Marketmaking Middlemen

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Objective

Intermediation modes:

- Middlemen/Merchants:
  (buying/selling, inventory holdings)

- Market makers:
  (transaction/participation fees, platform)

Explore a (simple) framework to study the determinant of intermediated market structure.

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Examples

- Amazon: originally a pure middleman, but started platform business.

- NYSE/ NASDAQ: specialists

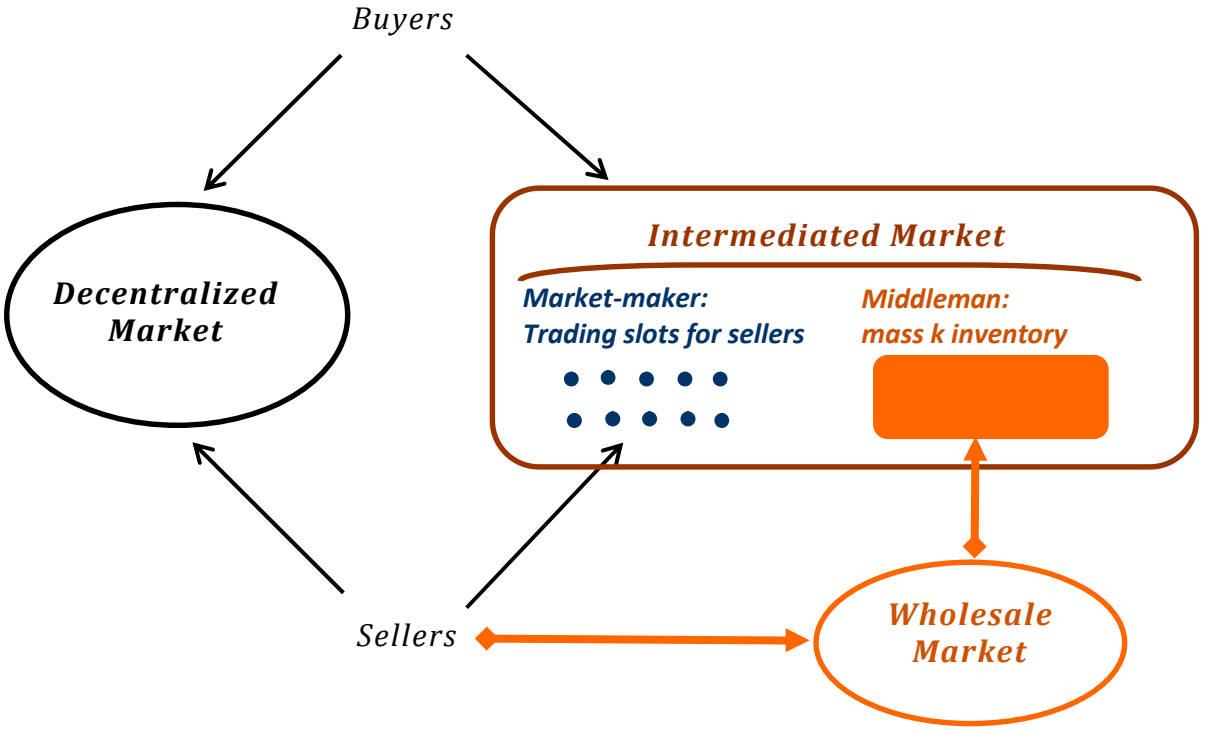
- The Trump Organization/ Trump International Realty

Key ingredients (1): search markets

- Decentralized market: random search, bilateral trade
- Intermediated (Centralized) market: directed search
  - Market-maker: provide a market place with publicly announced fees
  - Middleman: advanced inventory management technology for supply guarantee/proximity

Key ingredients (2): search technologies

- Single-market search: traditional retail markets (supermarkets, brick and mortar shops)
  - High search costs, High transportation costs, One-trip shopping
- Multi-market search: online shopping, durable goods
  - Advanced information/search technologies, Long search period


Buyers
Decentralized Market
Intermediated Market
Market-maker:
Trading slots for sellers
Middleman:
mass k inventory
Sellers
Wholesale Market

Setup

Consider a one-period economy (no trade generates zero value).

- Agents: B buyers and S sellers; a monopolistic intermediary; all risk neutral

- Homogeneous goods: unit demand/ constant marginal production cost; common consumption value

Single-market search

Timing of events:

1. The intermediary announces whether to open platform $\tilde{S} \in \{S, 0\}$, a set of fees $\mathbf{F} = \{f^i\}$, $i = b, s$, and a stock $K \in [0, B]$;

2. Buyers and sellers decide simultaneously which market to participate in, C market or D market;

3. Trade occurs in each active market (yet to be specified shortly below).

D market:

- Meeting probability λ^i, $i = b, s$ (with $\lambda^b B = \lambda^s S$).

- Surplus share:
  - Buyers's share β;
  - Sellers' share $1 - \beta$.

