

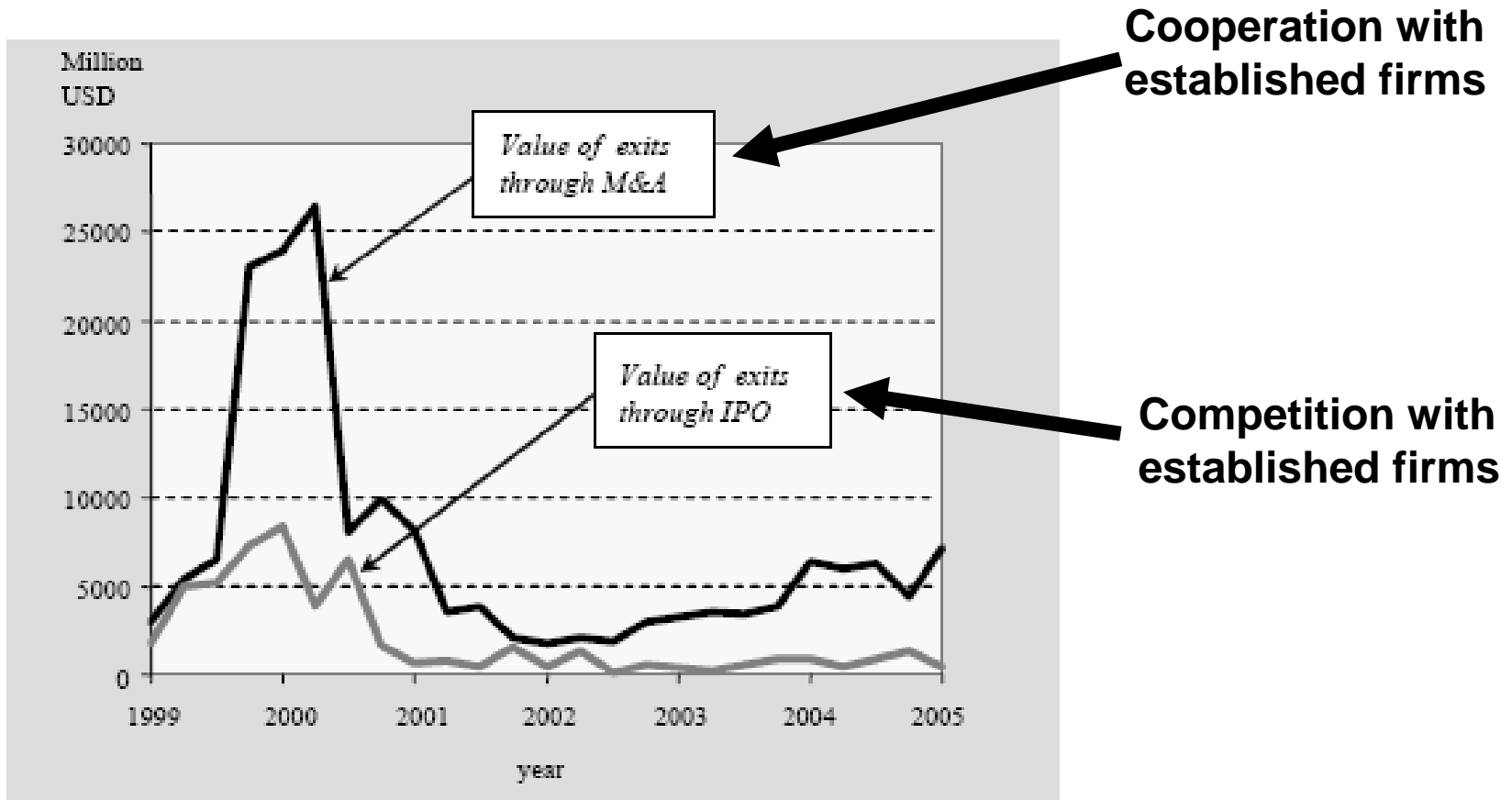
Start-Up Commercialisation Strategy and Innovative Dynamics

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Sources of Entrepreneurial Rents



