
Resource Allocation and Firm Scope

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Barcelona, June 2007

1. Introduction

- Firms frequently rely on resources that may not be available on the market
 - Most importantly: specialized human resources
 - Linked to organizational procedures
 - Stock of human capital bound in existing firms
 - Firms are endowed with stock of human capital
 - When firms merge, human resources are pooled and can be allocated (redeployed) to their best use
- ⇒ Benefit of expansion of firm scope

Control over skilled human resources as a merger rationale

- Value creation through HR becoming increasingly important
- Labor markets have constrained capacity: rationale for merger in many industries, in particular, industries like engineering, law firms, IT
- *Companies like SAIC buy companies like Boeing IS because there is a shortage of skilled workers, said Bill Roper, chief financial officer of SAIC. Its one way to acquire highly skilled, well-educated people (washingtontechnology.com)*
- CEO of Cisco: *...in a high tech acquisition you really are acquiring only people. ... we are not acquiring market shares, we are acquiring futures (HBS case)*
- Recognized by strategic management literature: use of “unique resources” main justification for expansion of scope
- Chandler: top management’s allocation and coordination function for the emergence and growth of the multi-divisional firm
- Underlying consideration: do things by authority that you cannot do through trade/contracts

Why can't you contract on some resources?

1. Describability of resources?
 2. Leakage of information?
 3. Describability of use?
- Theoretically, 3 is most satisfying
 - Empirically, support for 2: SNC Lavalin, multi-billion engineering firm in Canada
 - Case study by Marcel Boyer: SNC Lavalin cooperated with an Indian firm
 - because of its skilled human resources availability, both in number and quality,
 - Integrated fully later on to properly protect its investments

Costs of integration

- Merge firms, pool resources, allocate to best division
- Positive effect on incentives: competition among managers
- Negative effect:
 - information about productivity resides with division managers
 - want division managers to communicate truthfully to top, but also want them to exert effort
 - only possible when giving each division manager a stake in the other division/the entire firm

Costs of integration cont'd

- We show that negative effect outweighs positive effect
- Exception: message-contingent contracts possible
 - two effects neutralize each other
 - then, integration is always optimal
- In general, existence of a tradeoff: better resource allocation vs more expensive incentives
- Both benefits and costs driven by the need to aggregate dispersed information

Implications

■ Allocation of authority over resources

- never optimal to give authority over resources to one of the division managers
- either pyramidal hierarchy with top manager as pure coordinator is optimal
- or horizontal exchange

■ Testable predictions

- When should two firms integrate?
- What consequences for size and structure of compensation structure of managers running the production units?

2. Related literature

1. Theories of the firm

- Different role of information than in influence activity literature (Milgrom, Roberts, Meyer): Information is required input but this is also source for influence (lying about your project)
- Different role of authority (compared to Aghion and Tirole, Grossman and Hart): Authority in itself does *not mute* the incentives of people who do not have it. Importance of constraints on contract space.
- Multi-tasking.

2. Coordination in organizations

- Levitt-Snyder (1997): tradeoff communication-effort incentives.
- Athey-Roberts (2001): tradeoff effort incentives-externalities.
- Dessein-Garicano-Gertner (2006): tradeoff coordination-effort incentives
- Alonso-Dessein-Matouschek (2006): communication with unbiased coordinator

Related literature (cont'd)

3. Capital allocation in firms: large literature
 - Focus on efficiency of investments, not firm scope
 - Capital usually contractible => no meaningful theory of firm in our context
 - Most papers assume “empire building” behavior, we don’t

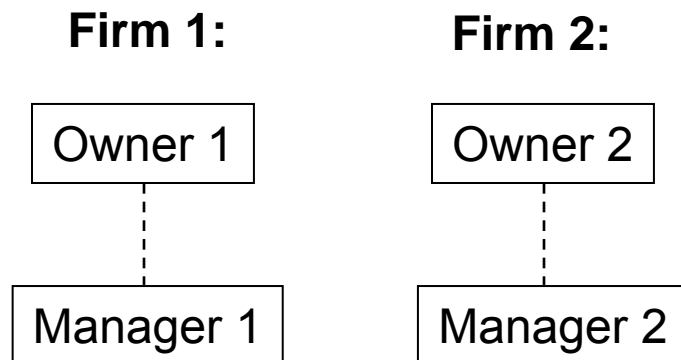
3. Model:

Basic setup and resources

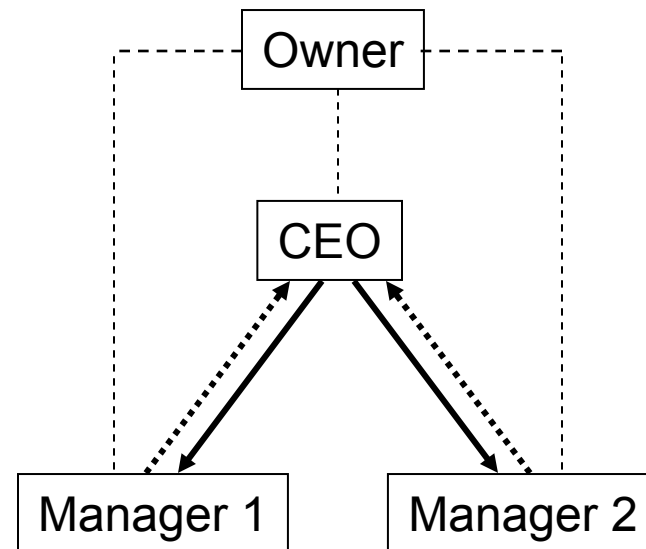
- Two production units, each run by a manager (=agent)
- Each unit is endowed with one unit of resources
- Resources are specific to one unit but could be used in the other
 - No external market for resources
 - Spot contracting between firms too costly
- Under integration with centralized allocation, both units can be allocated to one or the other “division”

We compare these structures:

Non-integration =
Independent firms:



Integrated firm:



----- Contracting
.....> Communication
————> Resource allocation

Example: allocating resources at Airbus Industries

- Different planes are developed by different units in the company
- Scarce resource: teams of aviation engineers, can be reallocated between Hamburg and Toulouse.
- Can do within the firm what is quite difficult across firms.
- Problem: what is the marginal value of putting an engineer on A320 or A380 production?
- Needed: private information of division managers; difficult to obtain.

Timing: overview

1. Contracting
2. Managers exert effort to create investment opportunities (“projects”), realized quality of project i is manager i 's private information
3. Resources allocated to projects
4. Project payoffs, wages

Effort and projects

- Manager i exerts high effort ($e_i=1$, at cost c) or low effort ($e_i=0$, at cost 0)
- $e_i=1$ leads to good project ($\theta_i=G$) with prob. p and bad one ($\theta_i=B$) with prob. $1 - p$
 - Same for low effort, with probability $q < p$
 - θ_i is manager i 's private information

Projects and payoffs

(cf. Stein 1997)

- Can invest either 1 or 2 units of resources in project
 - If project bad, expected profit is y_1 or y_2
 - If project good, expected profit is φy_1 or φy_2 , $\varphi > 1$
- Assume $1 < y_1 < y_2 < 2$ and $\varphi(y_2 - y_1) > y_1$
- ⇒ Efficient resource allocation k^* :
 - $k_1 = k_2 = 1$ if $\theta_1 = \theta_2$
 - $k_1 = 2, k_2 = 0$ if $\theta_1 = G$ and $\theta_2 = B$, and vice versa
- y_2 : returns to scale, or “relatedness”
- Actual profits are μ or 0
 - e.g. Prob.($\tilde{z}_i = \mu$) = y_1/μ if $\theta_i = B$ and $k_i = 1$

Preferences and contracting assumptions

- Managers are risk-neutral, protected by limited liability
 - $U_i = w_i - c e_i$
 - Res. wage low such that IR not binding
- Wages can be based only on profits of units/divisions
 - *cannot* be contingent on resource allocation, or on messages about project quality
 - But we'll see what happens when these are contractible

Independent firms

- Resource constraint: $k_i \leq 1$
- Weakly optimal for owner to give manager authority over resources
- Remaining problem: choose large enough bonus β for $\tilde{z}_i = \mu$ to induce high effort:

$$\max_{\beta} (1 - \beta) E_{\theta_i} [z_i(1, \theta_i) | e_i = 1]$$

$$\text{s.t.} \quad \beta E_{\theta_i} [z_i(1, \theta_i) | e_i = 1] - c \geq \beta E_{\theta_i} [z_i(1, \theta_i) | e_i = 0]$$

Integrated firm

- CEO has authority to allocate pooled resources
- We ignore agency problems at CEO level
- Stage 3:
 - (a) Managers send messages $\hat{\theta}_i$ to CEO;
 - (b) CEO allocates resources s.t. $k_1 + k_2 \leq 2$

