

Pricing Scheme Design for Information Goods

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eBizWorkshop Presentation
고려대학교 경영대학
유병준

Agenda

- Introduction
- Current Business
- Model 1: Customized Bundling
- Model 2: Fixed Fee vs. Unit Price
- Conclusion

Introduction (Model 1)

- Customization and packaging technologies available for more flexible pricing schemes to earn higher profit
- Customized bundling as second degree price discrimination:
 - when complete knowledge of consumers are not possible
 - when monitoring of consumer purchasing behavior is not possible
 - when external signal for categorizing consumers not available

Introduction (Model 2)

- Impact of Uncertainty on Pricing Scheme
 - Unit Price
 - Fixed Price
- Other IT factors related to the pricing scheme (Download cost, Congestion cost)

Introduction (Related Literature)

- Bundling
 - Pure bundling of 2 goods more profitable than pure unbundling / component pricing (Adams and Yellen 1976, Schmalensee 1984, McAfee, McMillan and Whinston 1989)
 - Pure bundling of N goods more profitable than pure unbundling (Bakos and Brynjolfsson 1999)
 - Customized Bundling (Chen & Hitt 2005) - One type consumer, show the benefit of customized bundling
 - Wu & Anandalingam – Numerical example of CB by integer programming
- Fixed Fee Pricing
 - M(Sundararajan 2005)

Current Business

- Many Movie Sites (Online streaming)
 - Mixture of Customized Bundling & Unit Price (very high)
- Music Sites
 - Monthly fee for online streaming
 - Unit fee for fixed fee (*Soribada: Partly Unit Fee)
- Game
 - Fixed Fee mostly + Unit (time) Price
- Broadcasting Companies
 - SBS: Customized Bundling -> Fixed Fee (including music service)
 - MBC: Fixed Fee (*KBS: Free)

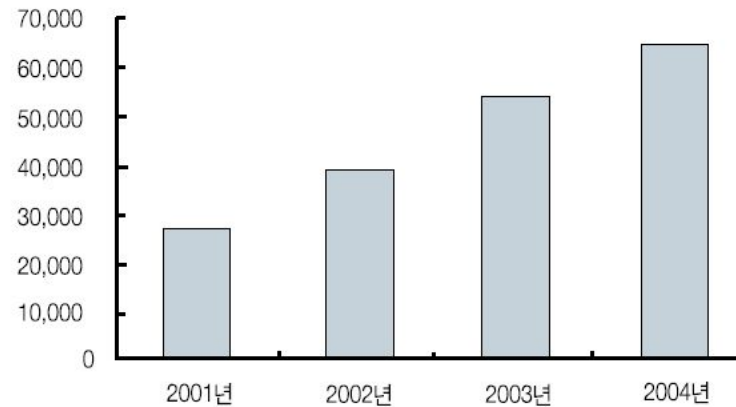
KOREA DC Market

- 6조5천억원 in 2004 (KIPA, 200505)

<표 1> 디지털 콘텐츠 전체 시장 규모

구분	DC매출액				성장률	
	2001년	2002년	2003년	2004년(잠정)	2001~2004	2003~2004
전체	2,667,381	3,913,829	5,467,043	6,484,757	34,5%	18,6%

단위 : 억원



<그림 1> 디지털 콘텐츠 산업 연간 시장 규모 추이

KOREA DC Market

<표 2> 분야별 디지털콘텐츠 매출액, 광고 매출액 및 기타 매출액(2004년) KIPA, 200505

단위: 백만원

구분	디지털콘텐츠 매출액	광고 매출액	기타 매출액	매출액 합계
게임	2,070,808	193,806	82,180	2,346,794
애니메이션	220,965	70,279	69,192	360,436
디지털영상	407,426	105,795	64,439	577,660
정보콘텐츠	536,681	64,970	74,428	676,079
e-Learning	583,790	39,553	303,427	926,770
디지털음악	201,413	-	35,399	236,812
전자출판	67,990	-	30,769	98,759
디지털 캐릭터	179,564	-	8,643	188,207

Korea: Broadcasting

- SBS

- 지난 2001년부터 유료 동영상 서비스를 시작한 SBSi의 콘텐츠 매출은 폭발적인 성장세를 보여준다. 2002년 64억4000여만원, 2003년 88억7000여만원, 2004년 117억1000여 만원으로 2년 동안 2배 가까이 늘어났다.

