Extending Sutton's "Bounds": A Model of Endogenous Market Structure, Innovation, and Licensing

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Motivation

- Anand and Khanna (2000)
  - Licensing and cross-licensing constitute 20-33% of all strategic alliances in R&D-intensive sectors
- Sutton (1998; 2007)
  - Endogenous fixed cost (EFC) model of market structure and innovation
  - Lower bound to industry concentration and R&D-intensity in industries characterized by quality-differentiated products and fixed costs in R&D

Objectives

- Combine and extend two veins of literature:
  - Relationship between market structure and incentives to innovate allowing for strategic alliances
  - Incentives to license technology in a fully endogenous framework
- Secondary contributions:
  - Heterogeneous firms (in R&D costs parameters)
  - Mixed models of vertical (quality) and horizontal (attributes) differentiation
  - Multiproduct competition (to a lesser extent)

Primary Findings

- Lower Bound to Concentration:
  - Given a feasible lump-sum royalty payment, the lower bound to concentration under licensing converges to a strictly greater bound
- Lower Bound to R&D-Intensity:
  - The lower bound to the R&D/sales ratio of the firm offering the market-leading level of quality, is greater than the lower bound to market concentration

K

Model Setup

- Definitions:
  - Industry consisting of K submarkets with quantity x_k and quality u_k
  - Each good consists of a set of attributes with associated competencies v_m such that overall quality is given by $u_k=f(v_1,\ldots, v_m,\ldots, v_{M^k})$
  - The set of qualities that a Firm i produces across products is $\mathbf{u}_i$ such that the set of qualities across all firms in equilibrium is given by a configuration $\mathbf{u}$

Model Setup

- Fixed (sunk) R&D Costs:

$$F(v_{im}) = F_0 {v_{im}}^{\beta_i}, \quad \beta_i \geq 2 \; \forall i.$$

- Fixed (sunk) Licensing Costs:

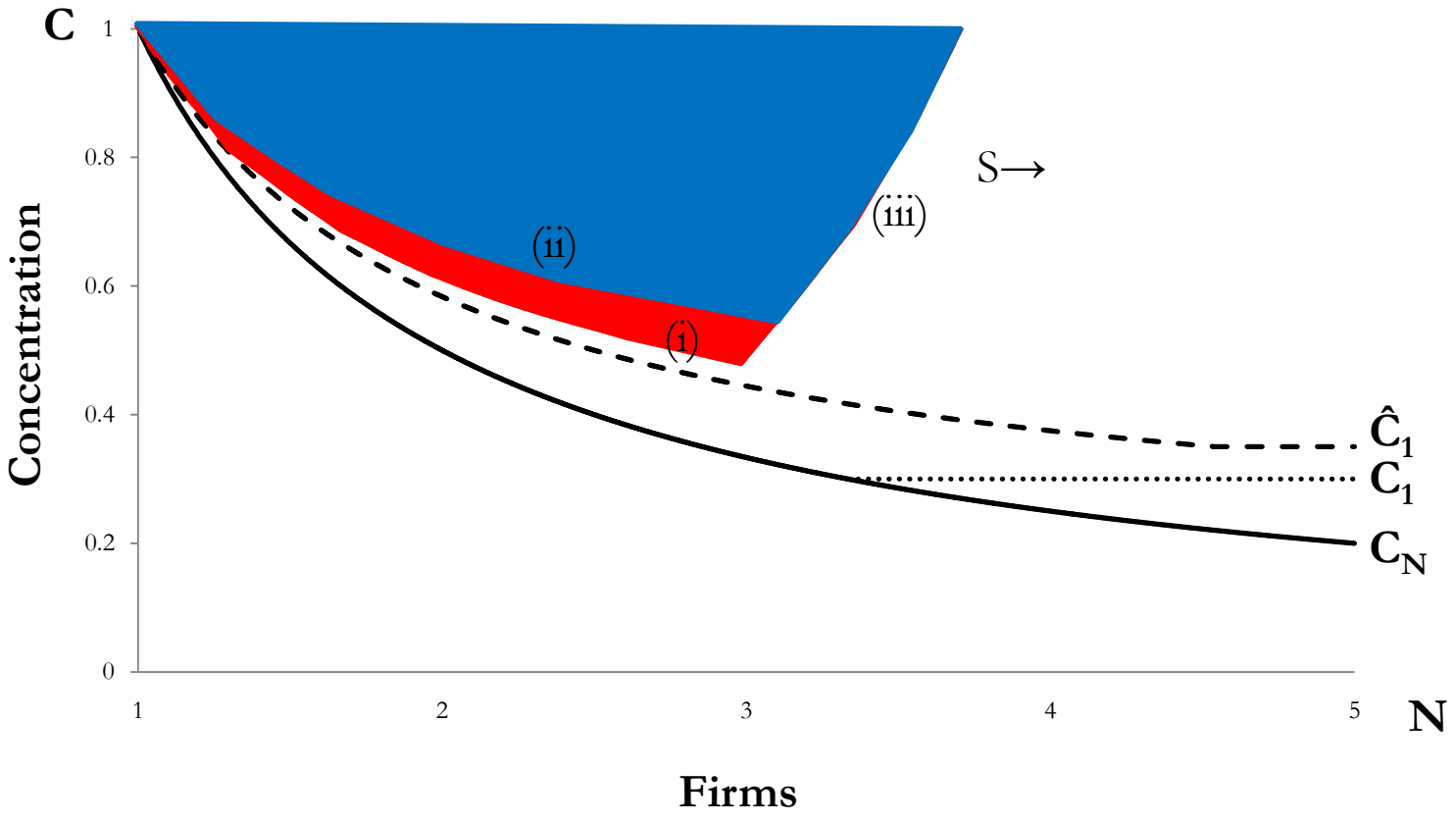
$$T(v_{jm}) = T_0 + P_{im}^{j} + F\left((1-\delta)v_{jm}\right)$$
$$= T_0 + \rho(v_{jm}) S \sum_{k \in I_m} r_{ik}(\mathbf{\acute{u}}) + F_0 (1-\delta)^{\beta_i} v_{jm}^{\beta_i}.$$