Contracting problem

- Find contract that maximizes $E[\text{total payoff} - \text{wages}]$, such that
 1. Each manager chooses high effort (IC-e)
 2. Managers with any type of project report truthfully (IC-G, IC-B)
 3. CEO's resource allocation at stage 3 maximizes profit net of wages (RA)
 4. Limited liability (LL)

Contracting assumptions, part 2

■ General contracts:

- contingent on both divisions' payoffs => quadruple of wages
- Full analysis in paper, Appendix B

■ Additively separable contracts:

$$\tilde{w}_i(\tilde{z}_i, \tilde{z}_j) = \alpha + \beta\tilde{z}_i + \gamma\tilde{z}_j$$

- Same main results, simpler exposition
- Expected wage: $w_i(z_i, z_j) = \alpha + \beta z_i + \gamma z_j$
- LL and non-binding IR: set $\alpha = 0$

4. Analysis:

4.1 Independent firms

- Optimal bonus for high payoff:

$$\beta^{ni} = \frac{c}{(p - q)(\varphi - 1)y_1}$$

- Assume high effort is optimal (= upper bound on c);
cf. Lemma 2
 - Otherwise integration always optimal

4.2 “Competition effect” of integration on effort incentives

Proposition 1: *With perfect information but unobservable effort, optimal contract has $\beta^{pi} < \beta^{ni}$ (and $\gamma^{pi}=0$)*

- Centralized resource allocation *improves* effort incentives (Stein 2002 and others)
- Two reasons:
 1. Supermodularity of project quality and resources
⇒ higher marginal benefit of effort (even for single manager)
 2. *Competition* between two managers for resources
 - “Conflicting tasks” as in Dewatripont-Tirole 1999

4.3 Competition effect vs. Information-rent effect

- With private info, must reward $\theta_i=B$ to get truthtelling
=> weaker incentives for effort (Levitt-Snyder 1997)
- Which effect dominates, competition or *information-rent effect*?

Proposition 2: Any contract that satisfies (IC-e), (IC-B), (RA) leads to weakly higher wage costs than under non-integration.

What drives Prop. 2?

- Let $\bar{w}_i(\theta_i, \hat{\theta}_i) = i$'s expected wage at stage 3a
- Proposition follows from (IC-e), (IC-B) and:

$$\bar{w}_i(B, G) \geq \frac{1}{\varphi} \bar{w}_i(G, G)$$

We get the same wage costs when...