- 조선일보 2005-03-20

- MBC

- 시사·보도 프로그램은 무료로, 연예 프로그램과 드라마는 유료로 서비스하는 MBC계열 iMBC의 매출도 지난 2003년 25억원에서 지난해 32억원으로 늘었다.

- 조선일보 2005-04-27

- KBS

- 인터넷 다시보기' 유료화 논란

- 조선일보 2005-04-27

Korea: Game

- 온라인게임의 경우 지난해보다 50% 가량 늘어난 1조1000억원, 모바일게임은 200% 성장한 2700억원에 이를 것으로 전망됐다.
 - 전자신문 2004-12-14

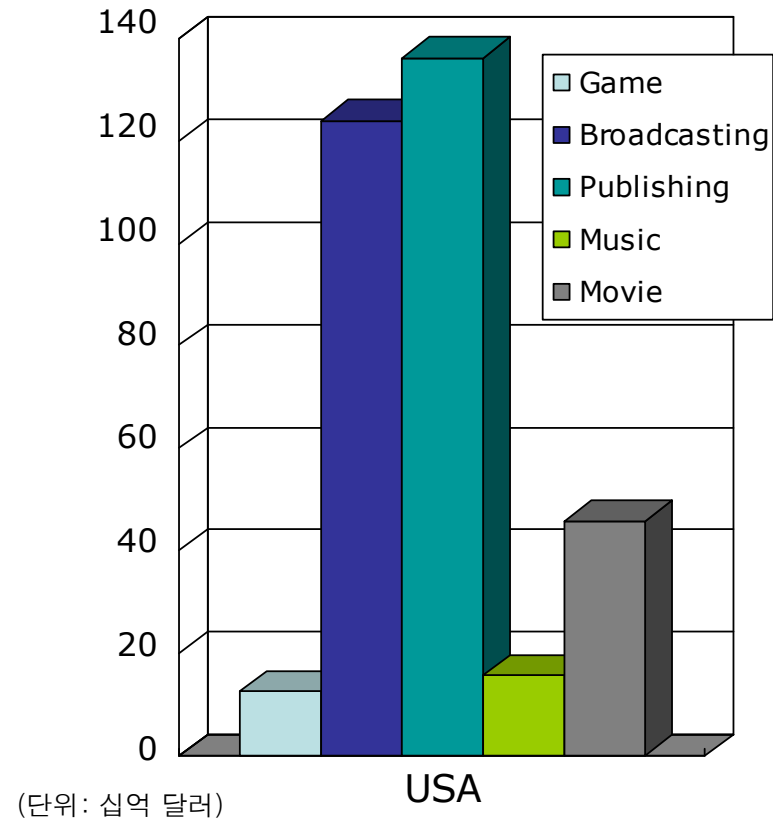
Etc (Cyworld)

- 1억1천만 달러에 이른 지난해 SK 커뮤니케이션스의 매출액 가운데 45%는 싸이월드에서 나왔으며 싸이월드의 매출 가운데 80%는 '도토리' 판매를 통한 것이라고 월 스트리트 저널은 밝혔다.
 - 연합뉴스 2005-06-09
- '도토리'의 하루 매출이 2억원에 달할 정도다
 - 국민일보 2005-03-08
- 넥슨의 온라인게임 '카트라이더'도 지난해 6월 서비스를 시작한 이후 1년도 안 돼 1100만명의 회원을 확보하며 인기 사이트로 떠올랐다. 소형 자동차인 '카트'를 타고 경주를 벌이는 이 게임은 지난해 12월 전국 PC방 조사에서 1998년부터 부동의 1위를 지켜온 '스타크래프트'를 제쳤다. 무료 게임이지만 아이템 판매로만 넥슨은 월 평균 50억원의 매출을 올리고 있다.
 - 국민일보 2005-03-08

USA DC Market

- Game
 - \$ 12,378,000,000
- Broadcasting
 - \$ 124,000,000,000
- Publishing
 - \$ 136,132,000,000
- Music
 - \$ 15,555,000,000
- Movie
 - \$ 45,630,000,000

- (Source: 한국문화콘텐츠진흥원, 200410)