Source: Thomson Venture/NVCA

Longevity of Entrepreneurial Influence

- Static rationale for cooperative commercialisation is strong
 - Avoid duplication of complementary assets
 - Soften product market competition
- Informal strategic concern (esp in teaching cases):
 - EMI & the CT Scanner: “licensing would be ... ‘selling our birthright.’”
 - Nucleon: licensing was viewed as ‘mortgaging away’ the company’s future.
 - Ecton: “Cannon was also concerned about the impact that an acquisition might have on Ecton’s product development process... The Ecton founders were worried that if their company were absorbed into a larger organization after acquisition, their development efforts for next-generation products would get mired ... Perhaps, they reasoned, their efforts would be more successful in the long run if they remained independent until they had a refined product development process that might survive acquisition and integration.”
 - Symantec: entrepreneurs seen as a casualty of the acquisition
- Informal economic reaction:
 - No problem. Then, start-up should build future losses into the ‘price’
- Formal evaluation
 - Requires a dynamic model of successive innovation

Technological Dynamics

- Most models of innovation and ideas markets are static
 - Roles of firms in an industry is fixed
 - Single innovation race
- Dynamics – on-going innovation races
 - Entrants come in and may become incumbents
 - Incumbents protect against entrants
 - Licensing may preserve roles in equilibrium but not off the equilibrium path

Segal-Whinston (AER, forth)

- Model of dynamic technological competition
 - SW apply to antitrust practices
 - SW consider entrants as competing and displacing incumbents – on-going change
- Here, two modifications
 - Incorporate ideas markets
 - Allow for multiple innovators
 - Model dynamic capabilities (firms may not be long-lived)

Entrepreneurial Options

- Suppose E successfully innovates. What can E do?
 - **Compete**: involves some intense competition before displacing established firm
 - **Integrate**: no competition and E becomes an employee of the established firm
 - **Sell-Out**: sell the current innovation and E goes back to potentially innovate again

Model Set-Up

- Technology
 - Sequential innovations – new product generations displacing old
 - Old generations provide competitive discipline
- Innovator selection
 - Innovator with the capability to invest towards the next generation is selected from a pool comprising an infinite number of potential start ups and also the firms active in the market for the previous generation.
 - If a start-up is selected, it becomes the entrant (E). It chooses ϕ_E (the probability of innovating in the current period) at a cost, $c(\phi_E)$.
 - If current incumbent is selected, there is no entry. The incumbent chooses ϕ_I (the probability of innovating in the current period) at a cost, $c(\phi_I)$.
- Firms
 - Incumbent (I) current patent holder of leading tech generation and has advantage in commercialising next gen. Earns per period profits of Π and a ‘bump’ to those profits of Δ if it innovates.
 - Common discount rate is δ
 - If it innovates, to compete, E needs to sink costs (f) and earns π before getting Π thereafter (then E becomes the incumbent and has an advantage in commercialising the next generation).
 - The incumbent’s profits are reduced to π (for the current period) but commercialisation advantage transfers to the entrant (who is relabeled I).
 - Assume that entry is credible ($\pi > f$) and that $2\pi < \Pi$.

Commercialisation Options

- If it innovates, E has to option to give I an exclusive license and commit not to compete.
 - Modeled using Nash bargaining over τ , the once-off payment to E .
 - E returns to the pool of potential innovators for the next generation while I remains the incumbent and preserves advantages.
- If E chooses to compete, then it becomes the incumbent (I) for the next generation
 - Both return to the pool of potential innovators and may become the next innovator.

Dynamic Capabilities

- What happens to a displaced incumbent or paid-off entrant
 - Static models: assume exits
 - SW: incumbent takes on the entrant role for the next generation
- Parameterise this:
 - σ_p is the probability that a displaced incumbent becomes the entrant. If not, a new firm enters.
 - σ_i is the probability that an entrant who licenses continues as the entrant. If not, a new firm enters.
 - σ_{ip} is the probability that an incumbent who has produced and innovated in the previous period, becomes the innovator. If not, a new firm enters.
- Higher probability implies a stronger dynamic capability (ability to transition between technological generations) – see Teece, Pisano and Shuen (1997)

No Licensing Case

- Continuation Payoffs

$$V_I = (1 - \phi_E)(\Pi + \delta V_I) + \phi_E(\pi + \sigma_p \delta V_E)$$

$$V_I^i = (1 - \phi_I)(\Pi + \delta V_I^i) + \phi_I(\Pi + \Delta + \sigma_{ip} \delta V_I^i + (1 - \sigma_{ip}) \delta V_I) - c(\phi_I)$$

$$V_E = (1 - \phi_E) \delta V_E + \phi_E(\pi - f + \sigma_i \delta V_I^i + (1 - \sigma_i) \delta V_I) - c(\phi_E)$$

