

Incomplete Contracts & Firm Boundaries

15.575: Economic Perspectives on Information Technology
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The Big Questions:

What is a firm?

Why do firms exist? Why are they useful economic institutions?

Where should the boundary of firms' ownership of assets, activities and responsibilities end?

Some Real Applications:

What functions and assets should the firm own?

What functions and assets should the firm outsource?

What does 'outsource' mean? Is there more than one way to 'buy' services or functions?

Agenda:

- Different Economic Theories of the Firm
 - Neoclassical, Principal-Agent, Transaction Costs, Nexus of Contracts
- Incomplete Contracts and the Property Rights Perspective
 - GHM Framework, Shapley Value, Application to Information and Technology
- Firm Boundaries –
 - Make or Buy? Elements of the Decision
 - Double Marginalization & Transfer Pricing
 - Neither Markets nor Hierarchies? What lies between?
- Discuss some recent cases of shifting firm boundaries...
 - Comcast/Disney
 - IBM/Daksh
- Discuss how IT changes the game...

Neoclassical Theory :

- The firm is a “*set of feasible production plans.*”
- Managers *buy and sell inputs,*
- in a *spot market,*
- choosing plans that *maximize owner’s welfare* (profit, expected NPV of future profits or market value).
- Production functions, cost functions, profit functions used to consider how to “*optimize the objective function of the firm.*”

• Strengths:

- Elegant
- Useful for modeling responses to exogenous change (e.g. wages, taxes).
- Strategic interaction between firms under imperfect competition.

• Limitations?

... Many questions unanswered:

- What types of costs considered? What types of costs ignored?
- How is production organized?
- Conflicting Incentives? Resolution?
- Boundaries? Mergers?
- Structure?

Principal Agent Theory (Managerial Theory of the Firm):

- Firm *still a production set, but...*
- *Asymmetric Information*: Managers make choices (about effort, investments) and know things (about themselves and the firm) that owners do not observe.
- *Moral Hazard (Incongruent Incentives)*: Manager is NOT necessarily maximizing owner's welfare.
- Owners *align manager's objectives* with their own through *incentives*.

One simplified framework example: A principal's optimization problem...

$$\text{Principal Max}_{w(\pi)} y(e) - w(\pi(e))$$

$$\text{s.t. (i) } v_m(w) - c(e) \geq \bar{u};$$

“Individual Rationality”

$$\text{(ii) } e \text{ solves Max } v_m(w) - c(e).$$

“Incentive Compatibility”

- “Individual Rationality” Constraint – A manager must at least receive her reservation utility in order to accept the contract.
- “Incentive Compatibility” Constraint – The manager must desire to choose the profit maximizing effort when facing the incentive scheme.

Principal Agent Theory (Managerial Theory of the Firm):

- Real world examples?
- Strengths:
 - Introduces conflicting interests
 - Introduces incentives
 - Separates principle from agent
- Limitations?
 - Fails to answer what defines a firm
 - Fails to answer questions about boundaries – when to buy or make
 - Fails to answer questions about structure – organizational design (at least directly)

Transaction Cost Economics:

- **Coase** (1937) asks... “If markets worked perfectly, why would there be firms?”
- Suggests that some environments are plagued by transaction costs that cause markets to perform inefficiently.
- **Transaction Costs:**
 - Costs associated with: Thinking, planning, contracting - Search, bargaining and enforcement of transactions
- **Coase Theorem:**
 - If transaction costs are zero, resources are allocated efficiently, *regardless of initial assignment of legal entitlements*.
- Where would Coase draw the boundary of the firm?
 - Where marginal cost savings of internal transactions = marginal cost of rigidity and errors in bureaucracy.
- **Williamson** (1975) identifies some conditions that *create or magnify* transaction costs:
 - **Specific Investments:** Investments particular to a set of individuals or assets. => lock-in... (Examples?) – why is lock-in a problem?
 - **Imperfect (Incomplete) Contracts:** Complete contracts too expensive.
 - A) Costs of ex post bargaining
 - B) Suboptimal ex ante investment incentives – incentives divorced from ex post bargaining power
- Integration (firm) reduces opportunistic behavior & provides incentives

Transaction Cost Economics:

- Strengths:
 - Introduces costs associated with bargaining, search, monitoring and enforcement.
 - Introduces notions of asset specificity, ex ante investment incentives
- Limitations?
 - Hard to formalize
 - Principal – Agent theory proposes that employees will shirk if incentives are not aligned... TCE assumes integration aligns incentives.
 - Assumes away moral hazard and shirking inside firms... it begs the question: *Why (how) does integration overcome incentive problems and contractual failure?*
- One response: Firm as a ‘**Nexus of Contracts**’ – The ‘market’ and the ‘firm’ are “categories of transactions on a continuum of types of contractual relations.”
 - Helpful for seeing that the firm is NOT an individual and that “the objective function of the firm” is misleading.
 - Leaves open why certain contractual forms are chosen, what determines firm size and the consequences of mergers and divestitures

Property Rights Framework: (Grossman, Hart, Moore)

- Purpose: Resolve the question previous theories fail to address: *How integration changes incentives...*
- What do we know up to this point?
 1. Firm is NOT an individual, but actors with incongruent incentives and asymmetric information.
 2. Transacting is costly
 3. Contracts are a) imperfect and incomplete... and so b) there are residual rights to the ex post value of a contractual relationship that are too costly to secure by contract.
 4. Incentives to make relationship specific investments depend on ex post bargaining power.
- What is the primary analytical focus of the Property Rights Framework?

The role of *ownership* of *physical assets* in determining *ex post bargaining power* and thus *ex ante investment incentives*.

Property Rights Framework: (Grossman, Hart, Moore)

- Ownership of an asset determines residual rights of control over that asset. (e.g. owning vs. renting a car)
- Without complete contracts, allocation of residual rights determines *ex post bargaining power and the division of ex post surplus*.
- Bargaining power results from the threat of withholding owned assets. (“Hold Up”)
- Bargaining power affects *ex ante incentives of actors to invest in the relationship*.
- *The boundaries of the firm matter because they determine who owns and controls which assets.*

It aims to show how incentives change when ownership changes

This directly addresses acquisition, divestiture, outsourcing and the make or buy decision

Property Rights Framework: (Grossman, Hart, Moore)

- All actions assumed non-contractible
- Cost of agent i 's action $x_i = c(x_i)$
- Marginal value of i 's actions in a coalition with a subset S of other agents = $v^i(S, A(S)|x)$;
 - where $A(S)$ is the set of all assets owned by the coalition and x is the vector of actions.
- Division of total value apportioned by **Shapley Value**:

$$= \sum_{S \mid i \text{ is an element of } S} p(S) [v(S, A|x) - v(S \setminus \{i\}, A(S \setminus \{i\})|x)],$$

Pay each agent an amount equal to her contribution to each potential coalition multiplied by the probability that she will be in any given coalition

(A)	S	A	B	C
	ABC	0	1	0
	ACB	0	0	1
	BAC	1	0	0
	BCA	1	0	0
	CAB	1	0	0
	CBA	1	0	0

- Marginal value of actions greater with access to more assets:

$$v^i(S, A|x) \geq v^i(S, A'|x)$$

For all subsets A' of A

Information, Technology and Organization

Brynjolfsson (1994) - Treats information as an asset the agent owns.

Examines allocation of *information* assets, incentives and ownership structure.

- GHM limits interpretation to alienable physical assets, but intangible intellectual capital is critical.
- a_I – entrepreneur's information; a_F – physical assets of the firm ... are complimentary assets – each is *essential* to production.
- Who should own the firm? Based on optimal incentives to invest?

$$\frac{1}{2} v^1(a_F, a_I) + \frac{1}{2} v^1(a_I) = c'_1(x_1)$$

$$\frac{1}{2} v^2(a_F, a_I) + \frac{1}{2} v^2(a_F) = c'_2(x_2)$$

$$\frac{1}{2} v^1(a_F, a_I) + \frac{1}{2} v^1(a_I, a_F) = c'_1(x_1)$$

$$\frac{1}{2} v^2(a_F, a_I) = c'_2(x_2)$$

Actors equate marginal cost of action with marginal benefit as determined by Shapley

If agent does not own the firm:

Hold-up Problem – she needs a_F to produce

If agent owns firm:

No Hold-up Problem, incentive to E greater

Value to the Owner is unchanged

as $v(a_F) = 0$

Why is the owner incentivized?

