

Selling Platforms

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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
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RESULTS AND INSIGHTS

- ▶ network effects exert externalities on sales agent: increase both mean and variance of sales (\Rightarrow 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; β =agent's productivity; $\epsilon \approx N(0, \sigma^2)$

- ▶ risk-averse agent, earns $\omega(w) = \alpha_0 + \alpha_1 Q$, picks effort level w^*

$$\left(\max. U(\omega(Q), w) = -e^{-\rho(\omega(Q) - C(w))} \geq R \right) \Rightarrow w^* = \beta \alpha_1$$

- ▶ firm designs (α_0, α_1) to max. $\mathbb{E}[\Pi] = \mathbb{E}[Q] - (\alpha_0 + \alpha_1 \mathbb{E}[Q])$

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

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SELLING ONE-SIDED NETWORK GOODS

direct network effects, intensity η

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

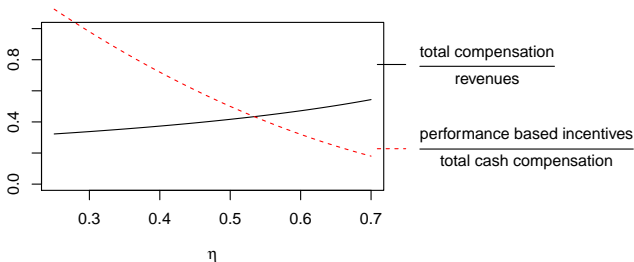
$$q = \frac{V + \beta w}{1 - \eta} + \frac{\epsilon}{1 - \eta}; \quad \eta \text{ increases mean AND volatility}$$

- ▶ η makes agent more productive, puts in more work, $w^* = \beta \frac{\alpha_1}{1 - \eta}$ and has more compensation risk, $Var(\omega(q)) = \alpha_1^2 \frac{\sigma^2}{(1 - \eta)^2}$

how to adjust commission rate and reward structure?

SELLING NETWORK GOODS: RESULTS

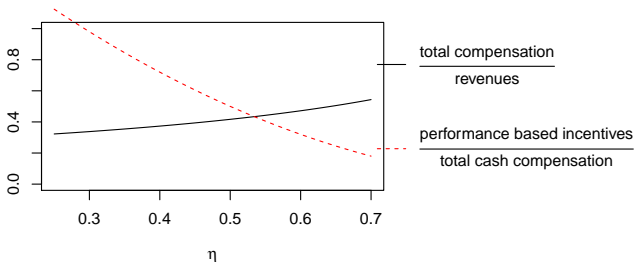
- ▶ η has no effect on commission rate, $\alpha_1^* = \frac{\beta^2}{\beta^2 + \rho\sigma^2}$
 - ∴ costs (risk-disutility) and gains (compensation) both $\approx \frac{\alpha_1^2}{(1-\eta)^2}$
- ▶ firm takes more risk; more of agent's compensation as fixed salary



- ▶ yet gives agent a greater share of earnings (... net profit increases)

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SELLING TWO-SIDED NETWORK GOODS (B,S)

cross-market network effects, intensity η_b, η_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

$$\alpha_1^* = \frac{\beta^2}{\beta^2 + \rho(\sigma_s^2 + \sigma_b^2 \eta_s^2)}; \quad \Lambda_2^* = 2 \frac{(V_s + V_b \eta_s)(1 - \eta_b \eta_s)}{\beta^2} + \frac{2\beta^2}{\beta^2 + \rho(\sigma_s^2 + \sigma_b^2 \eta_s^2)}$$

- ▶ η_b behaves like η ! (no impact on α_1^*) but α_1^* varies with η_s to internalize externality (agent not rewarded for Q_b which η_s affects)
- ▶ high η_b is good for firm (like η), but high η_s may not be!
∴ η_s affects Q_b , not accounted for in agent's compensation

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 η_b and η_s)

second metric \Rightarrow better tuning for multiple externalities

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MUTLIPLE 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: η does impact optimal commission rate (firm must use α_1^* to manage externalities across agents)
- ▶ two-sided goods: η_b now impacts α_1^*

SUMMARY: IMPACT OF NETWORK EFFECTS ON DESIGN

	One Agent	Two Agents
Traditional Good	$\frac{\beta^2}{\beta^2 + \rho\sigma^2}$	$\frac{\beta^2}{\beta^2 + \rho\sigma^2}$
Network Good	$\frac{\beta^2}{\beta^2 + \rho\sigma^2}$	$\frac{\beta^2(1-\eta)}{\beta^2(1-\eta)^2 + \rho(1-2(1-\eta)\eta)\sigma^2}$
Platform Good	$\frac{\beta^2}{\beta^2 + \rho(\sigma_s^2 + \sigma_b^2\eta_s^2)}$	$\frac{\beta^2(1-\eta_b\eta_s)}{\beta^2(1-\eta_b\eta_s)^2 + \rho(\sigma_s^2(1-\eta_b\eta_s)^2 + \eta_s^2(\sigma_s^2\eta_b^2 + \sigma_b^2))}$

optimal commission rate α_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