Interconnecting Differentiated Networks

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Introduction

To interconnect or not?

Monopolies to Duopoly

Conclusion

Network Effects

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- Products where consumers’ value of the product depends on the number of people using it
- Examples: software (MS Office, Windows v Apple, instant messengers...), fax machines...
- Somewhat of a shorthand for two-sided markets
- Interconnected networks - as if you are on the same network (can call people who are with AT&T, even if I have T-Mobile)
Is there too much or too little interconnection?

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- Networks can interconnect
- If they do, consumers derive utility from the number of people in the interconnected network, but the firms have to pay some fixed cost $F$
- ’Too little’ because $CW$ is always positive, and therefore whenever firms interconnect, it is optimal for society, but not vice-versa
Problems

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2. CW goes up because there is more demand, and quantity in the market goes up
3. What if there is no extra demand to capture after networks interconnect?
Results of This Paper

1. Hotelling like framework (product differentiation)
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Results of This Paper

1. Hotelling like framework (product differentiation)
2. CW can go down (too much interconnection)
3. Yes, consumers are getting a bigger network, but the demand becomes less elastic, and prices might increase so much as to make the CW change negative overall
4. Other results: unexpected results with not the whole market covered, some partial interconnection results
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1. A Salop circle, length $M$.
2. Joining a network with $m$ consumers gives utility of $g(m)$
3. Joining a network NOT at the ideal point $i$ means a loss of utility of $h(i)$
4. Both $h$ and $g$ are increasing
Supply

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3. Before the market opens, jointly decide whether to interconnect
4. If yes, consumers get utility of $g(M)$ from the product at the ideal point, and each firm has to pay $F > 0$
Separate Networks

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- $\Pi_0 = i \times p_0$... using the FOC and invoking symmetry:
- $p = \frac{M}{2N} \left(h'\left(\frac{M}{2N}\right) - g'\left(\frac{M}{N}\right)\right)$
Interconnected Networks

- Marginal Consumer:
  \[ g(M) - h(i) - p_0 = g(M) - h\left(\frac{1}{N} - i\right) - p_1 \]
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- \( p = \frac{M}{2N} h'\left(\frac{M}{2N}\right) \)
- \( \Delta \Pi = \frac{M^2}{2N^2} g'\left(\frac{M}{N}\right) \)
- \( \Delta CW_{\text{per consumer}} = g(M) - g\left(\frac{M}{N}\right) - \frac{M}{2N} g'\left(\frac{M}{N}\right) \)

**Bigger network**

**Price hike**
Some propositions

Proposition

*Consumer Welfare increases after networks interconnect if and only if* \( \frac{M}{2N} g'(\frac{M}{N}) < g(M) - g(\frac{M}{N}) \).

*In particular, it can decrease.*
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In particular, it can decrease.

Proposition

Firms interconnect if and only if \[ \frac{M^2}{2N^2} g'(\frac{M}{N}) > F. \]
It is socially optimal to interconnect if and only if \[ M(g(M) - g\left(\frac{M}{N}\right)) > NF. \]
If the interconnection was not beneficial to society, consumer welfare decreases.
Consumer utility (prices are slopes)

No Interconnection
Consumer utility (prices are slopes)

Interconnection
Questions

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- What if there is extra demand for the product, like in Katz and Shapiro?
- What if the firms were not competing before interconnection, but do compete after? (since they are on the same network)
- From two (local monopolist) firms in the corners to a duopoly
- Now that the market is covered after interconnection, what happens to the incentives to interconnect?
Setup

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Setup

- To get more tractible results, assume \( h(x) = tx, \ g(n) = jn, \) and \( N = 2 \)
- Two firms are located at both ends of the Hotelling interval
- If not interconnected, consumers in the middle are left out (too far from perfect)
- If the firms do interconnect, market becomes covered
Solution

- Local monopoly profit: \( \Pi_{monopoly} = \frac{R^2}{4(t-j)} \)
  
  \( \text{(price} = \frac{R}{2}) \)
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- Duopoly profit: \( \Pi_{\text{duopolist}} = \frac{M^2}{8} t \)
Solution

- Local monopoly profit: $\Pi_{monopoly} = \frac{R^2}{4(t-j)}$
  \(\text{price} = \frac{R}{2}\)
- Duopoly profit: $\Pi_{duopolist} = \frac{M^2}{8}t$
- Interconnect iff $\frac{M^2}{8}t - \frac{R^2}{4(t-j)} > F$
Results in Words

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- The higher the differentiation, the more incentive there is to interconnect (do not compete as much after)
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- Interconnect iff \( \frac{M^2}{8} t - \frac{R^2}{4(t-j)} > F \)
- The higher the differentiation, the more incentive there is to interconnect (do not compete as much after)
- The higher the network effects, the lower is the incentive to interconnect (getting rid of the network effects after interconnection)
Takeaways!!!

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Takeaways!!!

1. Hotelling instead of Cournot with Network Effects - different qualitative results
2. Interconnection can be bad for consumers - yes, bigger network, but higher prices because of decreased elasticity
3. Interconnection is bad for society when the network effects are too steep
4. Monopolists do not want to interconnect to become a duopoly exactly when the network effects are bigger (and when products are not differentiated)
5. Thanks for coming! (partial interconnection?)