Organize to Compete

July 2008

Ricardo Alonso
University of Southern California

Wouter Dessein
Columbia University

Niko Matouschek
Northwestern University

Motivation

- Impact of competitive environment on organizational design
- Focus on multi-divisional firms
  - dominate large sectors in the economy (Chandler 1977)
  - organization design (somewhat) observable
  - coordination and dispersed information
- Why link organization to competitive environment?
  - contingency theory (Lawrence and Lorsch 1967):
    optimal internal organization of a firm depends on its external environment.
  - empirical evidence

Motivation

- Bloom, Van Reenen, Sadun (2007)

  "Decentralization positively linked with stronger product market competition."

- Acemoglu, Aghion, Lelarge, Van Reenen and Zilibotti (2008)

  "Robust positive association of competition and decentralization."

- Guadalupe and Wulf (2007)

  Effect of foreign competition on organizational design.

Motivation

- Standard argument:

  Competition increases the value of information → decentralization

  – What about the costs of decentralization?

  – Competition makes mistakes more costly, but so are biased decisions

- Our argument:

  Competition affects externalities between divisions

  – Externalities between divisions depend on profit margins (-)

  – Competition may affect perceived differentiation between products of divisions (+)

Result Preview (II)

- Downward shifts in demand ("size effect")
  - only reduction in profit margins
  - results in more decentralization
- Rotation of demand ("price pressure effect")
  - → competition may favor centralization
  - despite fact that information becomes more valuable

Motivation

- Key ingredients (Alonso, Dessein and Matouschek 2008):
  - adaptation-coordination trade-off
  - the organization lacks commitment
  - dispersed information & strategic communication

Plan of Talk

- The Model
- Decision Making
- Communication
- Competition and Organizational Structure
- Case: Cournot-Complements
- Conclusions

The Model

	Division 1	Division 2	HQ
Profits:	$\pi_1 = p_1 q_1$	$\pi_2 = p_2 q_2$	0
Managers:	$\lambda\pi_1 + (1-\lambda)\pi_2$	$(1-\lambda)\pi_1 + \lambda\pi_2$	$\pi_1 + \pi_2$

Own division bias $\lambda \in [\frac{1}{2}, 1]$

Demand

Division 1

$$p_1 = a + \theta_1 - q_1 - \gamma q_2$$

intercept with $a \geq s$ and $\theta_1 \sim U[-s/2, s/2]$

cross effect with $-1 \leq \gamma \leq 1$

$$q_1 = \frac{1}{1-\gamma^2}\left(a + \theta_1 - p_1 - \gamma\left(a + \theta_2 - p_2\right)\right)$$

Division 2

$$p_2 = a + \theta_2 - q_2 - \gamma q_1$$

intercept with $\theta_2 \sim U[-s/2, s/2]$

$$q_2 = \frac{1}{1-\gamma^2}\left(a + \theta_2 - p_2 - \gamma\left(a + \theta_1 - p_1\right)\right)$$

The Model

	Division 1	Division 2	HQ
Profits:	$\pi_1 = p_1 q_1$	$\pi_2 = p_2 q_2$	0
Managers:	$\lambda\pi_1 + (1-\lambda)\pi_2$	$(1-\lambda)\pi_1 + \lambda\pi_2$	$\pi_1 + \pi_2$
Information:	θ_1 $\theta_2 \sim U[-s/2, s/2]$	$\theta_1 \sim U[-s/2, s/2]$ θ_2	$\theta_1 \sim U[-s/2, s/2]$ $\theta_2 \sim U[-s/2, s/2]$

