agent pays principal all rents.

2. Contractible transfers.

- Set transfer equal to v.
- Agent "buys the firm".

Motivation 1: Wealth Constraints

General Contract $\langle Q_{i,t}, \phi_{i,t}, \phi^0_{i,t} \rangle$

- $\phi_{i,t}$ is voluntary payment from i to principal.
- $\phi^0_{i,t}$ is contractible payment from i to principal.

Proposition 7.

Suppose the agent has zero wealth. Then any self–enforcing contract $\langle Q_{i,t}, \phi_{i,t}, \phi^0_{i,t} \rangle$ delivers the same payoffs as a contract of the form $\langle Q_{i,t}, p_t \rangle$.

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Case Study: McDonalds (Kaufman and Lafontaine, 1994).

- In 1980s, franchisees made ex ante rents of \$400K.
- Franchise fee was only \$22.5K.

Motivation 2: Cowboys

Free Entry of Principals

- Suppose there are many 'cowboy principals' in the world.
- These cowboys have costs $c_{i,t} = \infty \ (\forall i)(\forall t)$.

General Contract $\langle Q_{i,t}, \phi_{i,t}, \phi^0_{i,t} \rangle$

- Contract is cowboy–proof if cowboys makes negative profits.

Proposition 8.

Any self–enforcing cowboy–proof contract $\langle Q_{i,t}, \phi_{i,t}, \phi^0_{i,t} \rangle$ delivers the same payoffs as a contract of the form $\langle Q_{i,t}, p_t \rangle$.

Strategy for Outsourcing

Kern, Willocks and van Heck (2002), "The Winner's Curse in IT Outsourcing", California Management Review.

> *"The goal must be win–win, where the supplier can make a return. In a one–sided venture, the supplier has to try to cover its costs in any way possible, which is likely to effect services, operations and relations adversely."*

Contracts without Rents

Optimal contract exhibits loyalty

- Multi–sourcing reduces the frequency of trade.
- Hence defection more likely.

Optimal contract

- Contract is stationary.
- Bias trade towards most recently used agent.

Extensions

Incentives to innovate

- How does contract affect entry of new agents?
- How does contract affect incentives to invest in R&D?
- How does potential entry affect optimal contract?

Different quantity levels, $Q \in \{0, 1 \ldots, L\}$

- Slow build up of trade.

Renegotiation–proofness

- Equilibrium is ϵ–renegotiation–proof if $N \geq \hat{N}_\epsilon$.

Summary

Agents' ability to holdup principal gives them rents.

- These rents are independent of number of trades.
- Act like fixed cost of relationship.

Characterisation of optimal ASE contract.

- Principal divides agents into 'insiders' and 'outsiders'.
- Trade biased towards insiders.

ASE contract is robust.

- If parties patient, contract is self–enforcing.
- With maintenance payments, contract robust to private info.

Full Problem with IID Costs and $N = 1$

Suppose $N = 1$. The optimal ASE contract obeys

$$\begin{aligned} Q_t &= \mathbf{1}_{c_t \le c^*} && \text{if } i \notin \mathcal{I}_t \\ Q_t &= \mathbf{1}_{c_t \le v} && \text{if } i \in \mathcal{I}_t \end{aligned}$$

If $\delta > \hat{\delta}$, then optimal ASE contract is implementable.

Proposition 4.

Suppose $N = 1$. Then the optimal SE contract obeys

$$\begin{aligned} Q_t &= \mathbf{1}_{c_t \le \kappa^*} && \textit{if } i \notin \mathcal{I}_t \\ Q_t &= \mathbf{1}_{c_t \le \kappa^{**}} && \textit{if } i \in \mathcal{I}_t \end{aligned}$$

where $\kappa^* \le \kappa^{**}$, $\kappa^* \le c^*$ and $\kappa^{**} \le v$.

A Complementary Theory for Loyalty

Suppose agents are impatient.

- If multi–source then reduce frequency of trade.
- Hence defection more likely.

Model with transfers.

- Optimal contract stationary.
- For fixed N, efficient contract enforceable if $\delta \geq \delta_N$
- For fixed δ, efficient contract not enforceable if $N \geq N_\delta$.

Optimal contract

- When $N = 1$, then trade if $c_t \in [0, c^*] \subset [0, v]$.
- When $N = 2$, bias trade towards most recently used agent.
- What happens as N grows large?