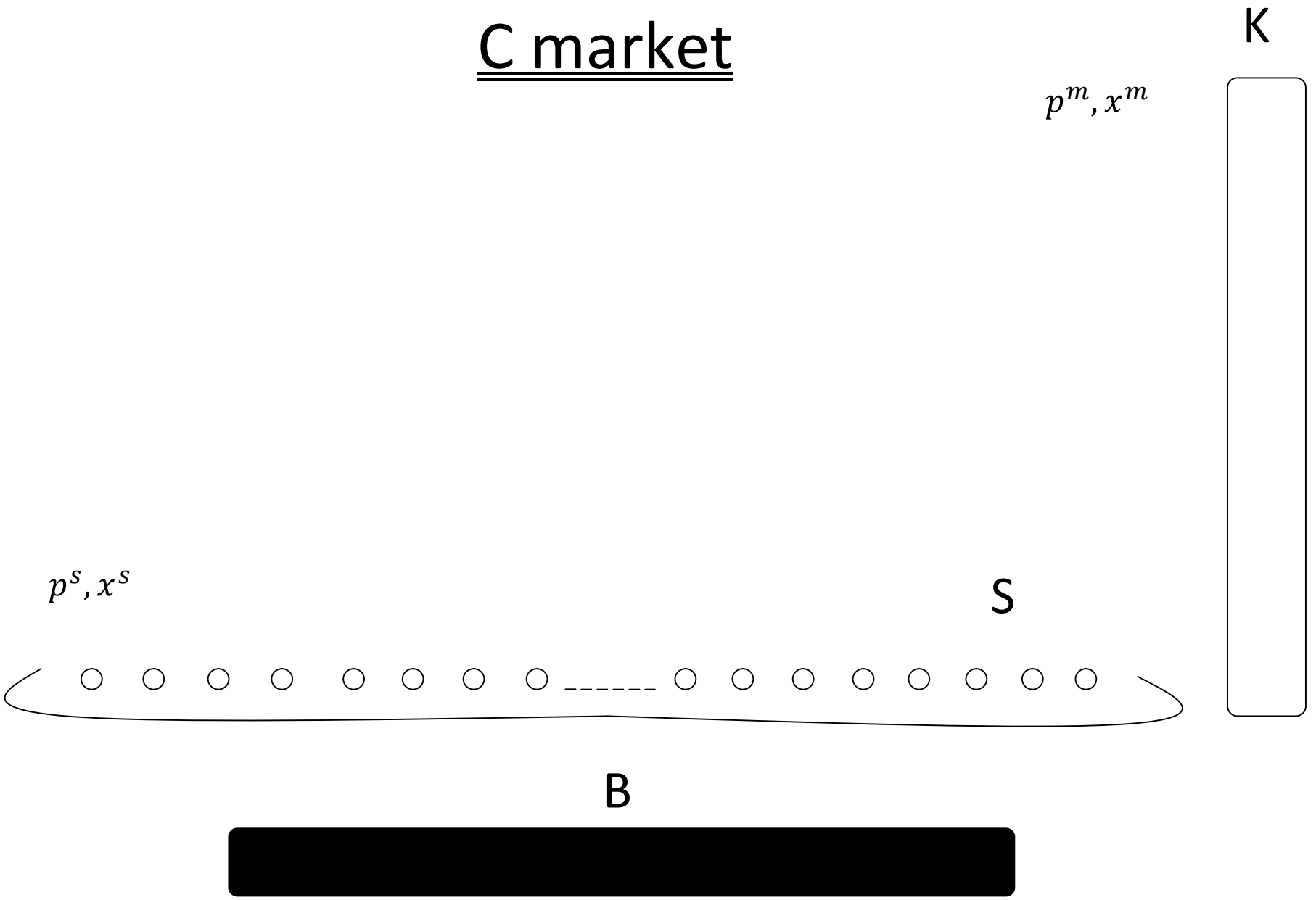
C market: (directed search market)

1. Each seller, or a middleman, announces a price, p^s, p^m;

2. Observing those prices and capacities 1 or K, buyers decide which supplier to trade with, subject to coordination frictions;

3. Trade occurs at the announced price.

C market



- Meeting process: A random number of buyers arrive at individual sellers/middleman.

- Sellers: $\eta^s = \frac{1-e^{-x^s}}{x^s}$

- Middleman: $\eta^m = \min\{\frac{K}{x^m}, 1\}$

where

$$\tilde{S}x^s + x^m = B$$

- Determination of allocation, x^m, x^s:

$$x^m = \begin{cases} B & \text{if } V^m(B) \geq V^s(0) \\ (0, B) & \text{if } V^m(x^m) = V^s(x^s) \\ 0 & \text{if } V^m(0) \leq V^s(\frac{B}{S}), \end{cases}$$

where

$$\begin{aligned} V^s(x^s) &= \eta^s(x^s)(1 - p^s - f^b) \\ V^m(x^m) &= \eta^m(x^m)(1 - p^m). \end{aligned}$$

Definition

- Pure middleman mode: $x^m = B$ and $x^s = 0$
- Pure market-maker mode: $x^m = 0$ and $x^s = \frac{B}{S}$
- Market-making middleman mode: $0 < x^m < B$ and $0 < x^s < \frac{B}{S}$

- The participation constraint of buyers in the C market:

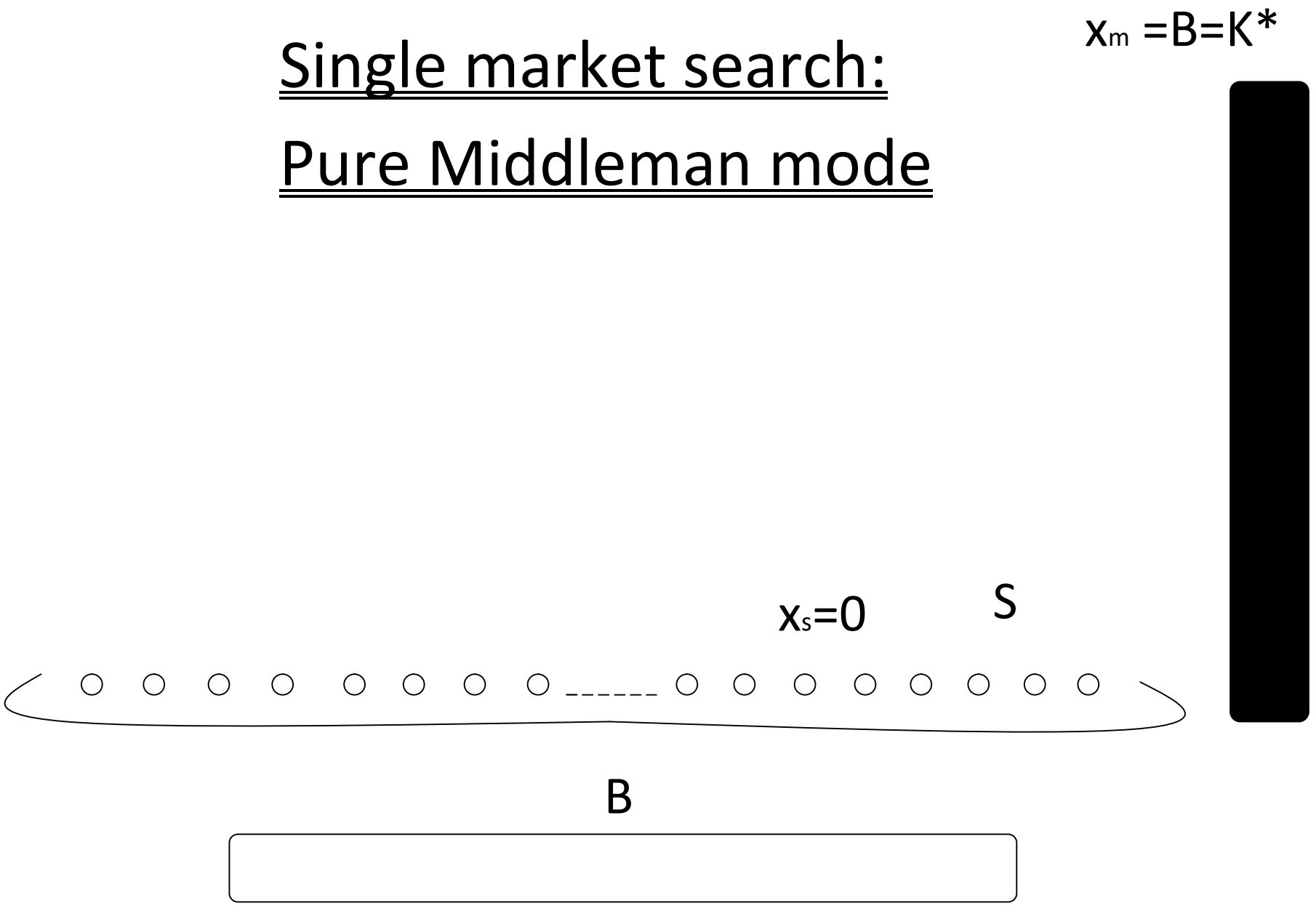
$$V^m(x^m) = \eta^m(1 - p^m) \geq \lambda^b \beta.$$