Competition

Division 1

$$p_1 = a + \theta_1 - q_1 - \gamma q_2 - \rho q_{f1}$$

Competitive fringe

$$p_{f1} = 1 - q_{f1} - \rho q_1 = c_f$$

Division 2

$$p_2 = a + \theta_2 - q_2 - \gamma q_1 - \rho q_{f2}$$

Competitive fringe

$$p_{f2} = 1 - q_{f2} - \rho q_2 = c_f$$

Competition

Division 1

$$p_1 = a - \rho(1 - c_f) + \theta_1 - (1 - \rho^2) q_1 - \gamma q_2$$

Competitive fringe

$$p_{f1} = 1 - q_{f1} - \rho q_1 = c_f$$

Division 2

$$p_2 = a - \rho(1 - c_f) + \theta_2 - (1 - \rho^2) q_2 - \gamma q_1$$

Competitive fringe

$$p_{f2} = 1 - q_{f2} - \rho q_2 = c_f$$

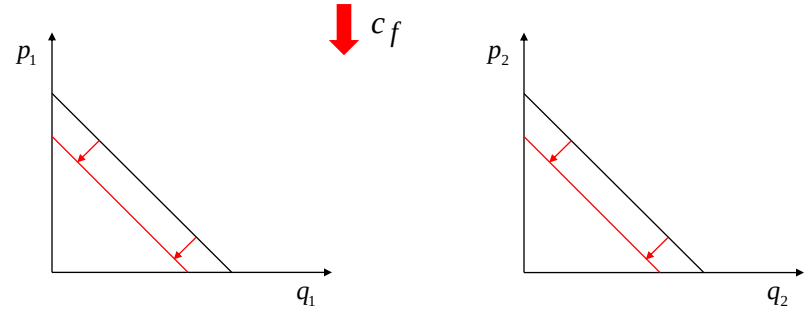
Competition- Size effect

Division 1

$$p_1 = a - \rho(1 - c_f) + \theta_1 - (1 - \rho^2)q_1 - \gamma q_2$$

Division 2

$$p_2 = a - \rho(1 - c_f) + \theta_2 - (1 - \rho^2)q_2 - \gamma q_1$$



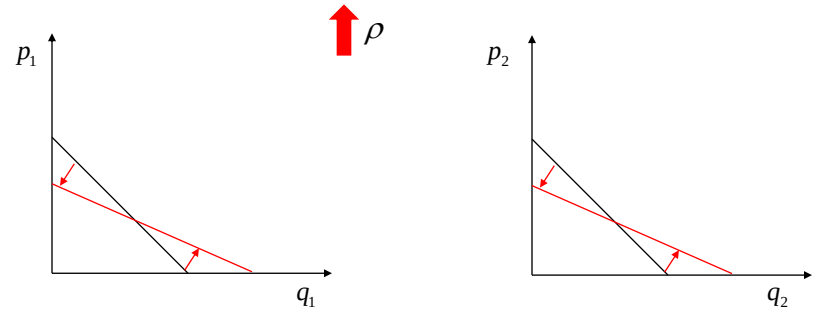
Competition- Price Pressure

Division 1

$$p_1 = a - \rho(1 - c_f) + \theta_1 - (1 - \rho^2)q_1 - \gamma q_2$$

Division 2

$$p_2 = a - \rho(1 - c_f) + \theta_2 - (1 - \rho^2)q_2 - \gamma q_1$$



Demand

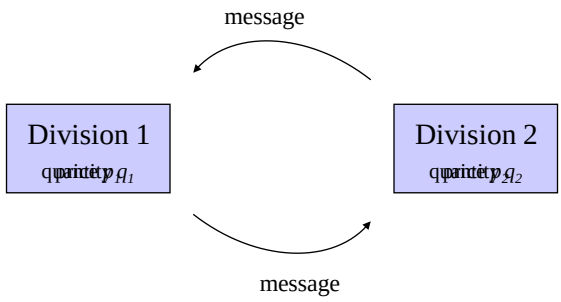
Division 1

Division 2

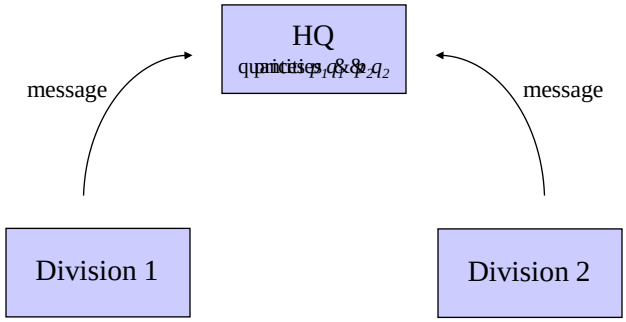
$$p_1 = \underbrace{a - \rho(1 - c_f) + \theta_1}_{\alpha_1} - \underbrace{(1 - \rho^2)q_1}_{\beta q_1} - \gamma q_2 \qquad p_2 = \underbrace{a - \rho(1 - c_f) + \theta_2}_{\alpha_2} - \underbrace{(1 - \rho^2)q_2}_{\beta q_2} - \gamma q_1$$