USA DC Market

2006년 8대 주요 온라인 콘텐츠 매출액 전망

(단위 : 백만 달러)

구분	매출액
온라인 게임	1,800
온라인 음악	1,700
오디오-비주얼 엔터테인먼트	600
성인 콘텐츠	400
비즈니스-금융	350
아동 콘텐츠	95
스포츠 콘텐츠	95
소비자 쇼핑 보조	85

Source : Jupiter Media Metrix, March 2002

해외 문화콘텐츠시장동향: 미국 (문화콘텐츠진흥원 200410) 에서 재인용

Model 1: Customized Bundling

- Compare three pricing strategies in terms of profit and consumer surplus
 - Pure Unbundling
 - Pure Bundling
 - **Customized Bundling**
- Solve the complexity of Bundle pricing ($2^N - 1$) (Chen and Hitt 2005)

Basic Model

- Assumptions

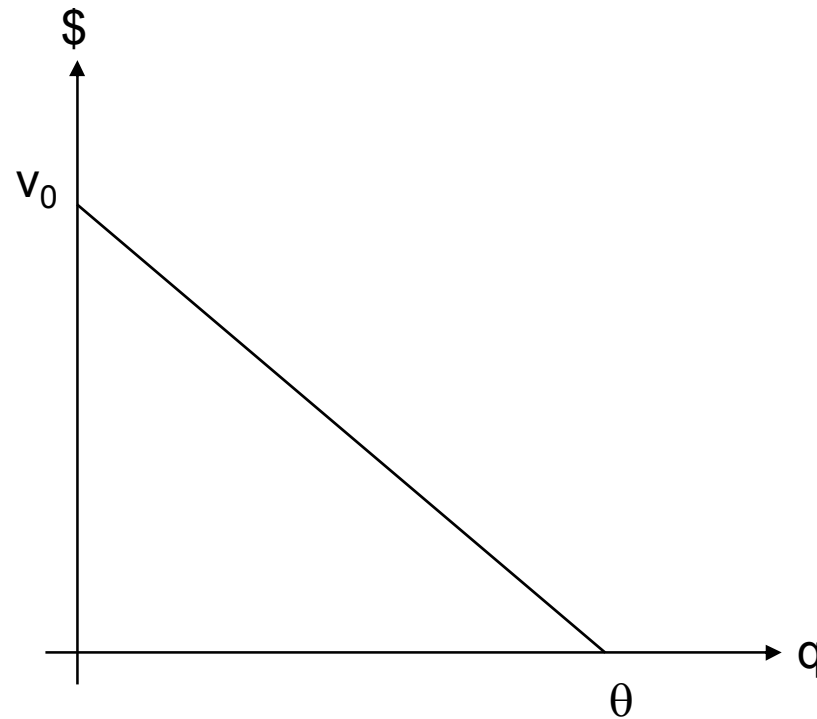
- There is *free disposal* of unwanted goods
- Reproduction and resale of goods among consumers are not allowed.
- The marginal cost of producing an information good is c .
- The firm knows that the consumer valuation profile is given by

$$v(\theta, q) = v_0 - \frac{v_0}{\theta} q$$

- The firm knows that the distribution of θ is Uniform(0,1)

A Typical Consumer Valuation Profile

- Equivalent to marginal utility of information good ($0 < \theta, q < Q = 1$)



Customized Bundling (1)

- Incentive compatibility constraints require

$$P_{cb}(q(\theta)) = V(\theta, q(\theta)) - \int_{\theta_0}^{\theta} v(\tilde{\theta}, q(\tilde{\theta})) d\tilde{\theta}$$

- Firm's profit maximization problem

$$\max_{q(\theta)} \int_{\theta_0}^{\theta} [P(q(\theta)) - c(q(\theta))] f(\theta) d\theta$$

- F.O.C.

$$v(\theta, q^*) = c + \frac{\partial v(\theta, q^*)}{\partial \theta} \frac{1 - F(\theta)}{\theta}$$