Proposition 1 (Pure Middleman) *Given single-market search technologies, the intermediary will act as a pure middleman with*

- $x^m = K = B$;
- $p^m = 1 - \lambda^b \beta$;
- $\Pi = B(1 - \lambda^b \beta)$.

Single market search:

Pure Middleman mode



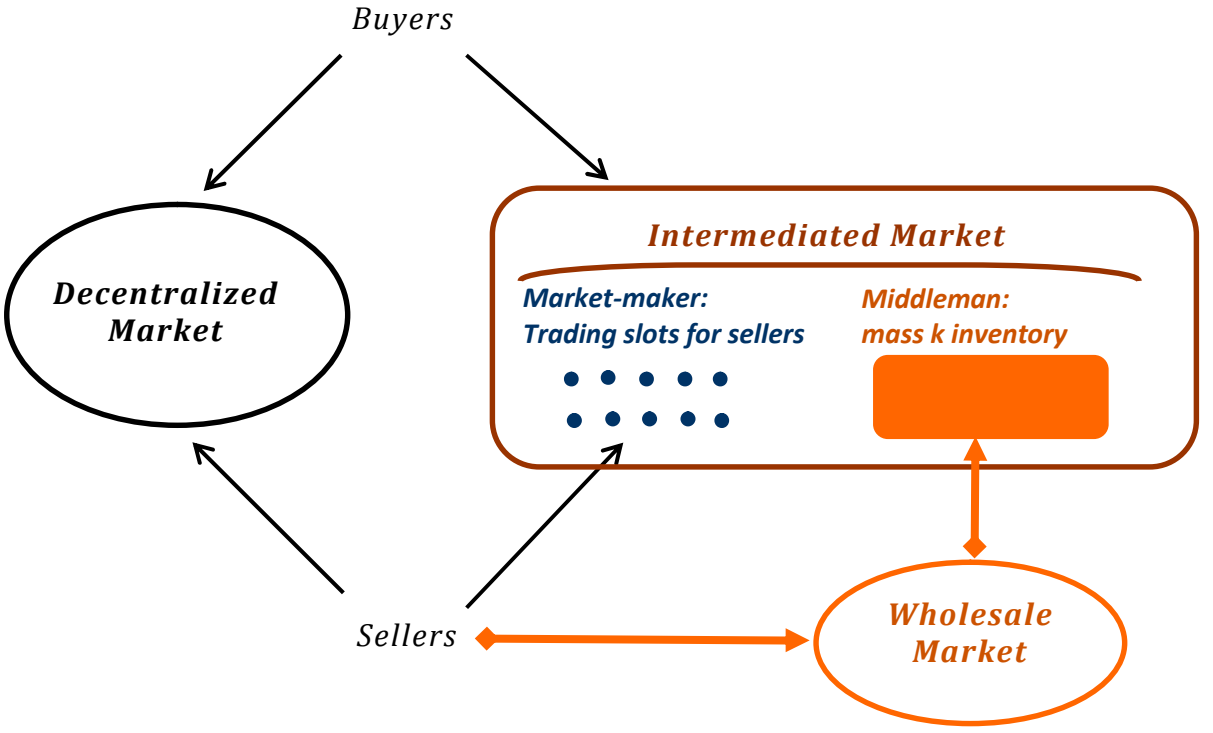
Two-sidedness

- Participation decision of one side depends on their beliefs on what the other side do

- Pessimistic belief: sellers believe zero buyers in C unless $V^B \geq \lambda^b \beta$

- Divide and Conquer strategy (if K is not observable).
  - subsidize buyers $-g^b \geq \lambda^b \beta$, tax sellers $V^s \geq g^s$
  - subsidize sellers $-g^s \geq \lambda^s (1-\beta)$, tax buyers $V^b \geq g^b$

Multi-market search


Buyers
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Outside option

1. Active platform $x^s > 0$:

$$1 - p^s - f^b \geq \lambda^b(1 - x^s\eta^s)\beta \quad (1)$$

$$p^s - f^s \geq \lambda^s\xi(x^m, K)(1 - \beta) \quad (2)$$

2. Active middleman $x^m > 0$:

$$1 - p^m \geq \lambda^b(1 - x^s\eta^s)\beta. \quad (3)$$

Pure middleman: Given $x^m = B$ and $x^s = 0$ (by announcing $\tilde{S} = 0$), the intermediary

- stocks $K = B$;
- sets $p^m = 1 - \lambda^b \beta$ (with the binding IC (3));
- makes the profits

$$\tilde{\Pi}(B) = B(1 - \lambda^b \beta).$$

Active platform (standard procedure to pin down an equilibrium price)

- Suppose a seller sets her price to $p \neq p^s$ and it attracts x buyers.

- Buyers directed search:

$$V^s(x) = \eta^s(x)(1 - p - f^b) + (1 - \eta^s(x))\lambda^b e^{-x^s}\beta.$$

and

$$V^s(x) = V^s,$$

give $x = x(p \mid V^s)$.