Information, Technology and Organization

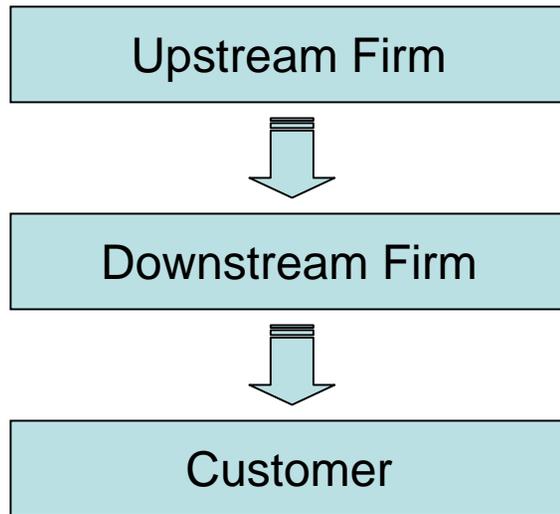
- **Indispensable Agents:** “If the entrepreneurs information is not completely essential then giving him ownership will reduce the incentives of the owner.”
- Which wins out depends on *how* indispensable the agent is.
- Agent who is indispensable to an asset should own that asset
- Complimentary assets should be owned by the same agent.
- **Knowledge transfer:** Moving the information rather than ownership of physical assets.
 - Requires: a) alienability and b) contractibility.
 - Knowledge/Info difficult to transfer
 - **Value of Alienability:** [Output under optimal ownership when Info alienable – Output under optimal ownership when Info must be “owned”.]
 - Alienability is made endogenous – Alienable when value is high
 - **Value of Contractibility:** [Optimal value when Info contractible – optimal value when Info not contractible]
 - May achieve first best

Make or Buy? Vertical Integration or Market Procurement?

Can we brainstorm....

- *Advantages of Market?*
 - Economies of Scale in Supply
 - Economies of Scope
 - Core Competencies
 - Benefits of Competition
 - Innovation
 - Price
 - No hold up for commodities
- *Advantages of Integration?*
 - Specific Investments – require coordination and monitoring
 - Reduce threat of Hold Up
 - Avoid Monopoly Distortion
 - Capture Supplier Rents
 - Entry Deterrence

Double Marginalization / Transfer Pricing



When the input market is not competitive – supplier may try to exercise market power setting $P > MC$.

The higher price may lead to an inefficiently low use of the input and a loss of value.

A vertically integrated firm would charge a lower price to maximize profits.

** But, integration is not costless and transfer pricing can occur internally.

p. 560 M&R - example

Based on these discussions – Under what conditions is outsourcing advantageous?

- Standard Inputs
- Competition in Supply
- Economies of Scale in Supply
- Economies of Scope in Supply would force focal firm into unrelated businesses
- Limited specific investments required

Firm Size (Kumar, Rajan and Zingales)

- Industry Level: capital intensive industries, high wage industries, R&D intensive industries have larger firms.
 - Countries with better judicial systems have larger firms. Why?
 - Interactions:
 - As judicial efficiency improves, difference in size between firms in physical capital intensive industries and less cap intensive industries diminishes
- Improves the power of ownership for non-physical assets
- Improved patent protection increases size of firms in R&D intensive industries.

Improves the power of ownership of intangible assets

How does this gel with Brynjolfsson's analysis of smaller firms and incentives to provide information?

Neither Market Nor Hierarchy

- What's in between?
- Value Added Partnerships?
 - Scale of large companies, flexibility, creativity and low overhead found in small companies.
 - Trust and reciprocity reduce some of the costs of market based transactions (opportunism, monitoring)
 - Reputation becomes critical.
- Mediated Exchanges?
 - Technology enabled
 - Market transactions without the market overhead
 - Security and transaction facilitation offloaded to the exchange.
 - Who should own the exchange assets?
- The role of IT in reducing coordination costs...
 - XML
 - Agent based transactions (When trust added to Semantic Web Stack)
 - Integrated Supply chains

Comcast-Disney Discussion

IBM-Daksh Discussion