Comparison of Three Schemes

$$\Pi_{pu}^* = \frac{Q(v_0 - c)^2}{8v_0} \quad CS_{pu}^* = \frac{Q(v_0 - c)^2}{16v_0} \quad W_{pu}^* = \frac{3Q(v_0 - c)^2}{16v_0}$$

$$\Pi_{pb}^* = \frac{Q(v_0 - 2c)^2}{8v_0} \quad CS_{pb}^* = \frac{Q(v_0 - 2c)^2}{16v_0} \quad W_{pb}^* = \frac{3Q(v_0 - 2c)^2}{16v_0}$$

$$\Pi_{cb}^* = \frac{Q(v_0 - c)^2}{6v_0} \quad CS_{cb}^* = \frac{Q(v_0 - c)^2}{24v_0} \quad W_{cb}^* = \frac{5Q(v_0 - c)^2}{24v_0}$$

Question:
How many versions? (1)

- Observation: in general, only a few number of bundle sizes
- Our explanation: Menu cost (Wu and Anandalingam 2003)
- Problem solving approach
 - Obtain maximum profit earned if m versions offered as a function of m
 - Maximize this profit function w.r.t. m

How Many Versions? (2)

- Profit as a function of m

$$\Pi_m^* = \frac{(m+1)^2 - 1}{(m+1)^2} \times \frac{Qv_0}{6}$$

- **Proposition 4:** marginal benefit of an additional version is decreasing
- Profit function considering menu cost M

$$\Pi(m) = \frac{(m+1)^2 - 1}{(m+1)^2} \times \frac{Qv_0}{6} - M(m)$$

- Optimal number of versions can be solved by F.O.C.

$$\frac{Qv_0}{3(m+1)^3} = M'(m)$$

How Many Versions? (3)

- Segmentation

Marginal consumer type
for each version

$$\theta_1^* = 2\theta_0^*$$

$$\theta_2^* = 3\theta_0^*$$

⋮

$$\theta_{m-1}^* = m\theta_0^* \leq Q$$

Quality of each version

$$q_0^* = \frac{\theta_0^* \theta_1^*}{Q} = \frac{(1 \times 2) \theta_0^{*2}}{Q}$$

$$q_1^* = \frac{\theta_1^* \theta_2^*}{Q} = \frac{(2 \times 3) \theta_0^{*2}}{Q}$$

$$q_{i < m-1}^* = \frac{(i+1)(i+2) \theta_0^{*2}}{Q}$$

$$q_{m-1}^* = Q$$

How Many Versions? (4)

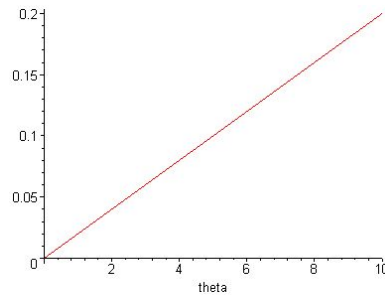
- Case 0: Uniformly distributed

Profit	$0.1481481481 v_0 Q$
Marginal consumer type of version 1	$0.3333333333 v_0 Q$
Marginal consumer type of version 2	$0.6666666667 v_0 Q$
Number of consumers buying version 1	0.3333333333
Number of consumers buying version 2	0.3333333333
Bundle size of version 1	$0.2222222222 Q$
Bundle size of version 2	Q

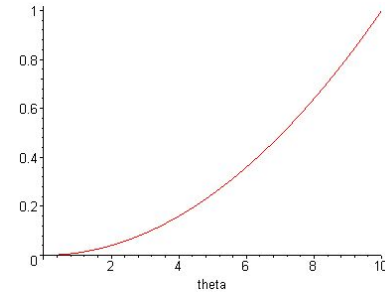
How many versions? (5)

- Types not uniformly distributed
- Case I: more high types

$$f(\theta) = \frac{2\theta}{Q^2}$$



$$F(\theta) = \frac{\theta^2}{Q^2}$$

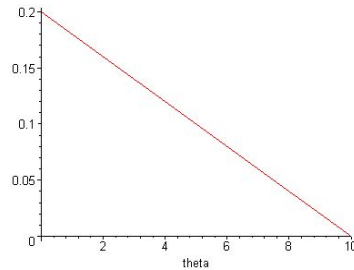


Profit	$0.2187479609 v_0 Q$
Marginal consumer type of version 1	$0.4383703458 v_0 Q$
Marginal consumer type of version 2	$0.7288804740 v_0 Q$
Number of consumers buying version 1	0.3390981853
Number of consumers buying version 2	0.4687332546
Bundle size of version 1	$0.2826479443 Q$
Bundle size of version 2	Q