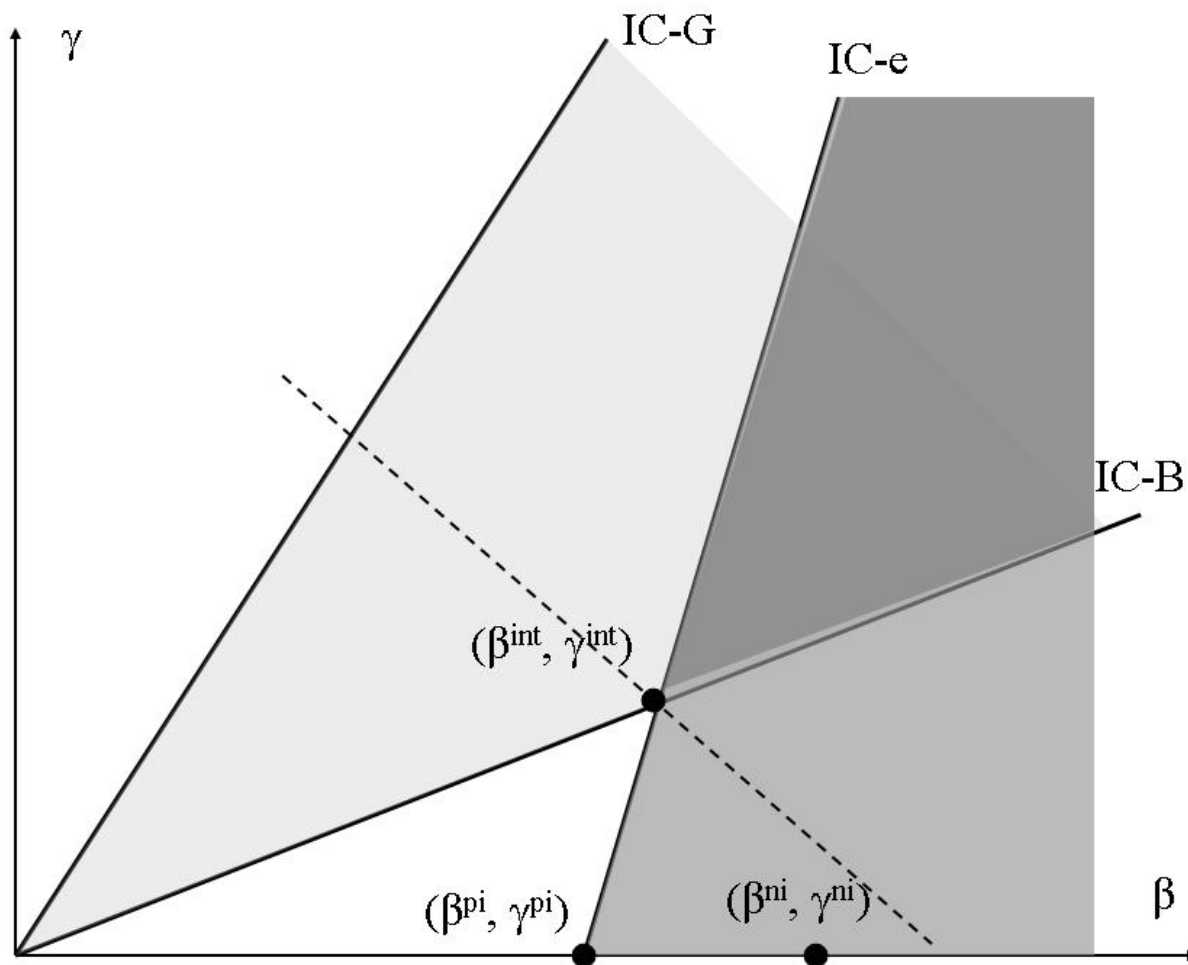
1. Messages but not resources are contractible
 - ⇒ **Benefits of integration without additional costs**
 - ⇒ Integration then dominates
2. Resources but not messages are contractible
 - ⇒ Benefits of integration also through bilateral trade
 - ⇒ No need for integration (cf. internal capital markets)
3. Both contractible => No need for integration

4.4 Strategic communication: synergies-incentives tradeoff

Proposition 3: *With performance-based contracts, optimal contract pays $\beta^{\text{int}} \in (\beta^{\text{pi}}, \beta^{\text{ni}})$ and $\gamma^{\text{int}} > 0$. Wage bill is strictly higher than under non-integration.*

- To get B-manager to tell truth, need to give him stake in benefit of allocating resources to other unit.
⇒ Communication is link between synergies and effort incentives