Equilibrium Configurations

- Viability Conditions: "Survivorship Principle"
  - No Licensing: $S\pi(\hat{u}|\mathbf{u}) - F^L(\hat{v}) - \sum_{m\neq n} F^L(v_m) \geq 0.$
  - Licensor: $[1 + L^n\rho(\hat{v}')\gamma_n]S\pi(\hat{u}'|\acute{\mathbf{u}}) - F^L(\hat{v}') - \sum_{m\neq n} F^L(v_m) \geq 0,$
  - Licensee: $[1 - \rho(\hat{v}')\gamma_n]S\pi(\hat{u}'|\acute{\mathbf{u}}) - \sum_{m\neq n} F^H(v_m) - \left[1 - (1-\delta)^{\beta^H}\right]F_0\hat{v}'^{\beta^H} - T_0 \geq 0,$
- Stability Conditions: "(No) Arbitrage Principle"
  - No Licensing: $S\pi(\kappa\hat{u}|\mathbf{u}) - F^L(\kappa\hat{v}) - \sum_{m\neq n} F^L(v_m) \leq 0, \quad \forall\kappa > 1.$
  - Licensor: $[1 + L^n\rho(\kappa\hat{v}')\gamma_n]S\pi(\kappa\hat{u}'|\acute{\mathbf{u}}) - F^L(\kappa\hat{v}') - \sum_{m\neq n} F^L(v_m) \leq 0, \quad \forall\kappa > 1,$
  - Licensee: $[1 + L^n\rho(\kappa\hat{v}')\gamma_n]S\pi(\kappa\hat{u}'|\acute{\mathbf{u}}) - \rho(\hat{v}')\gamma_n S\pi(\hat{u}'|\acute{\mathbf{u}}) - \sum_{m\neq n} F^H(v_m)$
    $-\kappa^{\beta^H}\left[1 - (1-\delta)^{\beta^H}\right]F_0\hat{v}'^{\beta^H} - T_0 \leq 0, \quad \forall\kappa > 1.$

Equilibrium Configurations

Figure 1: Equilibrium Configurations



Lower Bound to Concentration under Licensing

- Define: $\acute{a}(\kappa) \equiv \inf_{\acute{\mathbf{u}}} \frac{\pi(\kappa \hat{u}' | \acute{\mathbf{u}})}{r(\acute{\mathbf{u}})}.$

- Royalty payment: $\rho(\hat{v}') \geq \frac{1}{\gamma_n} \left[\frac{\kappa^{\beta^H} - \kappa^{\beta^L}}{\kappa^{\beta^L} L^n + \kappa^{\beta^H} - 1} \right], \forall \kappa \geq 1,$

- Lower Bound to Industry Concentration under Licensing:

$$\frac{\acute{a}(\kappa)}{\kappa^{\beta^H}} \cdot \left[\frac{1 + L^n \gamma_n \rho(\kappa \hat{v}')}{1 - \left(\frac{\kappa^{\beta^H} - 1}{\kappa^{\beta^H}} \right) \gamma_n \rho(\hat{v}')} \right] + \left(\frac{\kappa^{\beta^H} - 1}{\kappa^{\beta^H}} \right) \left[\frac{\sum_{m \neq n} F^H(\overline{v}_m) + T_0}{\left[1 - \left(\frac{\kappa^{\beta^H} - 1}{\kappa^{\beta^H}} \right) \gamma_n \rho(\hat{v}') \right] Sr(\acute{\mathbf{u}})} \right].$$

Lower Bound to R&D-Intensity under Licensing

- Define: $$\acute{\alpha} \equiv \sup_{\kappa} \frac{\acute{a}(\kappa)}{\kappa^{\beta^H}} \cdot \left[\frac{1 + L^n \gamma_n \rho(\kappa \hat{v}')}{1 - \left(\frac{\kappa^{\beta^H} - 1}{\kappa^{\beta^H}} \right) \gamma_n \rho(\hat{v}')} \right].$$

- Lower Bound to R&D-Intensity under Licensing:

$$\acute{\alpha} \kappa^{\beta^H - \beta^L} \left[1 - \left(\frac{\kappa^{\beta^H} - 1}{\kappa^{\beta^H}} \right) \gamma_n \rho(\hat{v}') \right], \forall \kappa > 1.$$

Conclusion

- Analysis of licensing agreements and anticompetitive behavior should distinguish between industry characteristics
- Welfare (consumer) effects are ambiguous
  - Increased concentration: "Bad"
  - Increased R&D-intensity: "Good" (Both higher quality and more differentiated goods)
  - Ambiguous change in total industry R&D

Thanks!

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