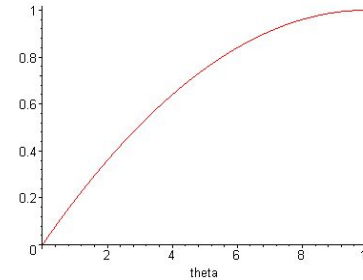
How Many Versions? (6)

- Case 2: More low types

$$f(\theta) = \frac{2Q - 2\theta}{Q^2}$$



$$F(\theta) = \frac{2Q\theta - \theta^2}{Q^2}$$

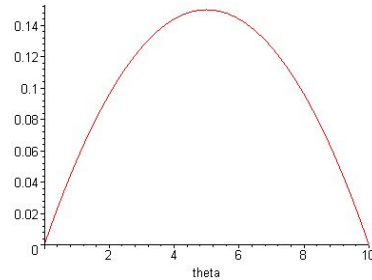


Profit	$0.09087910625 v_0 Q$
Marginal consumer type of version 1	$0.2146004368 v_0 Q$
Marginal consumer type of version 2	$0.4875756557 v_0 Q$
Number of consumers buying version 1	0.3542767653
Number of consumers buying version 2	0.2625787086
Bundle size of version 1	$0.1516658354 Q$
Bundle size of version 2	Q

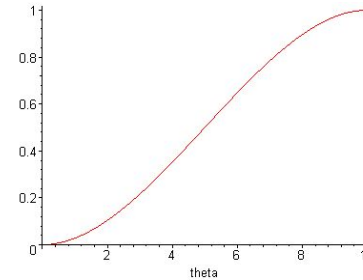
How Many Versions? (7)

- Case 3: More consumers in the middle

$$f(\theta) = \frac{6\theta(Q - \theta)}{Q^3}$$



$$F(\theta) = \frac{\theta^2(3Q - 2\theta)}{Q^3}$$



Profit	$0.1520992270 v_0 Q$
Marginal consumer type of version 1	$0.3099169901 v_0 Q$
Marginal consumer type of version 2	$0.5740617383 v_0 Q$
Number of consumers buying version 1	0.3816686562
Number of consumers buying version 2	0.3897198708
Bundle size of version 1	$0.2108509204 Q$
Bundle size of version 2	Q

Menu Cost

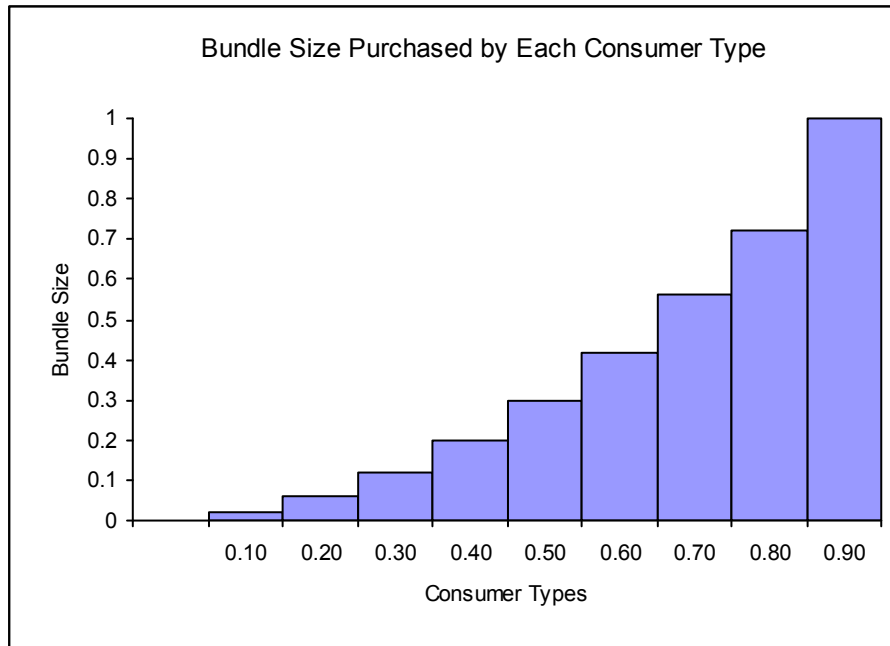


Figure 9a. Distribution of Consumer Types over Bundles when Cognitive Cost is Zero
(Q, v_0 normalized to 1, $e(m)$ set at 0.02)