$\frac{\gamma^2}{\beta^2}$ Measure of (horizontal) product differentiation

Decentralization



Centralization



The Model

- More general linear demand structures:

$$p_1 = a_1 + \theta_1 - b_1 q_1 - \gamma q_2 - \rho_{f1} q_{f1}$$
$$p_2 = a_2 + \theta_2 - b_2 q_2 - \gamma q_1 - \rho_{f2} q_{f2}$$
$$p_{f1} = a_{f1} - b_{f1} q_{f1} - \rho_{f1} q_1$$
$$p_{f2} = a_{f2} - b_{f2} q_{f2} - \rho_{f2} q_2$$

- Demand uncertainty ←→ cost uncertainty
- Demand interdependence ←→ cost interdependence

Plan of Talk

- The Model
- Decision Making
- Communication
- Competition and Organizational Structure
- Case: Cournot-Complements
- Conclusions

Price Setting – Centralization

$$\max_{p_1,p_2} E\left[\pi_1+\pi_2 \middle| m_1,m_2\right]$$

$$p_1^C = \frac{1}{2}E\left[\alpha_1 \middle| m_1\right]$$

$$p_2^C = \frac{1}{2}E\left[\alpha_2 \middle| m_2\right]$$

Price Setting – Decentralization

Manager 1

$$\max_{p_1} E\left[\lambda\pi_1 + (1-\lambda)\pi_2 \,|\, \theta_1, m_1, m_2\right]$$

$$p_1^D = \frac{1}{2}\alpha_1 - \frac{\gamma}{2\beta}\left(E\left[\alpha_2 + \frac{1}{\lambda}p_2^D \,|\, m_1, m_2\right]\right)$$

$$p_1^C = \frac{1}{2}E\left[\alpha_1 \,|\, m_1\right]$$

Manager 2

$$\max_{p_2} E\left[(1-\lambda)\pi_1 + \lambda\pi_2 \,|\, \theta_2, m_1, m_2\right]$$

$$p_2^D = \frac{1}{2}\alpha_2 - \frac{\gamma}{2\beta}\left(E\left[\alpha_1 + \frac{1}{\lambda}p_1^D \,|\, m_1, m_2\right]\right)$$

$$p_2^C = \frac{1}{2}E\left[\alpha_2 \,|\, m_2\right]$$

Quantity Setting – Centralization

$$\max_{q_1, q_2} E\left[\pi_1 + \pi_2 \,|\, m_1, m_2\right]$$

$$q_1^C = \frac{E\left[\alpha_1 \,|\, m_1\right] - 2\gamma q_2^C}{2\beta}$$

$$q_2^C = \frac{E\left[\alpha_2 \,|\, m_2\right] - 2\gamma q_1^C}{2\beta}$$

Quantity Setting – Decentralization

Manager 1

$$\max_{q_1} E\left[\lambda\pi_1 + (1-\lambda)\pi_2 \mid \theta_1, m_1, m_2\right]$$

$$q_1^D = \frac{\alpha_1 - 2\gamma E\left[q_2^D \mid m\right]}{2\beta} + \left(\frac{2\lambda - 1}{2\lambda}\right)\frac{\gamma}{\beta}\left(E\left[q_2^D \mid m\right]\right)$$

$$q_1^C = \frac{E\left[\alpha_1 \mid m_1\right] - 2\gamma q_2^C}{2\beta}$$

Manager 2

$$\max_{q_2} E\left[(1-\lambda)\pi_1 + \lambda\pi_2 \mid \theta_2, m_1, m_2\right]$$

$$q_2^D = \frac{\alpha_2 - 2\gamma E\left[q_1^D \mid m\right]}{2\beta} + \left(\frac{2\lambda - 1}{2\lambda}\right)\frac{\gamma}{\beta}\left(E\left[q_1^D \mid m\right]\right)$$

$$q_2^C = \frac{E\left[\alpha_2 \mid m_2\right] - 2\gamma q_2^C}{2\beta}$$

Plan of Talk

- The Model
- Decision Making
- Communication
  - Vertical Communication
  - Horizontal Communication
- Competition and Organizational Structure
- Case: Cournot-Complements
- Conclusions