- Profit maximization:

$p^s(V^s) =$

$\text{argmax}_p\{(1 - e^{-x(p|V^s)})(p - f^s) + e^{-x(p|V^s)}\lambda^s\xi(x^m, K)(1 - \beta)\}$

- Equilibrium price:

$$p^s - f^s = \varphi^s(x^s)(v(x^m, K) - f) + \lambda^s\xi(x^m, K)(1 - \beta),$$

where $\varphi^s(x^s) = -\frac{\partial\eta^s/\partial x^s}{\eta^s/x^s}$.

Remark 1 *Whenever a platform is active, conditions (1) - (3) are reduced to:*

$$f \leq v\left(x^m, K\right), \tag{4}$$

where

$$v\left(x^m, K\right) \equiv 1 - \lambda^b e^{-x^s}\beta - \lambda^s \xi\left(x^m, K\right)(1-\beta)$$

Lemma 1 *With multiple-market search, an active platform can enlarge the intermediation surplus* $v(x^m, K)$.

Pure market-maker: Given the equilibrium price p^s , and $x^m = 0$ and $x^s = \frac{B}{S}$ (by annoucing $K = 0$), the intermediary

- sets $f = f^b + f^s = v(0,0)$;

- makes the profits

$$\tilde{\Pi}(0) = S\left(1 - e^{-\frac{B}{S}}\right) v(0,0).$$

Market-making middleman: Given p^m satisfying $V^m(x^m) = V^s(x^s)$, the intermediary's problem is:

$$\tilde{\Pi}(x^m) = \max_{x^m, f, K} \Pi(x^m, f, K) = S(1 - e^{-x^s})f + \min\{K, x^m\} p^m$$

subject to (4), $f \leq v(x^m, K)$, and $x^m \in (0, B)$.

Lemma 2 *The market-making middleman sets:* $K = x^m$ *and* $f = v(x^m, K)$.

Remark 2 *Benefits of using an active platform:*

- *a larger intermediation surplus* $v(x^m, K)$*;*

- *a higher middleman price,*

$$p^m = 1 - \lambda^b e^{-x^s} \beta.$$

Proposition 2 (Market-making middleman/Pure Market-maker) *Given multi-market search technologies, the intermediary will open an active platform and act as:*

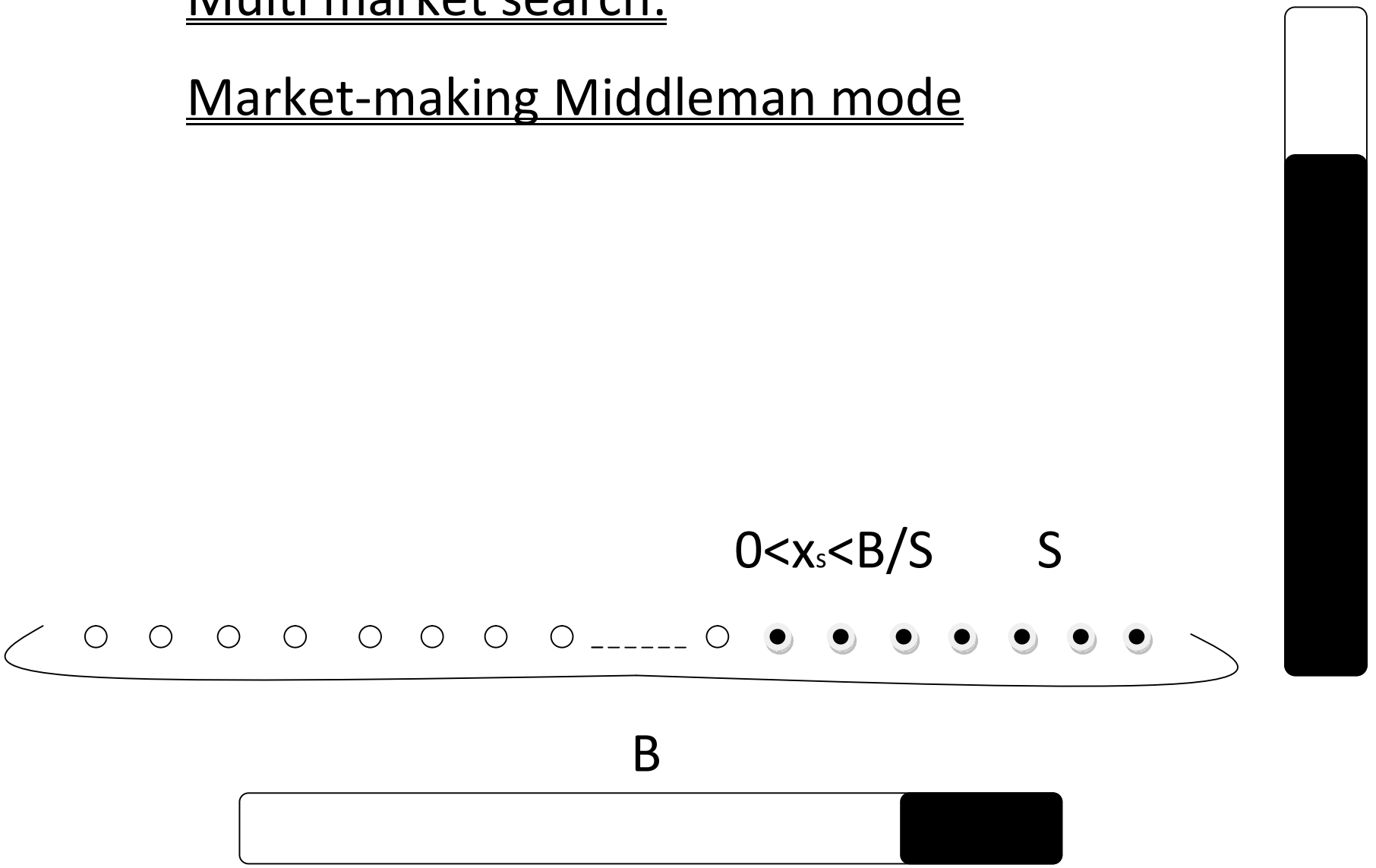
- *a market-making middleman if* $\lambda^b\beta \leq \frac{1}{2}$ *or if* $\lambda^b\beta > \frac{1}{2}$ *and* $\frac{B}{S} \geq \bar{x}$*, some* $\bar{x} \in (0, B)$*;*

