“Companies like Cisco, Intel and Microsoft recognize the threat posed by nimble young firms getting technologies to market at unimaginable speeds [...] and they are willing to pay extremely high premiums to protect their franchises”

Entrepreneurial Innovations in Network Industries

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Introduction
The Question

• Entrepreneurial Innovations

• Network Industries
The Question

What is the effect of network effects and standardization on innovation incentives?
Contribution

- Sale of the innovation to incumbents
- How common is it?
VC exits in the US 1999-2005

Source:
Thomson Venture Economics/
National Venture Capital Association
## Recent Tech Acquisitions

<table>
<thead>
<tr>
<th>Company</th>
<th>Acquirer</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DoubleClick</td>
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</tr>
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<td>Ebay</td>
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</tbody>
</table>
The Question

What is the effect of network effects and standardization on innovation incentives...

...allowing also for the possibility of a sale of the innovation to incumbents?
The Model
Timing

1. Entrepreneur $e$ chooses effort to innovate, $\rho$.

2. Acquisition/entry and exit game

   - Acquisition by an incumbent firm
   - Entry by the entrepreneur $e$

   Potential exits by non-acquiring incumbents

3. Product market interaction,
Product Market Interaction

- PM Profits: \( \pi_j(x_j, x_{-j}, l, k, z, c) \quad l = \{i, e\} \)

- Nash Eq.: \( x_j^*(l, k, z, c) \)

- Reduced form profits: \( \pi_j(l, k, z, c) \)
Product Market Interaction

- **Quality:**
  \[
  \frac{d\pi_A(i)}{dk} > 0, \quad \frac{d\pi_E(e)}{dk} > 0, \quad \text{and} \quad \frac{d\pi_N(l)}{dk} < 0
  \]

- **Network Effects:**
  \[
  \frac{d\pi_A(i)}{dz} > 0, \quad \frac{d\pi_E(e)}{dz} > 0, \quad \text{and} \quad \frac{d\pi_N(l)}{dz} < 0
  \]

- **Compatibility:**
  \[
  \frac{d\pi_A(i)}{dc} < 0, \quad \frac{d\pi_E(e)}{dc} < 0, \quad \text{and} \quad \frac{d\pi_N(l)}{dc} > 0
  \]
Timing

1. Entrepreneur $e$ chooses effort to innovate, $\rho$.

2. Acquisition/entry and exit game
   - Acquisition by an incumbent firm
   - Entry by the entrepreneur $e$
   - Potential exits by non-acquiring incumbents

3. Product market interaction,
Entry or Sale?

- Entry costs: \( \frac{dF(z,c)}{dz} > 0 \) and \( \frac{dF(z,c)}{dc} < 0 \)

- Sale through first price perfect information auction with externalities
Auction with Externalities

- **Entrepreneur** \( v_e = \pi_E(e) - F \)

- **Incumbent**
  - Entry deterring \( v_{ii} = \pi_A(i) - \pi_N(i) \)
  - Preemptive \( v_{ie} = \pi_A(i) - \frac{n-1}{n} \pi_N(e) \)

Note: \( v_{ie} > v_{ii} \)
Equilibrium Ownership Structure

- **Net value of Entry-deterrence:** $V_{ie} - V_e$
- **Net value of Preemption:** $V_{ii} - V_e$

\[
\frac{d(V_{ii} - V_e)}{dk} = \left( \frac{d\pi_A(i)}{dk} - \frac{d\pi_E(e)}{dk} \right) - \frac{d\pi_N(i)}{dk} > 0
\]

$R_E \in \{V_{ii}, V_e\}$
Equilibrium Ownership Structure

Net value of Entry-deterrence: \( v_{ie} - v_e \)