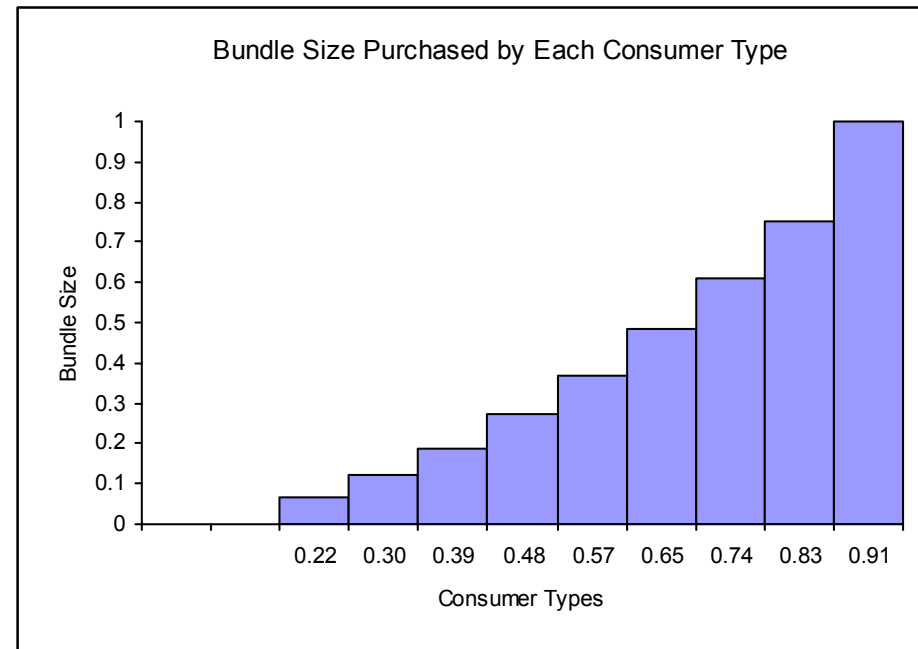


Figure 9b. Distribution of Consumer Types over Bundles when Cognitive Cost is Positive
(Q, v_0 normalized to 1, $e(m)$ set at 0.02)

Size of segment reduced, however,
bundle size in average increases

Model 2: Fixed Fee vs. Unit Price

- Fixed Fee vs. Unit Price: Optimal Decision
- How does uncertainty affect firm's pricing decisions?

Beta-VODs

- **KBS:** 무료 (유료화 논의 중)
- **MBC:** 프로그램에 따라 건당, 일일, 월간 단위로 과금되며 무료사용 기간은 없다. (건당 500원, 일일 4000원 월간 15000원) 시사 교양 프로그램의 경우 무료가 많고 드라마 예능 프로그램은 유료이다.
Free Contents (무료이용권 - 광고주)
- **SBS:** 건당 혹은 월간 유료 package “S”. 일일정액 제도는 없으며 Package 가입 전 2일간 무료체험 가능. 일부 시사프로그램은 무료.
- **EBS:** 건당 요금제 없음. 기간별, 프로그램별 package only
- **영화 Contents회사들:** 소정의 Beta Period