- *a pure market-maker if* $\lambda^b\beta > \frac{1}{2}$ *and* $\frac{B}{S} < \bar{x}$*.*

$0<x_m = K^*<B$

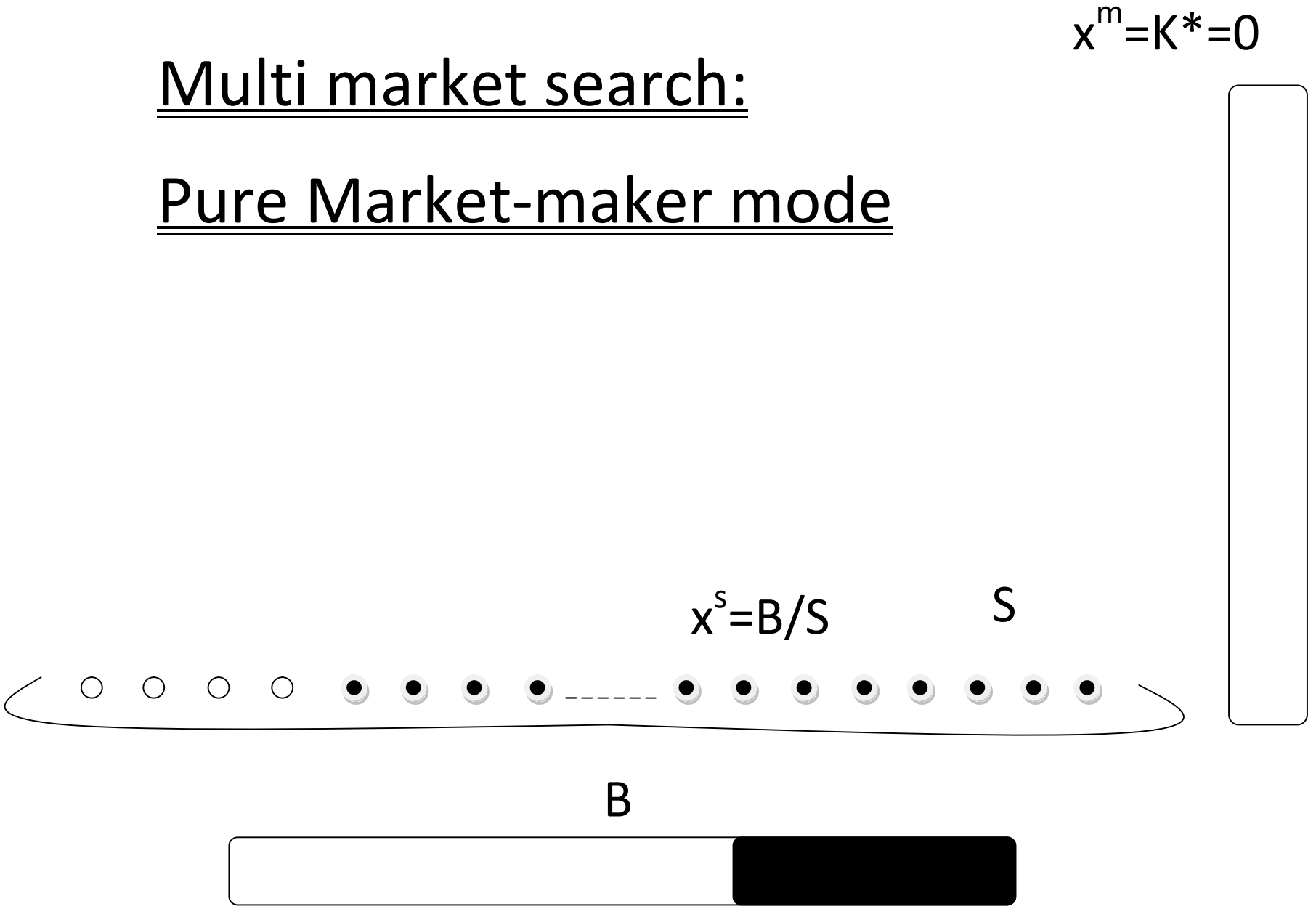
Multi market search:

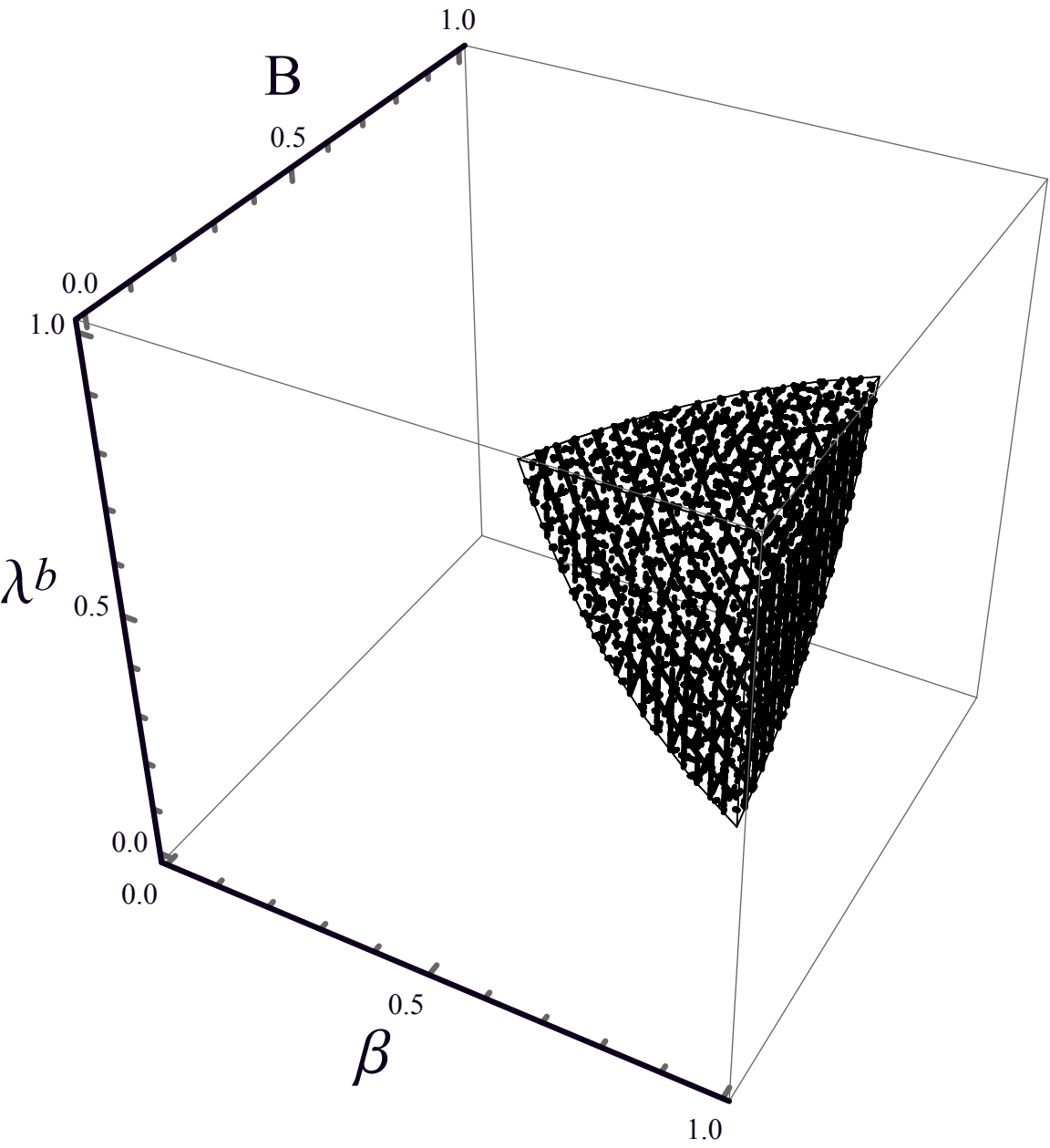
Market-making Middleman mode



Multi market search:

Pure Market-maker mode




B
1.0
0.5
0.0
1.0
λ^b
0.5
0.0
0.0
0.5
β
1.0

· Buyers' option value:

$$e^{-x^s}\lambda^b\beta$$

Corollary 1 (Comparative statics) *Consider a parameter space in which the market-making middleman mode is profit-maximizing. Then, an increase in buyer's bargaining power β or buyer's meeting rate λ^b in the D market, or a decrease in the buyer-seller population ratio, $\frac{B}{S}$, leads to a smaller middleman sector x^m and a larger platform x^s.*

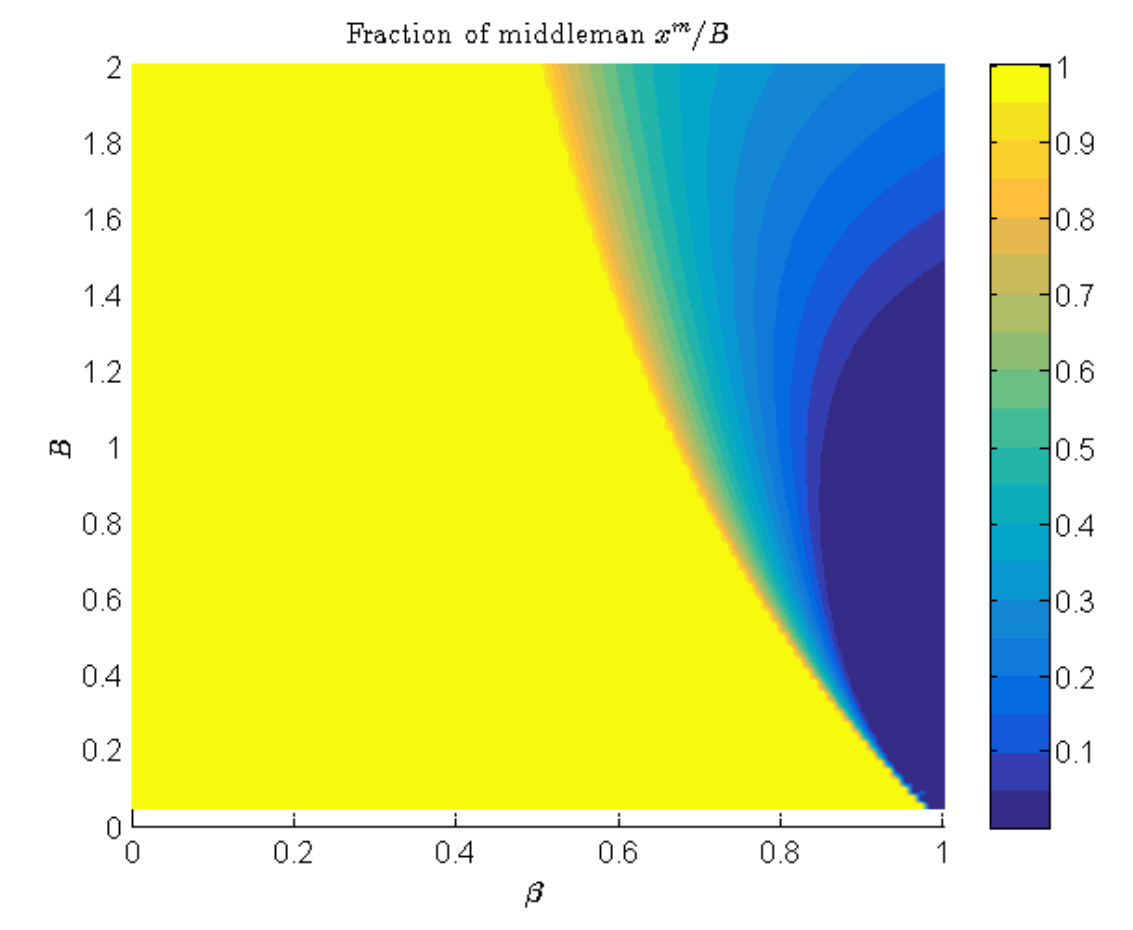
Extension (1): Non-linear matching function