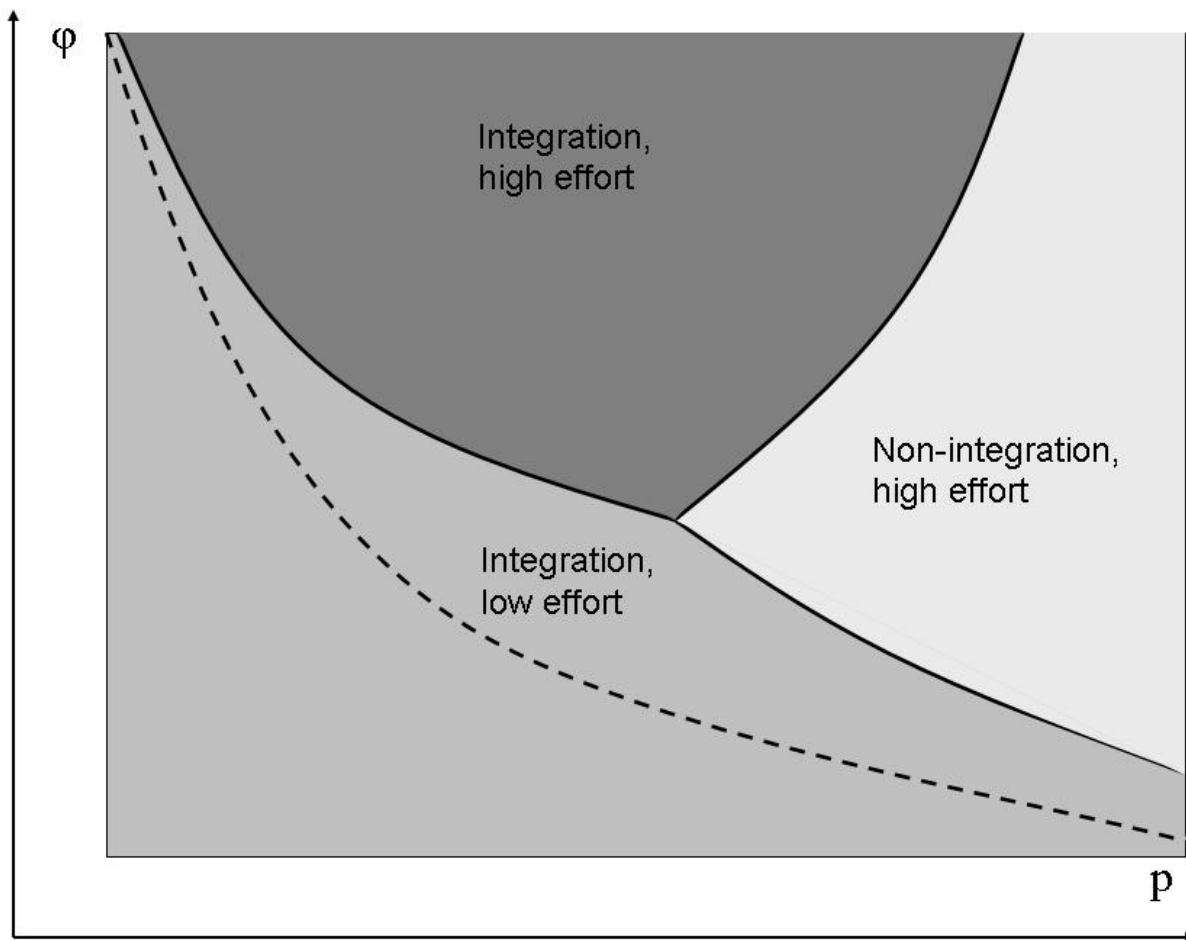
Proposition 3 illustrated



General contracts

- Pay β if only own unit has high payoff, γ if only other..., δ if both have high payoff
- New complication: (RA) doesn't automatically implement k^*
 - Incentive to misallocate if β or δ too large
- **All main results (Props. 1-6) carry over!**
- Only exception: counterpart of Prop. 3:
 - If $p < 1/(1+\phi)$, can get truthtelling at no additional cost with $\beta, \delta > 0$ and $\gamma=0$
 - arises iff δ has positive effect on (IC-B)

