

IM 7011: Information Economics

Incentives in Decentralized Systems (Part 2)
Lecture 4.1: Channel Structure Selection

Ling-Chieh Kung

Department of Information Management
National Taiwan University

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Introduction

- ▶ In this lecture, we will continue our discussion on the incentive issues in decentralized systems.
- ▶ Last time we studied **channel coordination** problems.
- ▶ Today we discuss **channel structure** problems by introducing the seminal work done by McGuire and Staelin (1983).¹

¹McGuire, T. W., R. Staelin. 1983. An industry equilibrium analysis of downstream vertical integration. *Marketing Science* **2**(1) 115–130.

Channel structure

- ▶ The selection of a **distribution channel** is one of the most fundamental marketing problems.
 - ▶ A brand owner (e.g., manufacturer) decides how to deliver products to **end consumers**.
- ▶ What are the options for a manufacturer to reach end consumers?
 - ▶ It may sell through independent retailers.
 - ▶ It may sell through franchises.
 - ▶ It may operate its own retail store.
 - ▶ It may operate its own outlet.
 - ▶ It may operate a online store.
- ▶ In general, a channel is either **direct** or **indirect**.
 - ▶ For the above five channels, which are direct and which are indirect?
 - ▶ A direct channel is **integrated**; an indirect channel is **decentralized**.
- ▶ One may even **mix** different distribution channels.

Direct and indirect channels

- ▶ What are the benefits of adopting a direct channel?
 - ▶ To understand end consumers.
 - ▶ In principle, controlling everything (complete **integration**) is optimal.
- ▶ Why indirect channels are so common?
- ▶ Sometimes you have no choice...
- ▶ Let the **professionals** do it!
 - ▶ A retailer may have a better reputation.
 - ▶ A retailer may do better marketing.
 - ▶ A retailer may attract more consumers by offering more choices.
 - ▶ A retailer may better forecast demands.
 - ▶ A retailer may provide better services.

Channel structure vs. channel coordination

- ▶ When a channel must be indirect, we may study mechanisms or contracts that coordinate an indirect channel.
 - ▶ This is the subject of **channel coordination**.
- ▶ When one may choose or mix different channels, she faces the **channel structure selection** problem.
- ▶ We want to find the best channel structure under different scenarios.

Interesting channel structure problems

- ▶ Suppose I write a paper to consider a very complicated channel and eventually show that a direct channel is better than an indirect one.
 - ▶ Is it interesting?
 - ▶ It is **trivial**: Complete integration is optimal.
- ▶ What if I show that a franchise store (i.e., an indirect channel) outperforms a self-owned store (i.e., a direct channel)?
 - ▶ Whether your result is interesting depends on the underlying reason.
 - ▶ If it is because the franchise store is capable to do be better selling business, it is again trivial.
 - ▶ Integrating a weak person may be worse than working with a strong one.
- ▶ What is interesting?
- ▶ If (1) the manufacturer is as strong as the retailer and (2) integration is not optimal, the result is interesting (or at least nontrivial).

When is vertical integration suboptimal?

- ▶ McGuire and Staelin (1983) show that it is possible!
- ▶ They show that vertical integration may be suboptimal under **horizontal competition**.
- ▶ Their model is simple: It is a combination of price competition (Bertrand game) and pricing in a supply chain (Stackelberg game).
- ▶ While in either game integration is better, mixing the two games generates new insights!

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Incentives in Decentralized Systems (Part 2)

Lecture 4.2: McGuire and Staelin (1983): Introduction and Model

Ling-Chieh Kung

Department of Information Management
National Taiwan University

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Road map

- ▶ **Introduction.**
- ▶ Model.
- ▶ Analysis: pricing games.

Research objective

- ▶ A key question in distribution channel selection is about the number of levels of **intermediary** to distribute products.
 - ▶ Selling through a **company store**: zero level; integration.
 - ▶ Selling through a **franchise store**: one level; decentralization.
- ▶ In this paper, the intermediary is assumed to be **no stronger than** the manufacturer in the sales business.
- ▶ Then a reason for inserting one level of intermediary is provided.

Research scope

- ▶ The environment studied is one with **exclusive** retail stores.
 - ▶ A retail store sells products only from **one** manufacturer.
 - ▶ We are comparing **company stores** and **franchise stores**.
- ▶ When do we see this?
 - ▶ Gasoline.
 - ▶ New automobiles.
 - ▶ Fast food restaurants.
 - ▶ And more.
- ▶ The model is an extension of **bilateral monopolies**.
 - ▶ Bilateral monopolies: a producer-distributor relationship with each party enjoying monopoly.
- ▶ The paper searches for conditions for the **industry equilibrium** to have zero or one level of intermediary.
 - ▶ The level of intermediary is **not fixed**; it is chosen by firms (in a decentralized manner) to maximize their profits.

