Selling Platforms

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with Olivier Rubel
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“SELLING” PLATFORMS

- exciting part of economy and society
- some grow virally, due to network effects, many must be “sold”
  - single-sided network goods: e.g., Kyruus
  - two-sided goods: e.g., OpenTable, American Well, CreditKarma
- “selling” is fraught with uncertainty, moral hazard ... managed via risk-sharing compensation plans (commission rate)
  - NE alter rewards, productivity and risk exposure of selling agent
    - what is the net influence on plan design?
    - how should network and platform firms manage sales agents?
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BACKGROUND AND RESEARCH QUESTIONS

▶ platforms need to be “sold” (too)
▶ salesforce management literature: principal-agent model - does not recognize role of network effects
▶ our research: impact of NE on
  ▶ mix of guaranteed and performance-based incentives?
  ▶ risk and reward sharing between firm and agent?
▶ how should firm respond to externalities created by NE
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RESULTS AND INSIGHTS

▶ network effects exert externalities on sales agent: increase both mean and variance of sales (⇒ compensation risk)
▶ spectrum of influence, depending on nature of network effects
  ▶ one-sided (direct) vs. two-sided (indirect) NE
  ▶ which side to meter for commission
  ▶ one vs. two agents
▶ firm’s ability to leverage network effects depends on balance between # externalities vs. # instruments to manage them.
CONCEPTUAL FRAMEWORK AND BENCHMARK CASE

Compensation design without network effects

- Agent’s influence on sales: \( Q = V + \beta w + \epsilon \)
  - \( V \) = base sales; \( \beta \) = agent’s productivity; \( \epsilon \approx N(0, \sigma^2) \)

- Risk-averse agent, earns \( \omega(w) = \alpha_0 + \alpha_1 Q \), picks effort level \( w^* \)
  
  \[
  \left( \text{max. } U(\omega(Q), w) = -e^{-\rho(\omega(Q) - C(w))} \geq R \right) \Rightarrow \ w^* = \beta \alpha_1
  \]

- Firm designs \( (\alpha_0, \alpha_1) \) to max. \( \mathbb{E}[\Pi] = \mathbb{E}[Q] - (\alpha_0 + \alpha_1 \mathbb{E}[Q]) \)

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  \Rightarrow \alpha_1^* = \frac{\beta^2}{\beta^2 + \rho \sigma^2}; \quad \Lambda_0 = \frac{\alpha_1 \mathbb{E}[Q]}{\alpha_0 + \alpha_1 \mathbb{E}[Q]} = \frac{2\beta^2}{\beta^2 + \rho \sigma^2} \frac{\beta^4 + V(\beta^2 + \rho \sigma^2)}{\beta^4 + 2R(\beta^2 + \rho \sigma^2)}
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SELLING ONE-SIDED NETWORK GOODS

**Direct network effects, intensity $\eta$**

- with $Q = V + \beta w + \eta Q^e + \epsilon$, and rational expectations,

$$q = \frac{V + \beta w}{1 - \eta} + \frac{\epsilon}{1 - \eta}; \quad \eta \text{ increases mean AND volatility}$$

- $\eta$ makes agent more productive, puts in more work, $w^* = \beta \frac{\alpha_1}{1 - \eta}$

and has more compensation risk, $\text{Var}(\omega(q)) = \alpha_1^2 \frac{\sigma^2}{(1 - \eta)^2}$

**How to adjust commission rate and reward structure?**
► η has no effect on commission rate, $\alpha_1^* = \frac{\beta^2}{\beta^2 + \rho \sigma^2}$

$\therefore$ costs (risk-disutility) and gains (compensation) both $\approx \frac{\alpha_1^2}{(1-\eta)^2}$

► firm takes more risk; more of agent’s compensation as fixed salary

► yet gives agent a greater share of earnings (... net profit increases)
SELLING NETWORK GOODS: RESULTS

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SELLING TWO-SIDED NETWORK GOODS (B,S)

cross-market network effects, intensity $\eta_b, \eta_s$

- agent hired to recruit side $S$ participants, paid based on $S$ sales

\[
Q_b = V_b + \eta_b Q_s + \epsilon_b \\
Q_s = V_s + \eta_s Q_b + \epsilon_s.
\]