Motivation

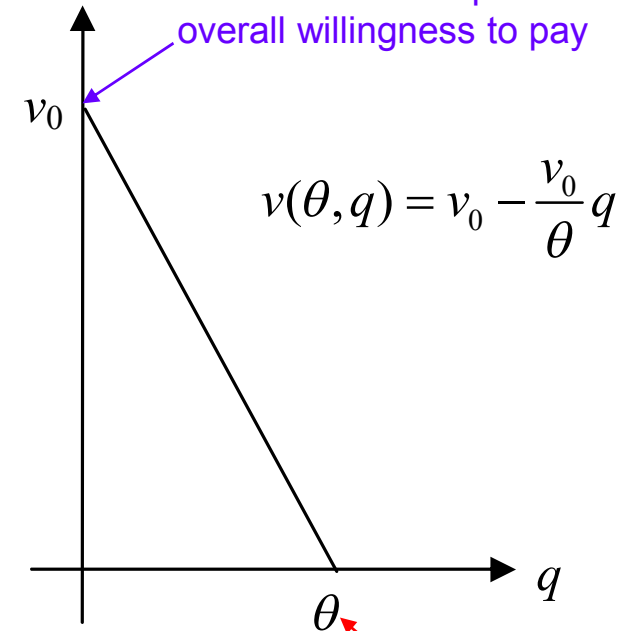
- The literature generally suggests that in the presence of consumer heterogeneity, versioning outperforms simpler pricing strategies, e.g, pure unbundling and pure bundling. However, simple pricing strategies are very common in the real business setting (Why?)
 - e.g., iTune music download, journal subscriptions.
- The literature has looked at menu cost and cognitive cost as an explanation for this observation. This paper explains the phenomenon by uncertainty.

Motivation

- A common assumption in the pricing literature is that consumer tastes vary only in one-dimension. With this assumption, utility functions that satisfy the single crossing property can be easily found and problem solving can be simplified significantly
 - We introduce a second dimension and interpret it as uncertainty about consumer's overall willingness to pay. We look at how uncertainty affects the optimality of some of the most frequently studied pricing strategies: unit pricing only (pure unbundling), fixed fee only (pure bundling), and mixed bundling
 - Mixed bundling represents a complex pricing strategy

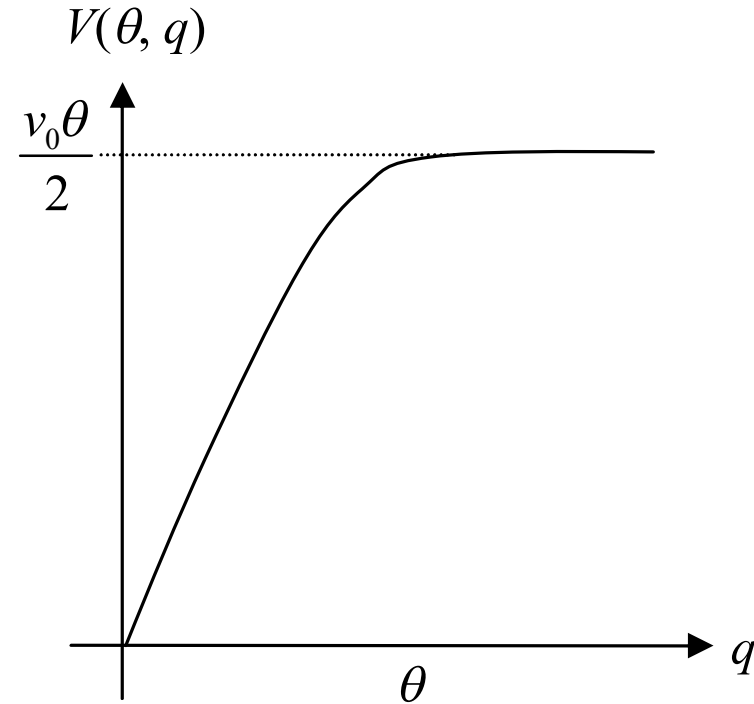
Model

$v(\theta, q)$ Can be used to represent consumers' overall willingness to pay



(a)

Represents a consumer's consumption level or demand for quality



(b)

We control for the spread of the distribution of heterogeneity in consumption level (θ) and the distribution of estimation error in consumers' overall willingness to pay (v_0)