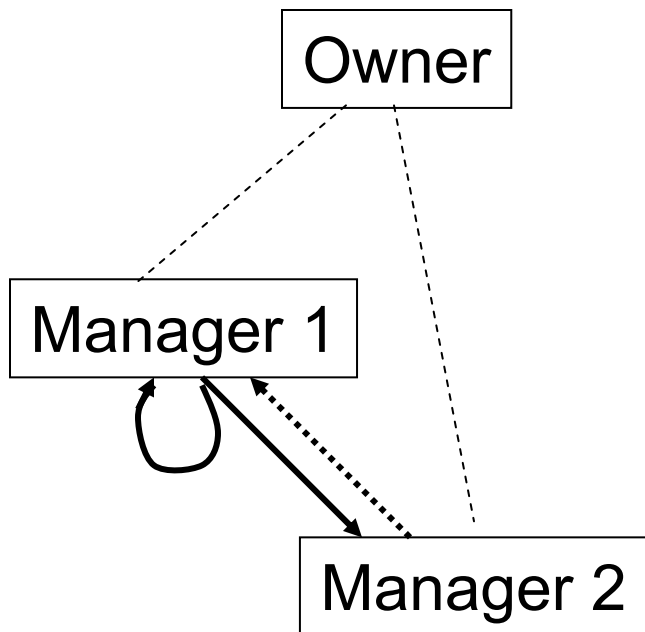
Optimal organizational choice



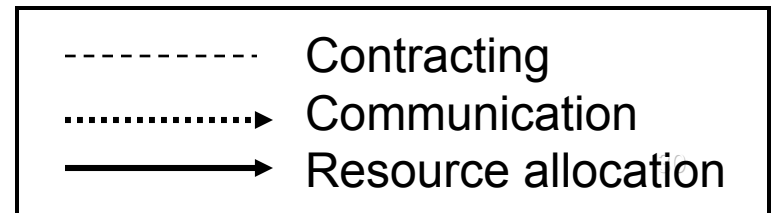
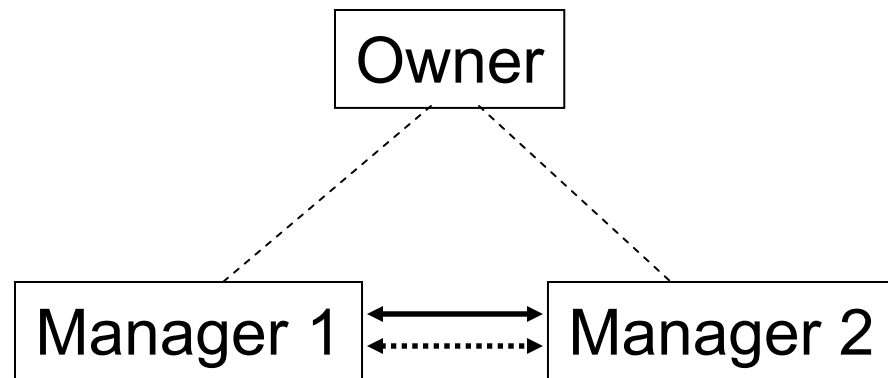
5. Who gets authority? (Why need a CEO?)

- Two alternative structures:

Skewed hierarchy



Horizontal exchange



Centralize authority

Propositions 5, 6: *ICs at least as restrictive in alternative structures as in CEO hierarchy. Same wage bill under horizontal exchange if $\phi^2 \geq y_1^2/(y_2-y_1)^2$, otherwise CEO hierarchy strictly dominates.*

- Logic: equivalence between
 - misallocating resources over which a manager has authority, and
 - lying to CEO to achieve the same outcome in the CEO hierarchy

Proposition 4 (cont'd)

- Difference: managers in CEO hierarchy don't know other's type, in alternative structures they do
⇒ IC-B in CEO hierarchy tends to be weaker than corresponding resource-allocation constraints in alternative structures
- Reminiscent of Dewatripont-Tirole (1999): running division and allocating resources are conflicting tasks
- Horizontal exchange: same constraints as in CEO hierarchy, plus one for manager with $\theta_i=B$ to lend resource if $\theta_i=G$ ⇒ stronger or weaker than (IC-B)

6. Predictions

1. y_2 = units' "relatedness":
 - Integration more likely the higher y_2
2. φ = variability of division payoffs. Higher $\varphi \Rightarrow$
 - Integration more likely
 - Lower compensation of division managers, lower γ / β
3. Prop. 2 & 3 \Rightarrow same predictions as 2., the more managers can be held accountable for what they say
4. higher y_2 and $\varphi \Rightarrow$ In integrated firms, horizontal exchange of resources more likely
 - "Peer groups" at BP, cf. Roberts (2004)

7. Contributions

1. Simple theory of benefits and costs of integration
 - Benefits and costs originate from same problem: aggregation of information
 - Minimal assumption about underlying agency problems
 - Cf. Williamson 1985: weaker incentives under integration as answer to “selective-intervention” puzzle
2. Incentive-based argument for optimality of a top management specialized in resource allocation
3. Predictions about integration decisions, org. structure and wages

Compare with:

(a) Influence-activity approach (Meyer-Milgrom-Roberts, Scharfstein-Stein):

- Does not spell out process of influence
- Here: communication is input into production and influence activity at same time



(b) Incentive-system theory (Holmström-Milgrom-Tirole):

- In a way, communication is a second task, but..
- No effort substitution: cheap talk
- No measurement problems/ distortions
- Instead: team production with communication

Compare with:

(c) PRT/Authority in organizations (GHM, Aghion-Tirole, Dessein, Hart-Holmström '02, Hart-Moore '05):

- Typically: no incentive contracts
- Shifting authority from A to B reduces B's incentives, due to:
 1. complementarity of decision rights and incentives
 2. Divergence of preferences over decisions
- We have 1. but not 2.
- Perfect information: CEO's authority *improves* incentives; problem arises when information is private

Concluding remarks

■ General perspective:

- Focus on role of managers as coordinators to understand limits of organization
- What matters for the theory of the firm? Authority and incentives as usual, but also: dispersion of knowledge and communication

■ What about agency problems at the top?

- Certainly, but limits of organization exist even without those