Net value of Preemption: \( v_{ii} - v_e \)

\[
\begin{align*}
\frac{d(v_{ii} - v_e)}{dz} &= \left( \frac{d\pi_A(i)}{dz} - \frac{d\pi_E(e)}{dz} \right) - \frac{d\pi_N(i)}{dz} + \frac{dF}{dz} > 0 \\
\frac{d(v_{ii} - v_e)}{dc} &= \left( \frac{d\pi_A(i)}{dc} - \frac{d\pi_E(e)}{dc} \right) - \frac{d\pi_N(i)}{dc} + \frac{dF}{dc} < 0 
\end{align*}
\]

\( R_E \in \{ v_{ii}, v_e \} \)
Recent Tech Acquisitions

\[ \frac{d(v_{ii} - v_{ee})}{dz} = \left( \frac{d\pi_A(i)}{dz} - \frac{d\pi_F(e)}{dz} \right) - \left( \frac{d\pi_N(i)}{dz} \right) + \frac{dF}{dz} > 0 \]

- **DoubleClick**
  - Google
  - $3.1 billion

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Timing

1. Entrepreneur $e$ chooses effort to innovate, $\rho$.

2. Acquisition/entry and exit game

   - *Acquisition by an incumbent firm*
   - *Entry by the entrepreneur $e$*
   - Potential exits by non-acquiring incumbents

3. Product market interaction,
Innovative Effort

- Maximizes \( \Pi_e = \omega(\rho)R_E - y(\rho) \), \( R_E \in \{v_{ii}, v_e\} \)

- Optimum

\[
\frac{d\Pi_e(\rho,v,c)}{d\rho} = \omega'(\rho)R_E - y'(\rho) = 0
\]

\[
\frac{d\rho^*(R_e)}{dR_e} = -\frac{w'(\rho^*)}{R_Ew''(\rho^*)-y''(\rho^*)} > 0
\]
Point 1

Selling innovations can be particularly important for innovation incentives in network industries.

- **Entry only**
  \[
  \frac{dp^*(v_e)}{dz} = \frac{dp^*(v_e)}{dv_e} \left( \frac{d\pi_E(i)}{dz} + \frac{dF}{dz} \right) + \left( \frac{d\pi_A(i)}{dz} + \frac{d\pi_N(i)}{dz} \right) > 0
  \]

- **Sale**
  \[
  \frac{dp^*(v_{ii})}{dz} = \frac{dp^*(v_{ii})}{dv_{ii}} \left( \frac{d\pi_E(i)}{dz} - \frac{d\pi_N(i)}{dz} \right) > 0
  \]
Point 2

Standardization can dampen innovation incentives through an adverse effect on the sales price.

\[ \frac{d\rho^*(v_e)}{dc} = \frac{d\rho^*(v_e)}{dv_e} \left( \frac{d\pi_E(i)}{dc} - \frac{dF}{dc} \right) + \left( \frac{d\pi_A(i)}{dc} - \frac{d\pi_N(i)}{dc} \right) < 0 \]

- Entry only
- Sale
Point 3

Bidding competition for innovations is important for innovation incentives in network industries

- Bidding competition \( R_E \in \{v_{ii}, v_e\} \)
- No bidding competition \( R_E \in \{v_e\} \)
- “Innovation waves” and concentration
Implications and Work in Progress
Policy Implications

• Sale of innovations => important mechanism

• Careful with standardization

• Policies encouraging potential competition
Empirical Implications

- Ratio (sales/entry) increasing in NE
- Ratio (sales/entry) decreasing in Comp.
- Innovation output higher in NE ind.
Work in Progress

- Innovating incumbents
- Asymmetries in market size
- Assumptions?
- Taking the model to the data
Takeaways
Takeaways

Selling innovations can be particularly important for innovation incentives in network industries.

Standardization can dampen innovation incentives through an adverse effect on the sales price.

Bidding competition for innovations is important for innovation incentives in network industries.
“Companies like Cisco, Intel and Microsoft recognize the threat posed by nimble young firms getting technologies to market at unimaginable speeds [...] and they are willing to pay extremely high premiums to protect their franchises”


… and it’s a good thing for innovation!
Thank you for your attention!