Incentives to Misrepresent – Price Setting

- Suppose Manager 1 can choose Manager HQ's posterior $\mu_1 \equiv E[\alpha_1 | m_1]$

$$\max_{\mu_1} E_{\theta_2}\left[\lambda\pi_1 + (1-\lambda)\pi_2\right] \quad s.t. \;\; p_1 = p_1^C \;\; and \;\; p_2 = p_2^C$$

$$\mu_1^* - \alpha_1 = -\frac{2\lambda - 1}{2\lambda}\frac{\gamma}{\beta}E[\alpha_2] \equiv -b$$

- Similarly for Manager 2:

$$\mu_2^* - \alpha_2 = -\frac{2\lambda - 1}{2\lambda}\frac{\gamma}{\beta}E[\alpha_1] = -b$$

Incentives to Misrepresent – Quantity Setting

- Suppose Manager 1 can choose Manager HQ's posterior $\mu_1 \equiv E[\alpha_1 | m_1]$

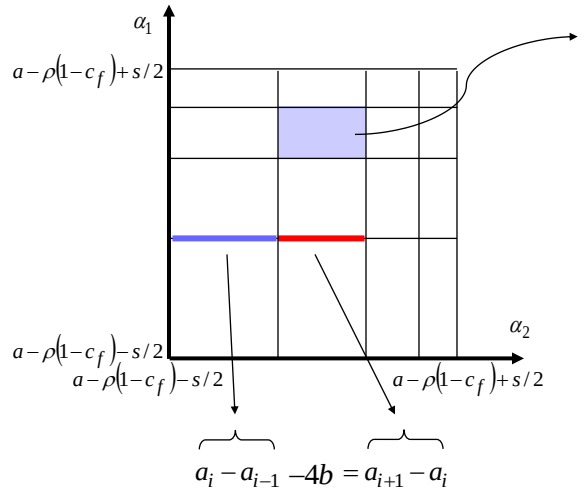
$$\max_{\mu_1} E_{\theta_2}\left[\lambda\pi_1 + (1-\lambda)\pi_2\right] \quad s.t. \;\; q_1 = q_1^C \;\; and \;\; q_2 = q_2^C$$

$$\mu_1^* - \alpha_1 = b$$

- Similarly for Manager 2:

$$\mu_2^* - \alpha_2 = b$$

Vertical Communication Equilibria – Price Setting



Managers 1 & 2 send messages

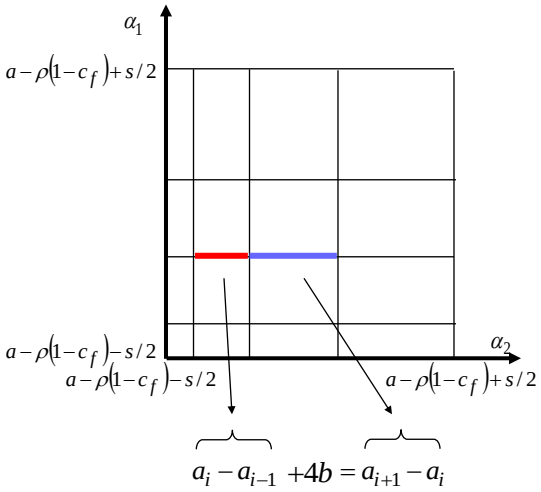
↓

Manager HQ updates beliefs

↓

Manager HQ sets prices

Vertical Communication Equilibria – Quantity Setting



Managers 1 & 2 send messages

↓

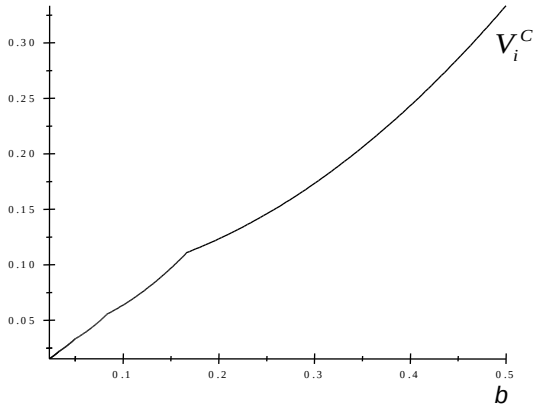
Manager HQ updates beliefs

↓

Manager HQ sets quantities

Quality of Vertical Communication

$$V_i^C = E\left[(m_i - \alpha_i)\right] = \begin{cases} \dfrac{s^2}{3N^2} + \dfrac{b^2}{3}\left(N^2 - 1\right) & \text{if } N(N+1) \geq \dfrac{s}{|b|} \geq N(N-1) \\ \dfrac{s^2}{3} & \text{if } |b| \geq \dfrac{s}{2} \end{cases}$$



Plan of Talk

- The Model
- Decision Making
- Communication
  - Vertical Communication
  - Horizontal Communication
- Competition and Organizational Structure
- Case: Cournot-Complements
- Conclusions

Communication Equilibria – Decentralization

- Price competition (for example substitutes):
  - a higher realization of α_1 has two *opposite* effects on optimal p_2:
    - direct effect: decreases quantity q_2
    - indirect effect: reaction to change in p_1
  - For HQ both effects cancel each other
    - First Best p_2 does not depend on α_1
  - Manager 1 puts more weight on indirect effect
    - Manager 1 would like to raise p_2
  - Manager 2 puts more weight on the direct effect
    - Manager 2 would like to lower p_2
  - Given this lack of congruence between managers:

– no communication for any $\lambda \in (\frac{1}{2}, 1]$

Communication Equilibria – Decentralization

- Quantity competition:
  - changes in α_1 have no direct effect on optimal q_2
    only indirect effect
  - Both managers agree on the sign of the change in q_2

– some communication for $\lambda = \frac{1}{2} + \varepsilon$

- Horizontal communication degrades very quickly with λ

– no communication for $\lambda = 1$

Plan of Talk

- The Model
- Decision Making
- Communication
- Competition and Organizational Structure
- Case: Cournot-Complements
- Conclusions

The Costs and Benefits from Decentralization

$$\Pi^D - \Pi^C = \left[\Pi^D(I_D) - \Pi^D(I_P)\right] + \left[\Pi^D(I_P) - \Pi^C(I_P)\right] + \left[\Pi^C(I_P) - \Pi^C(I_C)\right]$$

coordination effect loss of control gain in information

The Costs and Benefits from Decentralization

$$\Pi^D - \Pi^C = \left[\Pi^D(I_D) - \Pi^D(I_P)\right] + \left[\Pi^D(I_P) - \Pi^C(I_P)\right] + \left[\Pi^C(I_P) - \Pi^C(I_C)\right]$$

gain in information

Gain in information: $\left[\Pi^C(I_P) - \Pi^C(I_C)\right] = \frac{1}{2\beta\left(1 - \left(\frac{\gamma}{\beta}\right)^2\right)} V^C$

→ Increases in $|\gamma/\beta|$ and residual variance

→ Independent of nature of products or mode of competition.

→ Any difference across cases will owe to how other gains/losses behave.

The Costs and Benefits from Decentralization

$$\Pi^D - \Pi^C = \left[\Pi^D(I_D) - \Pi^D(I_P)\right] + \left[\Pi^D(I_P) - \Pi^C(I_P)\right] + \left[\Pi^C(I_P) - \Pi^C(I_C)\right]$$

loss of control

Loss of control:

→ Increases in $|\gamma/\beta|$ and $E[\alpha]$.