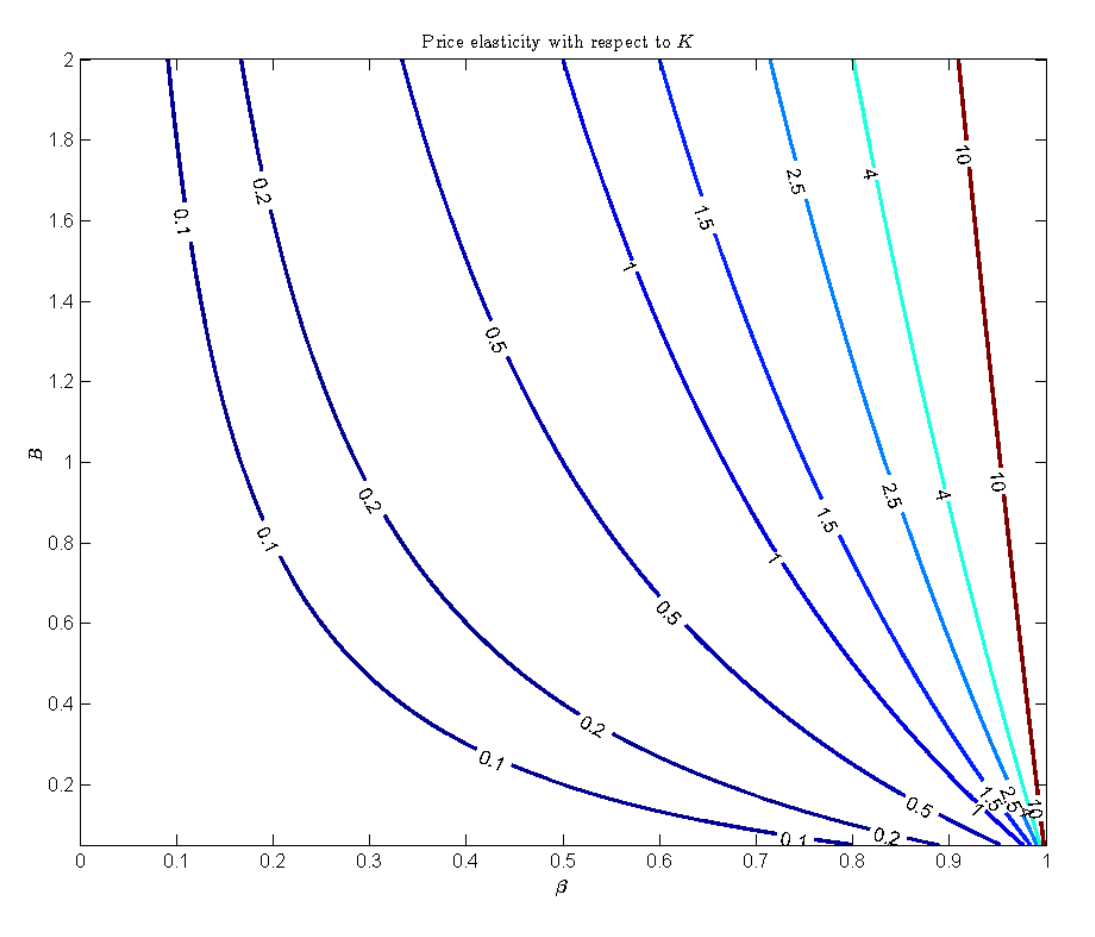
Suppose that: $\lambda^b = \lambda^b(x^D)$ is strictly concave and decreasing in x^D.

Suppose also that agents exit after successful trades in the C market:

$$B^D = \max\left\{B - \min\{x^m, K\} - S(1 - e^{-x^s}), 0\right\} \quad \text{and} \quad S^D = Se^{-x^s}.$$

Proposition 3 *With a non-linear matching function in the D market outlined above, a pure middleman mode can be profitable even with multi-market search technologies only if the middleman's price is inelastic at the full capacity* $x^m = K = B$. *Otherwise, the intermediary should be a marketmaking middleman or a pure market maker.*


Fraction of middleman x^m/B
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
B
0
0.2
0.4
0.6
0.8
1
β
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1


Price elasticity with respect to K
B
β
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.2
1.4
1.6
1.8
2
0.1
0.2
0.5
1
1.5
2.5
4
10

Extension (2): Endowment economy (Assume $\beta = 1$)

- Each seller is endowed with a unit of good.

- A middleman can assess αS sellers in the wholesales market.

  - Resource constraint:

$$K \leq \alpha S$$

  - Wholesales price:

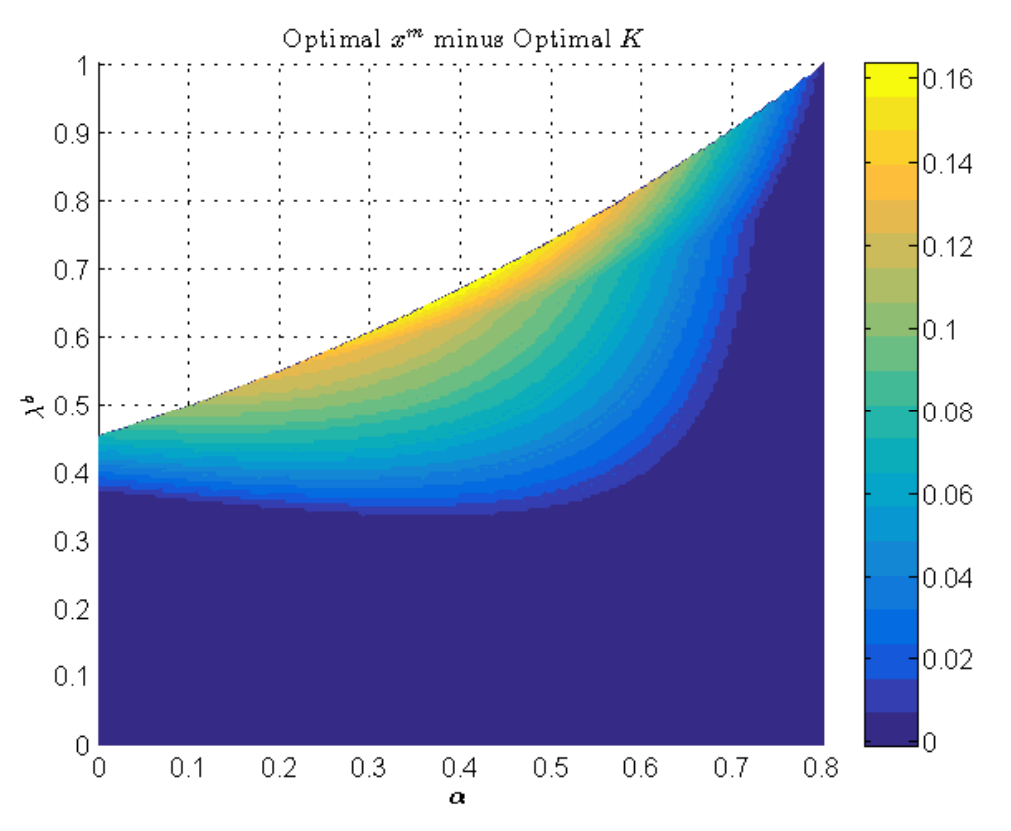
$$p^w \geq W(x^s), \quad \text{where} \quad x^s = \frac{B - x^m}{S - K}$$