Industry structure

- ▶ There are two manufacturers in the industry.
- ▶ They are selling different but **substitutable** products.
 - ▶ It is assumed that they are price setters and the demand of each product depends on both prices.
 - ▶ If both of them choose no intermediary, they play the **Bertrand game**.
- ▶ Each of them may independently decide whether to **delegate to a retailer** (insert one level of intermediary).
 - ▶ In this case, the manufacturer sets a wholesale price and the retailer sets a retail price.
 - ▶ The two players in the channel play the **channel pricing** game.¹
- ▶ Each of them decides whether to **downwards vertically integrate**.

¹In previous lectures, we call this the supply chain pricing game.

Road map

- ▶ Introduction.
- ▶ **Model.**
- ▶ Analysis: pricing games.

Model

- ▶ Two manufacturers.
- ▶ Each manufacturer has a downstream retail store (retailer).
- ▶ The retail store is either a company store (under integration) or a franchise store (under decentralization).
- ▶ The demands facing retail stores 1 and 2, respectively, are²

$$q_1 = 1 - p_1 + \theta p_2 \text{ and}$$

$$q_2 = 1 - p_2 + \theta p_1.$$

- ▶ The industry demand is normalized to 2 when both prices are zero.
- ▶ $\theta \in [0, 1)$ measures the **substitutability** between the two products.³

²The paper shows how a more general model reduces to this simple form.

³The general formulation disallow θ to be 1. You will see that allowing or disallowing $\theta = 1$ does not affect our results.

Model

- ▶ Under II, manufacturer i sets retail price p_i to solve

$$\pi_i^I \equiv \max_{p_i} p_i q_i, \quad i = 1, 2,$$

where π_i^I is the profit of channel i under integration.

- ▶ Under DD:

- ▶ First manufacturer i sets wholesale price w_i to solve

$$\pi_i^M \equiv \max_{w_i} w_i q_i, \quad i = 1, 2.$$

- ▶ Then retailer i sets retail price p_i to solve

$$\pi_i^R \equiv \max_{p_i} (p_i - w_i) q_i, \quad i = 1, 2.$$

- ▶ π_i^M and π_i^R are the profit of the manufacturer and retailer under decentralization.

Model

► Under ID:

- First manufacturer 2 sets wholesale price w_2 to solve

$$\hat{\pi}_2^M \equiv \max_{w_2} w_2 q_2.$$

- Then manufacturer 1 and retailer 2 set retail prices p_1 and p_2 to solve

$$\hat{\pi}_1^I \equiv \max_{p_1} p_1 q_1 \text{ and}$$

$$\hat{\pi}_2^R \equiv \max_{p_2} (p_2 - w_2) q_2.$$

- DI is similar to ID.

- To complete our analysis, we apply **backward induction**:

- Given any industry structure, find the equilibrium prices and profits.
- Find the equilibrium industry structures.

└ Analysis: pricing games

Road map

- ▶ Introduction.
- ▶ Model.
- ▶ **Analysis: pricing games.**

Illustrative analysis: the DD structure

- ▶ Suppose the two manufacturers have chosen to have franchise stores.
- ▶ This is the DD structure.
- ▶ Let $\pi_i^R(p_i) = (p_i - w_i)q_i = (p_i - w_i)(1 - p_i + \theta p_{3-i})$, where w_i s are announced by the manufacturers.
- ▶ The two retailers solve

$$\pi_i^R \equiv \max_{p_i} \pi_i^R(p_i), \quad i = 1, 2.$$

- ▶ If (p_1^*, p_2^*) is a Nash equilibrium, retailer i 's price p_i^* satisfies

$$\left. \frac{\partial}{\partial p_i} \pi_i^R(p_i) \right|_{p_i=p_i^*} = 1 - 2p_i^* + \theta p_{3-i}^* + w_i = 0, \quad i = 1, 2.$$

- ▶ A unique Nash equilibrium is

$$p_i^* = \frac{1}{2 - \theta} + \frac{2w_i + \theta w_{3-j}}{(2 + \theta)(2 - \theta)}, \quad i = 1, 2.$$

Intuitions behind the equilibrium retail prices

- ▶ Consider the equilibrium retail prices

$$p_i^* = \frac{1}{2 - \theta} + \frac{2w_i + \theta w_{3-i}}{(2 + \theta)(2 - \theta)}, \quad i = 1, 2.$$

- ▶ Do they make sense?
 - ▶ p_i^* goes up when w_i goes up.
 - ▶ p_i^* goes up when w_{3-i} goes up.
 - ▶ w_i has a larger effect on p_i^* than w_{3-i} does.
 - ▶ When $\theta = 0$, does p_i^* degenerate to that in the channel pricing game?
- ▶ Given these prices, the equilibrium demands are

$$q_i^* = \frac{1}{2 - \theta} - \frac{(2 - \theta^2)w_i - \theta w_{3-i}}{(2 + \theta)(2 - \theta)}, \quad i = 1, 2.$$

Do they make sense?