→ Substitutes: higher when prices than quantities

→ Complements: higher when quantities than prices

The Costs and Benefits from Decentralization

$$\Pi^D - \Pi^C = \left[\Pi^D(I_D) - \Pi^D(I_P)\right] + \left[\Pi^D(I_P) - \Pi^C(I_P)\right] + \left[\Pi^C(I_P) - \Pi^C(I_C)\right]$$

coordination effect

coordination effect: Quantity competition: coordination effect < 0

Price competition: coordination effect > 0

Substitutes and Bertrand-Complements

$\lambda = 1/2 + \varepsilon$

- Delegation Principle holds (Delegation always optimal)
- Competition does not affect choice of organizational structure

Bertrand

$$\Pi^D - \Pi^C = \left[\Pi^D(I_D) - \Pi^D(I_P)\right] + \left[\Pi^D(I_P) - \Pi^C(I_P)\right] + \left[\Pi^C(I_P) - \Pi^C(I_C)\right]$$

coordination effect loss of control gain in information

- Loss of control and coordination effect second order wrt λ

Bertrand

$$\Pi^D - \Pi^C = \left[\Pi^C(I_P) - \Pi^C(I_C)\right]$$

gain in information

- Loss of control and coordination effect second order wrt λ

Substitutes and Cournot Competition

$$\Pi^D - \Pi^C = \left[\Pi^D(I_D) - \Pi^D(I_P)\right] + \left[\Pi^D(I_P) - \Pi^C(I_P)\right] + \left[\Pi^C(I_P) - \Pi^C(I_C)\right]$$

coordination effect loss of control gain in information

- Loss of control second order wrt λ, but coordination effect first order.

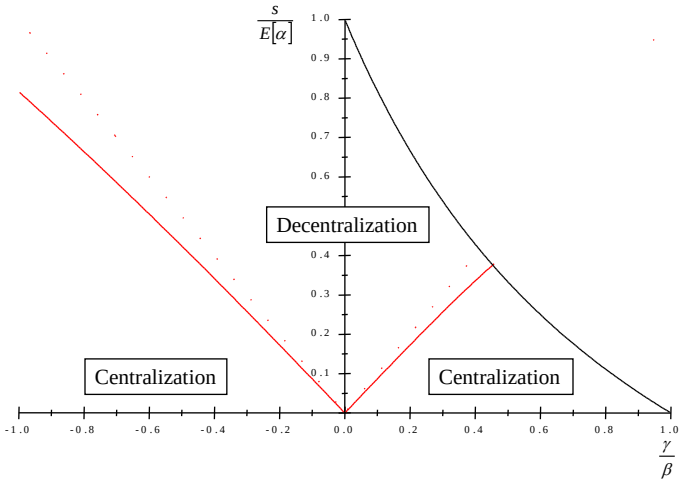
Substitutes and Cournot Competition

$$\Pi^D - \Pi^C = \left[\Pi^D(I_D) - \Pi^D(I_P)\right] + \left[\Pi^C(I_P) - \Pi^C(I_C)\right]$$

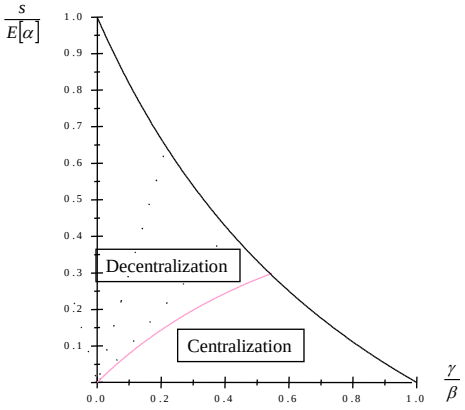
coordination effect gain in information

- Loss of control second order wrt λ, but coordination effect first order.
- However, gain in information outweighs coordination effect.