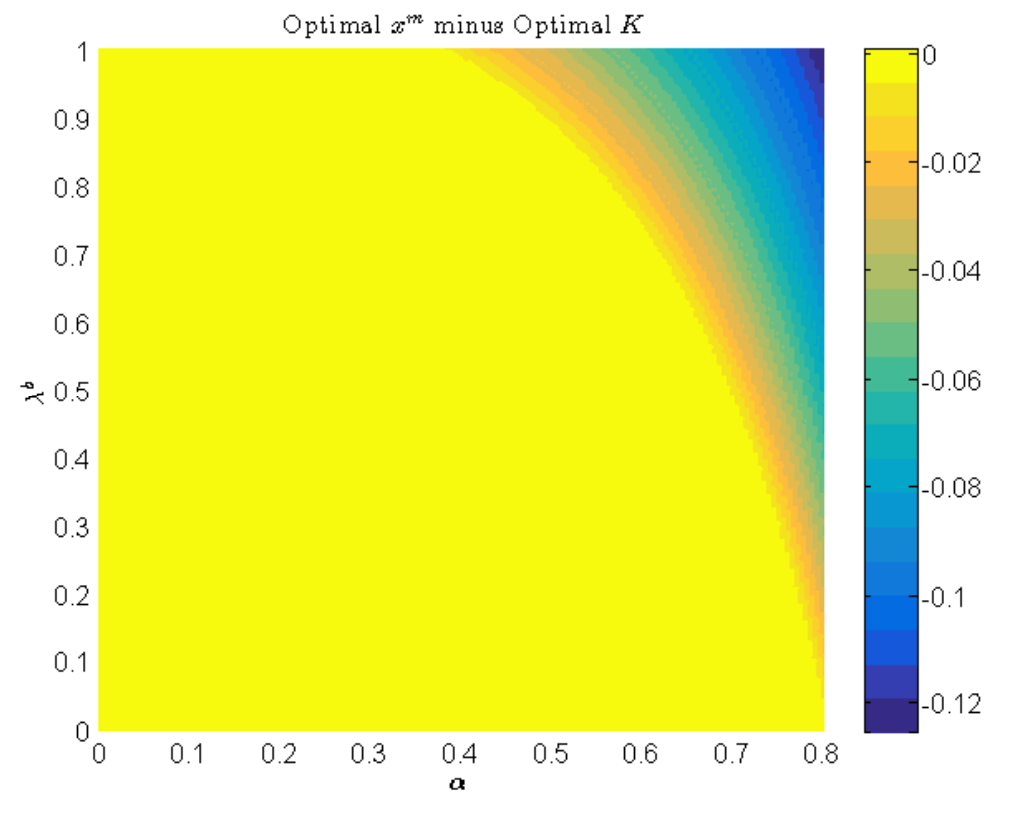
Proposition 4 *Consider the endowment economy outlined above with single-market search technology, and the zero trade share of sellers in the D market. The intermediation chooses to be:*

- *a pure middleman if* $B \leq \alpha S$*;*

- *a market-making middleman with* $K = \alpha S \leq x^m$ *if* $B > \alpha S$*.*

Proposition 5 *Consider the endowment economy outlined above with multi-market search technology, and the zero trade share of sellers in the D market. The intermediation chooses to be a market-making middleman or a pure market-maker with* $x^m \leq K = \alpha S$*.*


Optimal x^m minus Optimal K
λ^b
α
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0


Optimal x^m minus Optimal K
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
λ^b
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
α
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12

- Comparison:

  - For $\alpha S \geq B$, essentially the same as in the benchmark setup.

  - For $\alpha S < B$, the size of middleman sector, x^m, is smaller with multi-market search.

Applications

- Amazon:
  - Moved towards a market-making middleman at the time of high entry of web-based retailers.
  - Market behaviors: re-launch business in Amazon platform/ use Amazon as primary site
- NYSE/ NASDAQ:
  - Changing competitive environment faced by securities exchanges/ NYSE Arca

- Less active assets: ‘small cap securities’/ designated dealers in auction

- The Trump Organization/Trump International Realty:

  - Added a brokering business at the time of high entry of web-based platforms.

  - Supply security: co-development business

Literature

- Rubinstein and Wolinsky (1987), Duffie, Garleanu, and Pedersen (2006), Lagos and Rocheteau (2009), Lagos, Rocheteau, and Weill (2010), Weill (2007), Shevichenko (2004), Johri and Leach (2002), Masters (2007), Watanabe (2010, 2013), Wong and Wright (2014), Holzner and Watanabe (2015), Nosal, Wong and Wright (2015)

- Baye and Morgan (2001), Rochet and Tirole (2003, 2006), Caillaud and Jullien (2003), Rysman (2004), Armstrong (2006), Hagiu (2006), Nocke et al. (2007), Galeotti and Moraga-Gonzalez (2009), Weyl (2010), Loertscher and Niedermayer (2012), Edelman and Wright (2015)

- Rust and Hall (2003)

Rust and Hall (JPE, 2003) An important function of intermediaries is to hold inventory to provide a buffer stock that offers their customers liquidity at times when there is an imbalance between supply and demand. In the securities business, liquidity means being able to buy or sell a reasonable quantity of shares on short notice. In the steel market, liquidity is also associated with a demand for immediacy so that a customer can be guaranteed of receiving shipment of an order within a few days of placement. **Lacking inventories and stockouts, this model cannot be used to analyze the important role of intermediaries in providing liquidity**. (page 401).

Conclusion

- A simple framework to study the determination of intermediated market structure

- Emergence of market-making middleman