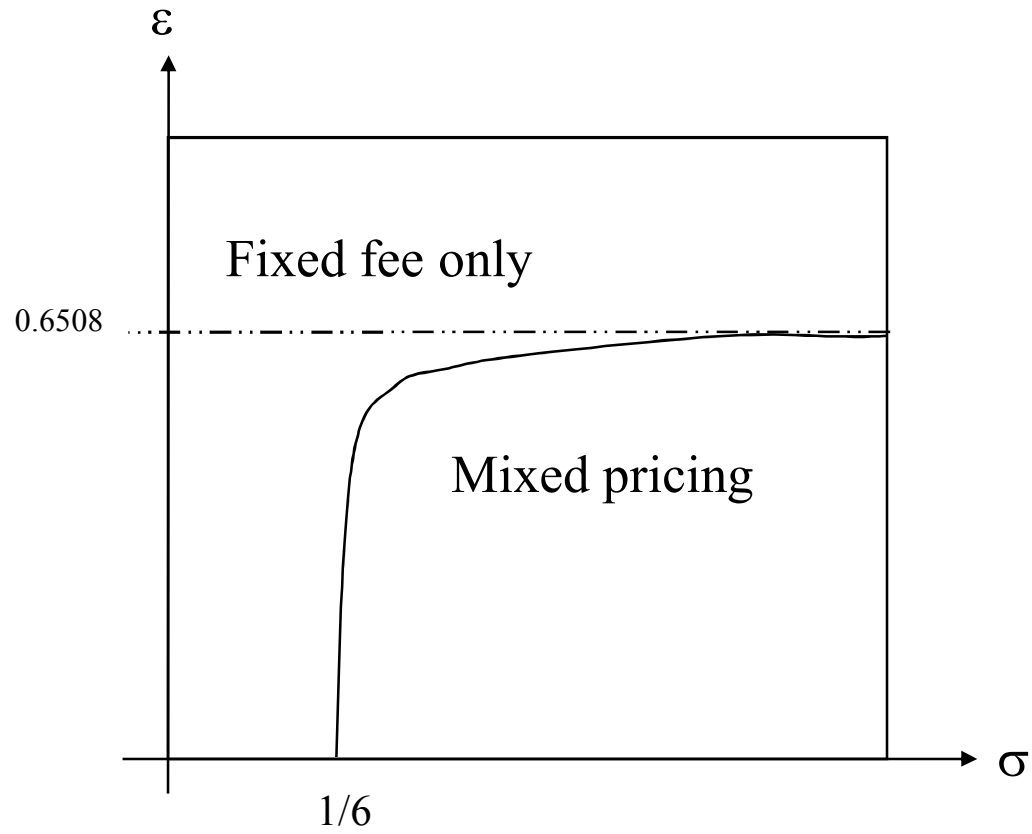
Approach

- Since we do not have the nice single crossing property, the problem is hard to solve. We look at the effect of each heterogeneity dimension one by one
 - Effect of heterogeneity in consumption level (θ)
 - Effect of uncertainty in estimating consumers' overall willingness to pay (v_0)
- and then discuss their combined effect. Numerical solutions of the combined effect are provided.

Results

- **Proposition 1:** Beyond a critical heterogeneity level, the additional profit earned by mixed pricing compared to unit pricing only and fixed fee only strategies increases as heterogeneity increases.
 - In other words, there is greater opportunity for complex strategies when heterogeneity in consumption level is high, i.e., consumer taste is diverse
- **Proposition 2:** The additional profit earned by mixed pricing compared to unit pricing only and fixed fee only strategies decreases as uncertainty in estimating consumers' overall willingness to pay increases, up to a point when mixed pricing is no longer more profitable than the simpler strategies
 - In other words, uncertainty in estimating consumers' overall willingness to pay favors simpler pricing strategies

Results



Extensions – More Uncertainties

- Congestion
- Download cost
- **Proposition 3:** Fixed fee only strategy is the least affected by congestion, followed by mixed pricing strategy and unit pricing only strategy in terms of profitability.
- **Proposition 4:** Fixed fee only strategy is the least affected by download costs, followed by mixed pricing strategy and unit pricing only strategy in terms of profitability.
- These results are intuitive. By subscribing to the fixed fee contract, consumer agree to pay a fixed amount of money regardless of actually consumption level. This agreement serves as a guarantee of incoming cash flow for the firm. Therefore, additional uncertainties at the consumer end make fixed fee only strategy more favorable

Business Implication

- New insights to the role of uncertainty in pricing decisions
- Explain why fixed fee only strategy is chosen
- Contents Providers need to collect more information about Customers' purchasing behavior (Too high unit price can be reduced when more information about customers is accumulated and uncertainty is reduced)

Conclusion

- Importance of Digital Contents business
- Characteristics of Digital Information Goods
 - Zero or small marginal costs, other tech-related costs
 - Need for different pricing strategies
- Reference from Economic theories can be useful for further insights

Thank You!
Any Questions?