- ▶ Let's continue to the manufacturers' problems.

The manufacturers' problems

- ▶ When the manufacturers make decisions, should they consider what the other one does?
- ▶ Let $\pi_i^M(w_i) = w_i q_i^* = w_i \left[\frac{1}{2-\theta} - \frac{(2-\theta^2)w_i - \theta w_{3-i}}{(2+\theta)(2-\theta)} \right]$, the manufacturers solve

$$\pi_i^M \equiv \max_{w_i} \pi_i^M(w_i), \quad i = 1, 2.$$

- ▶ If (w_1^*, w_2^*) is a Nash equilibrium, manufacturer i 's price w_i^* satisfies

$$\left. \frac{\partial}{\partial w_i} \pi_i^M(w_i) \right|_{w_i=w_i^*} = \frac{1}{2-\theta} - \frac{2(2-\theta^2)w_i^* - \theta w_{3-i}^*}{(2+\theta)(2-\theta)} = 0, \quad i = 1, 2.$$

- ▶ The equilibrium wholesale prices are

$$w_1^* = w_2^* = \frac{2+\theta}{4-\theta-2\theta^2}.$$

The complete equilibrium

- ▶ The equilibrium wholesale prices are $w_1^* = w_2^* = \frac{2+\theta}{4-\theta-2\theta^2}$.
- ▶ The equilibrium retail prices are

$$p_1^* = p_2^* = \frac{2(3-\theta^2)}{(2-\theta)(4-\theta-2\theta^2)}.$$

- ▶ The equilibrium demands are

$$q_1^* = q_2^* = \frac{2-\theta^2}{(2-\theta)(4-\theta-2\theta^2)}.$$

- ▶ The manufacturers' equilibrium profits are

$$\pi_1^M = \pi_2^M = \frac{(2+\theta)(2-\theta^2)}{(2-\theta)(4-\theta-2\theta^2)^2}.$$

- ▶ The retailers' equilibrium profits and the equilibrium channel profits can also be found.

Other industry structures

- ▶ For other industry structures, i.e., ID, DI, and II, we may find all the equilibrium outcomes.
- ▶ In particular, the manufacturers' equilibrium profits (the channel profit under integration) can be found.
- ▶ The four pairs of the manufacturers' equilibrium profits will be the basis for solving the stage-1 **channel structure game**.

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Incentives in Decentralized Systems (Part 2)
Lecture 4.3: McGuire and Staelin (1983): Implications

Ling-Chieh Kung

Department of Information Management
National Taiwan University

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Road map

- ▶ **Implications.**
- ▶ Extensions and conclusions.

The channel structure game

- ▶ The “real” problems of the two manufacturers are the selection of channel structures.
- ▶ In the channel structure game:
 - ▶ There are two players.
 - ▶ They make decisions simultaneously.
 - ▶ Each of them has two options: integration of decentralization.
 - ▶ The payoff matrix can be constructed by solving the four pricing games.

The channel structure game

- ▶ The payoff matrix:

		M2	
		I	D
M1	I	$\frac{1}{(2-\theta)^2}$	$\frac{2+\theta}{4(2-\theta)(2-\theta^2)}$
	D	$\left[\frac{4+\theta-2\theta^2}{2(2-\theta)(2-\theta^2)} \right]^2$	$\frac{(2+\theta)(2-\theta^2)}{(2-\theta)(4-\theta-2\theta^2)^2}$

- ▶ Is there any pure-strategy Nash equilibrium?
 - ▶ Why not mixed-strategy Nash equilibria?