- similar to network goods, agent works more, $w^* = \beta \frac{\alpha_1}{1-\eta_b \eta_s}$

and has more compensation risk, $= f(\eta_b, \eta_s)$

how to adjust commission rate and reward structure?
SELLING TWO-SIDED NETWORK GOODS: RESULTS

\[ \alpha_1^* = \frac{\beta^2}{\beta^2 + \rho \left( \sigma^2_s + \sigma^2_b \eta^2_s \right)}; \quad \Lambda_2^* = 2 \frac{(V_s + V_b \eta_s)(1 - \eta_b \eta_s)}{\beta^2} + \frac{2\beta^2}{\beta^2 + \rho \left( \sigma^2_s + \sigma^2_b \eta^2_s \right)} \]

- \( \eta_b \) behaves like \( \eta \) ! (no impact on \( \alpha_1^* \)) but \( \alpha_1^* \) varies with \( \eta_s \) to internalize externality (agent not rewarded for \( Q_b \) which \( \eta_s \) affects)
- high \( \eta_b \) is good for firm (like \( \eta \)), but high \( \eta_s \) may not be!
- \( \therefore \eta_s \) affects \( Q_b \), not accounted for in agent’s compensation

\[ \therefore \text{too many externalities, too few ways to manage the effects} \]
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TWO-SIDED INCENTIVES FOR TWO-SIDED GOODS?

- hire agent to recruit side $S$, but pay him also for $B$ sales!

$$\omega(q_s, q_b) = \alpha_0 + \alpha_1 q_s + \alpha_2 q_b; \quad w^* = \beta \frac{\alpha_1 + \alpha_2 \eta_b}{1 - \eta_b \eta_s}$$

- higher $\eta_b, \eta_s \Rightarrow$ higher commission rate; $\alpha_1^* = \frac{1}{(1-\eta_s \eta_b)(1+\rho \sigma_s^2)}$

- “pay to play” ... $\alpha_2^* = -\alpha_1^* \eta_s$

- firm is better off with stronger network effects (both $\eta_b$ and $\eta_s$)

second metric $\Rightarrow$ better tuning for multiple externalities
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MULTIPLE AGENTS FOR MULTIPLE TERRITORIES?

- agents \((i = 1, 2)\) exert indirect externality on each other, because participation is fueled by overall network size

\[
Q_i = V + \beta_i w_i + \eta (Q_1^e + Q_2^e) + \epsilon_i
\]

\[
Q_{si} = V_s + \eta_s Q_b + \beta_i w_i + \epsilon_{si}.
\]

- one-sided network goods: \(\eta\) does impact optimal commission rate (firm must use \(\alpha_1^*\) to manage externalities across agents)

- two-sided goods: \(\eta_b\) now impacts \(\alpha_1^*\)
### SUMMARY: IMPACT OF NETWORK EFFECTS ON DESIGN

<table>
<thead>
<tr>
<th></th>
<th>One Agent</th>
<th>Two Agents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traditional Good</strong></td>
<td>$\frac{\beta^2}{\beta^2 + \rho \sigma^2}$</td>
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</tr>
<tr>
<td><strong>Network Good</strong></td>
<td>$\frac{\beta^2}{\beta^2 + \rho \sigma^2}$</td>
<td>$\frac{\beta^2(1-\eta)}{\beta^2(1-\eta)^2 + \rho(1-2(1-\eta)\eta)\sigma^2}$</td>
</tr>
<tr>
<td><strong>Platform Good</strong></td>
<td>$\frac{\beta^2}{\beta^2 + \rho (\sigma_s^2 + \sigma_b^2 \eta_s^2)}$</td>
<td>$\frac{\beta^2(1-\eta b \eta_s)}{\beta^2(1-\eta b \eta_s)^2 + \rho (\sigma_s^2(1-\eta b \eta_s)^2 + \eta_s^2 (\sigma_s^2 \eta_b^2 + \sigma_b^2))}$</td>
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</table>

**optimal commission rate $\alpha_1^*$**
CONCLUSION AND GENERAL INSIGHTS

- network effects create externalities on selling outcomes and risks
- compensation plan design must account for network effects, in spectrum of ways depending on type of network good
- firm must deploy suitable number of incentives, and in suitable ways, to manage multiple externalities