# Patent Pools & Product Development: Perfect Complements Revisited

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[1]The views expressed are those of the authors. They are not purported to reflect the views of the U.S. Department of Justice.

# The Recent Debate

## The "Patent Thicket" and Stifled Innovation

- In particular in
  - business methods
  - software
  - electronics
  - bio-tech
- calls for the abolition of IP in these areas
- calls for increased cross-licensing and **patent pooling**

# Patent Pools

**Definition (Patent Pool)**

A collection of distinct patents held by separate entities that are pooled for purposes of joint licensing.

# Historical Background in the U.S.

- 1856: 1st patent pool (sewing machines)
- 1902: E. Bement & Sons v. National Harrow Co.
  - freedom of contract: "patent law trumps antitrust law"
- 1912: Standard Sanitary Mfg. v. U.S. ("the bathroom trust")
  - beginning of antitrust scrutiny of pool practices
- 1915: MPPC ("Edison Trust" of 1908)
  - found in violation of Sherman Act
- 1929–: Standard Oil Co. v. U.S. and subsequent case law
  - "blocking patents"
  - complements v. substitutes (viz. "competing" patents)

# Conventional Wisdom

Cournot-Shapiro (1838/2001) argument for perfectly complementary patents:

1. Independently set royalty rates for perfectly complementary inputs leads to (horizontal) double-marginalization (a.k.a. royalty stacking), reducing consumer and producer surplus.
2. Internalizing the pricing externality by pooling increases welfare.

# Incompleteness of Patents

Previous literature on patent pooling:

- access to IP is sufficient for entering downstream market
- product market is either monopolized or perfectly competitive

In contrast to the stylized models, patents are **incomplete** inputs in product development:

- further development is often necessary before commercialization can take place, and
- the nature of product market competition feeds back into the development process

# A More Complete Picture

Our aim is to develop a more comprehensive model with which to

1. revisit the conventional wisdom in light of subsequent development and commercialization
2. evaluate how pooling may affect subsequent development and commercialization
3. determine when pooling may not be desirable, even when patents are perfect complements

# Set-Up

1. Two upstream patent holders with
   - perfectly complementary patents
   - who need to decide on pool formation

2. Two downstream developer/retailers
   - have differentiated products & compete in prices

$$P_i = A_i - Q_i - \gamma Q_j, \quad \text{degree of prod. diff.: } \gamma \in (0,1)$$

   - which require initial (non-cooperative) development efforts

$$A_i = a + e_i + \beta e_j, \quad \text{extent of spillovers: } \beta \in (0,1)$$

# Costs

No production costs, only licensing costs:

1. **Fees** (treated as fixed costs)
   hence: the incentive to pool is tied to market profit
2. **Royalties** (common form of licensing)

$$\begin{aligned} \text{Pool:} \quad & R_p \times 2Q(R_p)^* && \Longrightarrow \quad R_p^* = \tfrac{a}{2} \\ \text{No Pool:} \quad & r_k \left(Q_i(r_k + r_l)^* + Q_j(r_k + r_l)^*\right) && \Longrightarrow \quad r^* = \tfrac{a}{3}. \end{aligned}$$

$$R_p^* = \frac{1}{2}a < \frac{2}{3}a = 2r^* = R_n^*$$

Theorem (Generalized Conventional Wisdom)

*Pooling increases all measures of welfare when there are royalty contracts, even when products are differentiated and there are are spillovers in development:*

$$W_p > W_n, \qquad \forall \gamma, \beta \text{ and } W \in \{CS, \Pi, V, TW\}$$

The Generalized Conventional Wisdom holds, provided that pooling doesn't affect spillovers or differentiation.