Equilibrium channel structures: polar cases

- Find all the pure-strategy Nash equilibria for the two polar cases:

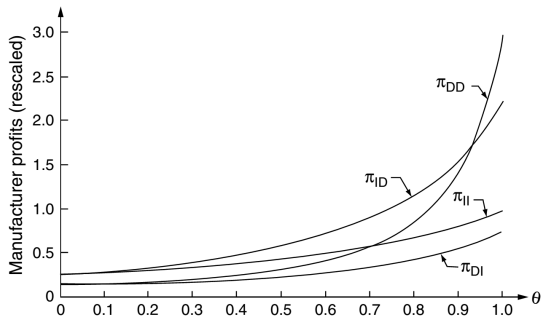
		M2		
		I	D	
M1	I	$\frac{1}{4}, \frac{1}{4}$	$\frac{1}{4}, \frac{1}{8}$	
	D	$\frac{1}{8}, \frac{1}{4}$	$\frac{1}{8}, \frac{1}{8}$	
		$(\theta = 0)$		

		M2		
		I	D	
M1	I	1, 1	$\frac{9}{4}, \frac{3}{4}$	
	D	$\frac{3}{4}, \frac{9}{4}$	3, 3	
		$(\theta = 1)$		

- DD is an **equilibrium** when $\theta = 1$!
- As all functions are continuous in $\theta \in [0, 1]$, DD must be an equilibrium for **large enough** θ .
- Let's do the complete analysis.

Equilibrium channel structures: general cases

Figure 2 Manufacturer's Profits as a Function of θ for Pure and Mixed Distribution Systems When Franchises Are Given Away



(McGuire and Staelin, 1983)

- ▶ $\pi_{II} > \pi_{DI}$: Mixture is never an equilibrium. II is always an equilibrium.
- ▶ If $\theta < 0.931$, $\pi_{ID} > \pi_{DD}$: DD is not an equilibrium. II is the only equilibrium.
- ▶ If $\theta > 0.931$, $\pi_{DD} > \pi_{ID}$: II is still an equilibrium. DD is **another equilibrium**.
- ▶ $\pi_{DD} > \pi_{II}$ if $\theta > 0.708$: **prisoners' dilemma** for $\theta \in (0.708, 0.931)$.

Incentives for decentralization

- ▶ Even though the retailer is not stronger than the manufacturer, a manufacturer may want to do decentralization.
 - ▶ This happens when θ is high, i.e., the products are quite similar or the **competition is quite intense**.
- ▶ What is the incentive for the manufacturer to do so?
- ▶ According to the paper:

*Manufacturers in a duopoly are better off if they can **shield** themselves from this environment by inserting privately-owned profit maximizers between themselves and the ultimate retail market.*
- ▶ “The competition is so intense that I’d better find someone to **fight for me**. I’d better not to engage in the competition directly.”
- ▶ Is there an explanation from the perspective of efficiency?

Decentralization can be more efficient

- ▶ If the manufacturers are better off by doing pure decentralization, pure decentralization must be generating a higher system profit.
- ▶ Why does DD outperform II?
- ▶ Suppose currently it is II.
 - ▶ The two manufacturers play the Bertrand game and consequently the equilibrium **prices are too low**.
- ▶ If they change to DD, each channel now has one additional layer of intermediary and the **price goes up**.
- ▶ Decentralization makes the prices **closer to the efficient level**.
- ▶ The pie becomes larger!

Decentralization provides credibility

- ▶ Under pure integration, the prices are too low and the two manufacturers are trapped in a prisoners' dilemma.
 - ▶ They know this. They know that together raising prices is win-win.
 - ▶ However, the promise to raise a price is **non-credible**.
 - ▶ They must somehow show that "I am (we are) forced to raise the price."
 - ▶ Having one additional layer provides **credibility**.
- ▶ Doing decentralization provides **incentives** for the competitor to raise its price (because it knows that I will raise my price).

Integration vs. decentralization

- ▶ Why integration fails? You told me integration is always optimal!
- ▶ The fact is **complete integration** is always optimal.
 - ▶ If the four firms are all integrated, the system is efficient.
 - ▶ But when complete integration is impossible (i.e., no manufacturer can integrate the other), **partial integration** may be worse than **no integration** (i.e., decentralization).
- ▶ This is the so-called “Principle of the second best”.
 - ▶ When you can control everything, do it.
 - ▶ When you cannot control everything, it may be better to control nothing.

Road map

- ▶ Implications.
- ▶ **Extensions and conclusions.**

Extensions

- ▶ When the manufacturers act to maximize channel profits, DD is an equilibrium if $\theta > 0.771$.
 - ▶ A manufacturer may do so because it can extract all the channel profit through some coordinating contracts.
 - ▶ The region for DD to be an equilibrium is enlarged. Why?
- ▶ When a manufacturer can set a sales quota or a price ceiling for its retailer, the result is still valid.
- ▶ When the two manufacturers collude, they will downwards integrate.
- ▶ The qualitative result remains valid under other game structures.

Conclusions

- ▶ A reason for a manufacturer to delegate to a retailer is provided.
- ▶ A manufacturer may do so when the competition is intense.
 - ▶ Having one additional layer drives the originally too-low prices up.
- ▶ The principal of the second best.