Equilibrium

Decompose innovation choice:

- Innovation prize (IB)

$$W_E = \pi - f + \delta \left(\sigma_i V_I^i + (1 - \sigma_i) V_I - V_E \right)$$

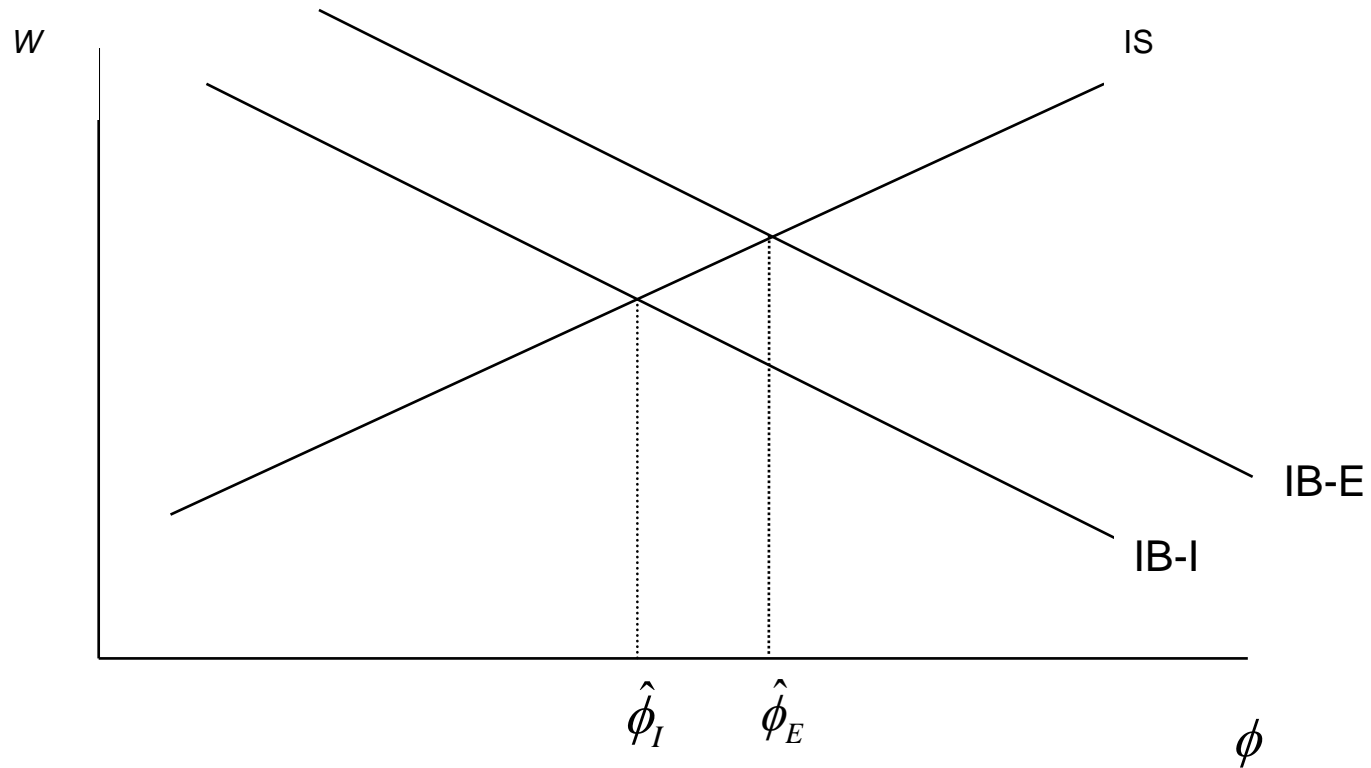
$$W_I = \Delta - (1 - \sigma_{ip}) \delta \left(V_I^i - V_I \right)$$

- Innovation supply (IS)

$$\phi \in \arg \max_{\phi \in [0,1]} \{ \phi W - c(\phi) \}$$

Equilibrium under Competition

Figure One: Equilibrium under Competition



Gains from Trade

| | E | I |
|-----------|--|---|
| Compete | $\pi - f + \sigma_i \delta V_I^i$ $+(1 - \sigma_i) \delta V_I$ | $\pi + \sigma_p \delta V_E$ |
| Integrate | price | $\Pi - \text{price} + \sigma_{pi} \delta V_I^i$ $+(1 - \sigma_{ip}) \delta V_I$ |
| Sell-Out | $\tau + \sigma_i \delta V_E$ | $\Pi - \tau + \sigma_p \delta V_I^i$ $+(1 - \sigma_p) \delta V_I$ |