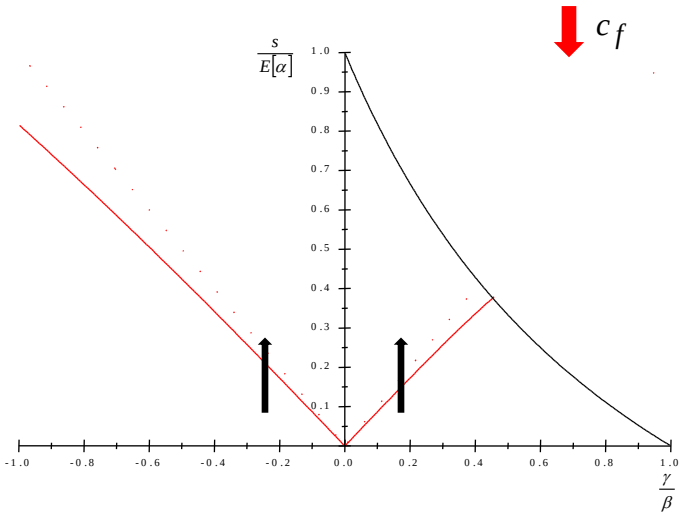
Focused Managers (λ=1) - Bertrand



Focused Managers (λ=1) - Cournot and Substitutes



"Size effect"- Bertrand



"Size effect"

c_f

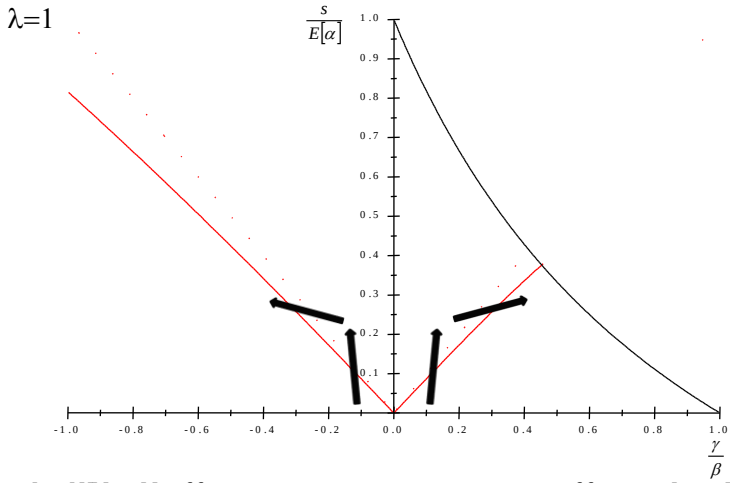
- Downward shift in demand reduces FB price-cost margins E[α]
- Gain in information: Does not affect the value of information but improves vertical communication

  → Force towards centralization
- Loss of control: Reduces intra-firm conflict:
- Coordination effect: Improves horizontal communication (Cournot)

  → Force towards decentralization
- Second and third effect dominate:

  → More intense price pressure leads to more decentralization

"Price pressure" - Bertrand



- For small levels of competition, initiation pressure favors decentralization

Price Pressure

ρ ↑

- Price pressure has two effects.
  - Reduces FB price-cost margins E[α] (similar to price pressure)
  - Reduces differentiation between products (increases |γ/β|).
- Second effect:
  - Gain in information: Increases value of information (mistakes are more costly) and worsens vertical communication.

→ Force towards decentralization

  - Loss of control: Less differentiation increases intra-firm conflict
  - Coordination: Increases importance of coordination

→ Force towards centralization

→ Overall the second effect leads to more centralization

Price Pressure

- Higher price pressure will lead to more decentralization whenever the first effect dominates.
- For small levels of competition, an increase in price pressure

  … improves communication to HQ…

  … but also reduces intra-firm conflict.

  → more competition favors decentralization
- For high levels of competition, an increase in price pressure

  … makes mistakes more costly…

  … but increases the coordination effect…

  … and also leads to more intra-firm conflict.

  → more competition favors centralization

Summary

- If division managers are very aligned
  - decentralization dominates (delegation principle)
  - level of competition does not affect organizational structure
- A decrease in FB profit margins unambiguously favors decentralization
- An increase in price pressure:

  → Favors decentralization for low levels of competition

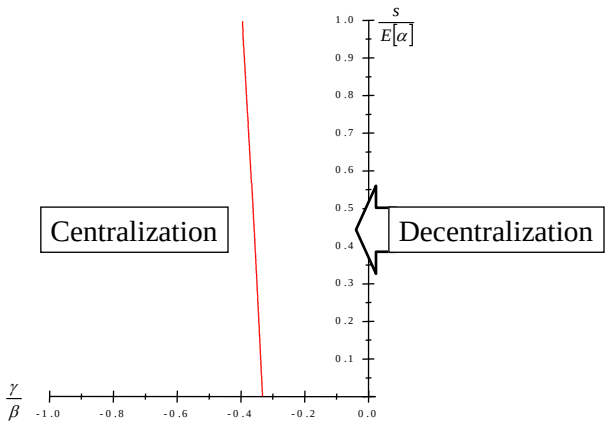
  → Favors centralization if intense competition
- More likely to decentralize with higher uncertainty and more product differentiation for any level of competitive pressure.

Plan of Talk

- The Model
- Decision Making
- Communication
- Competition and Organizational Structure
- Case: Cournot-Complements
- Conclusions

Cournot- Complements

$\lambda = 1/2 + \varepsilon$



- Delegation principle fails
  - For complements and high |t| always better to centralize in spite of negligible conflict.

Cournot- Complements

$$\Pi^D - \Pi^C = \left[\Pi^D(I_D) - \Pi^D(I_P)\right] + \left[\Pi^D(I_P) - \Pi^C(I_P)\right] + \left[\Pi^C(I_P) - \Pi^C(I_C)\right]$$

coordination effect loss of control gain in information

- Loss of control second order wrt λ, but coordination effect first order.

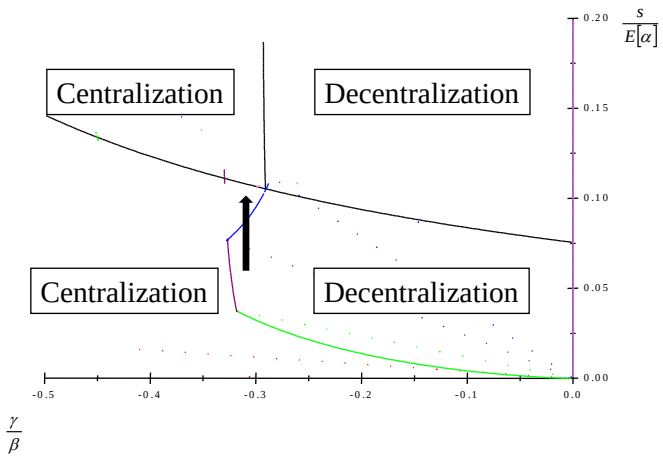
Cournot- Complements

$$\Pi^D - \Pi^C = \left[\Pi^D(I_D) - \Pi^D(I_P)\right] + \left[\Pi^C(I_P) - \Pi^C(I_C)\right]$$

coordination effect gain in information

- Loss of control second order wrt λ, but coordination effect first order.
  - gain in information: $\frac{\beta}{2\left(\beta^2 - \gamma^2\right)}\frac{\partial V_C}{\partial \lambda}$
  - coordination effect: $\frac{\beta}{2\left(\beta^2 - \gamma^2\right)}\frac{\gamma^2}{\beta^2}\frac{\partial V_D}{\partial \lambda}$
    - Ability of agents to coordinate proportional to how well agents communicate horizontally
    - Gain in information proportional to how well agents communicate vertically
    - Coordination effect relatively more important with $|\gamma/\beta|$

λ=0.51– Cournot Complement



- Decrease in FB profit margins can lead to centralization

Summary – Cournot Complements

- If division managers are very aligned (almost team theory case):
  - centralization may dominate (delegation principle fails)
  - level of competition affects organizational structure
- A decrease in FB profit margins can lead to centralization
- An increase in price pressure:

  → Can favor centralization for low levels of competition

Plan of Talk

- The Model
- Decision Making
- Communication
- Competition and Organizational Structure
- Case: Cournot-Complements
- Conclusions

Conclusions

- Internal organization of multi-divisional firms
- Internal organization ←→ market structure
- Competition can affect the gain in information but also internal conflict and ability of managers to coordinate.
- Reduction of profit margins favors decentralization
- Price pressure exacerbates conflict and can favor centralization.
- Even if Managers are very aligned centralization maybe optimal