Licensing Case

- Gains from trade from licensing if:

$$\underbrace{\Pi - \tau + \sigma_p \delta V_I^i + (1 - \sigma_p) \delta V_I + \tau + \sigma_i \delta V_E}_{\text{Joint Payoff from Cooperation}}$$

$$\geq \underbrace{\pi + \sigma_p \delta V_E + \pi - f + \sigma_i \delta V_I^i + (1 - \sigma_i) \delta V_I}_{\text{Joint Payoff from Competition}}$$

$$\Pi - (2\pi - f) \geq (\sigma_i - \sigma_p) \delta (V_I^i - V_E - V_I)$$

$$V_E > V_I^i - V_I$$

Licensing Case

- If $\sigma_i < \sigma_p$, may not be positive
 - E.g.: $\sigma_i = 0$, $\sigma_p = 1$; then neither party earns δV_E by signing a licensing agreement; this confers a positive externality on a third party
 - If $\delta V_E > \Pi - 2\pi + f$; overall gain will not be positive
- V_E is endogenous so need to solve for it under licensing
 - Use the Nash bargaining solution (E bargaining power of γ)

$$\tau = \Pi\gamma + (2\pi - f)(1 - \gamma) + \delta(V_I - (\sigma_E(1 - \gamma) + \sigma_I\gamma)V_E)$$

Licensing Case

- Continuation Payoffs

$$V_I = \Pi + \delta V_I + \phi_E \left(\tau + \sigma_p \delta (V_I^i - \delta V_I) \right)$$

$$V_I^i = (1 - \phi_I)(\Pi + \delta V_I^i) + \phi_I (\Pi + \Delta + \sigma_{ip} \delta V_I^i + (1 - \sigma_{ip}) \delta V_I) - c(\phi_I)$$

$$V_E = (1 - \phi_E) \delta V_E + \phi_E (\tau + \sigma_i \delta V_E) - c(\phi_E)$$

Equilibrium

Decompose innovation choice:

- Innovation prize (IB)

$$W_E = \tau - (1 - \sigma_i) \delta V_E$$

$$W_I = \Delta - (1 - \sigma_{ip}) \delta (V_I^i - V_I)$$

- Innovation supply (IS)

$$\phi \in \arg \max_{\phi \in [0,1]} \{ \phi W - c(\phi) \}$$

Will Licensing Occur?

- Proposition 1: Licensing is an equilibrium outcome if:
 - (i) $\sigma_i \geq \sigma_p$
 - (ii) δ is sufficiently small
 - As $\sigma_p - \sigma_i$ and δ each approach 1, licensing is not an equilibrium outcome and competition occurs.
- Licensing is not an equilibrium when expected entrant profits are high but the probability that the current entrant remains is low
 - Not so much the value of the birthright being high for E but for a new player.
- Bargaining power: as γ approaches 1, $V_I > 0$
 - Prior to innovation, the incumbent captures monopoly rents, so observationally is cash flow positive
 - However, more profitable to be E than I

Acquisition

- Gains from trade

$$\underbrace{\Pi - \tau + \sigma_{pi} \delta V_I^i + (1 - \sigma_{ip}) \delta V_I + \tau}_{\text{Joint Payoff from Cooperation}}$$
$$\geq \underbrace{\pi + \sigma_p \delta V_E + \pi - f + \sigma_i \delta V_I^i + (1 - \sigma_i) \delta V_I}_{\text{Joint Payoff from Competition}}$$

$$\Pi - (2\pi - f) \geq \sigma_p \delta V_E - (\sigma_{ip} - \sigma_i) \delta (V_I^i - V_I)$$

Licensing vs Acquisition

- Acquisition is preferred to licensing if:

$$(\sigma_{ip} - \sigma_p)(V_I^i - V_I) \geq \sigma_i V_E$$

Future Research

- IP practices
 - Impact of cumulative innovation
 - Minimum inventive step
 - Disclosure requirements
 - Experimental use
 - Protection from expropriation
- Strength of IP (may reduce innovation)
- Role of bargaining on scientific/academic innovation