# Patents and Tacit Knowledge

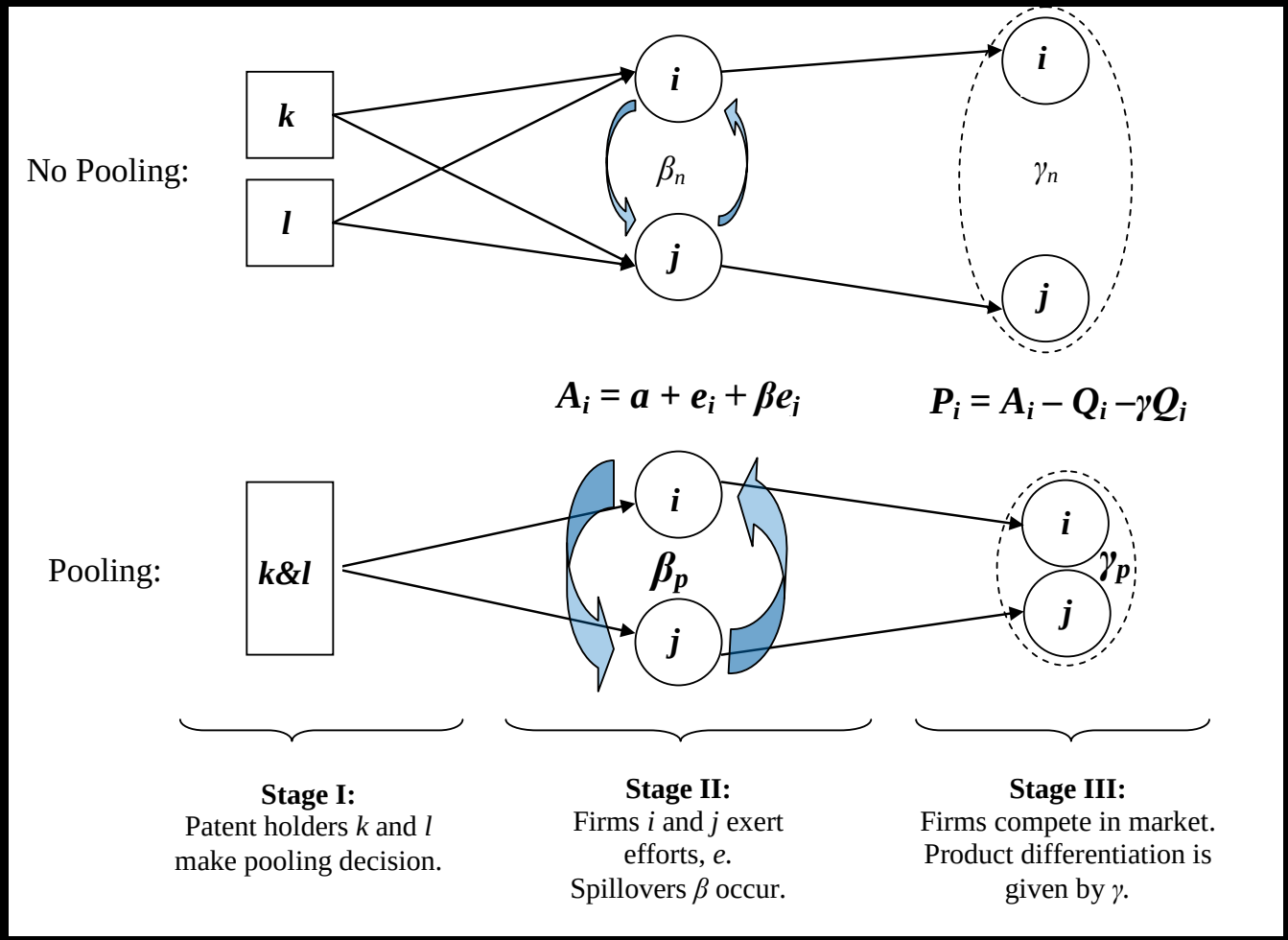
- Many patents are tied to '**tacit knowledge**' (human capital) that is not automatically disclosed and may not be fully revealed in a licensing process
- This leads to possible collaboration between IP-holders and developers, constituting knowledge transfer
- Knowledge transfer may be augmented by pool formation

# The Impact of Pooling on Development and Product Differentiation

Patent pools can, thus, be viewed as information sharing institutions.

- Spillover Effects:
  - Pooling increases spillovers in development: $\beta_p > \beta_n$.
- Differentiation Effects:
  - Pooling increases product homogeneity: $\gamma_p > \gamma_n$.

# The Structure of Innovation and Competition



# Spillover Effects

Equilibrium effort is increasing in the amount of spillovers if products are strongly differentiated, but decreasing if products are similar.

$$\frac{de^*}{d\beta} \gtreqless 0 \quad \Longleftrightarrow \quad \gamma \lesseqgtr \mathcal{S}_e.$$

When products are sufficiently homogenous, increased spillovers reduce the market size.

$$\frac{dA^*}{d\beta} \gtreqless 0 \quad \Longleftrightarrow \quad \gamma \lesseqgtr \mathcal{S}_A.$$

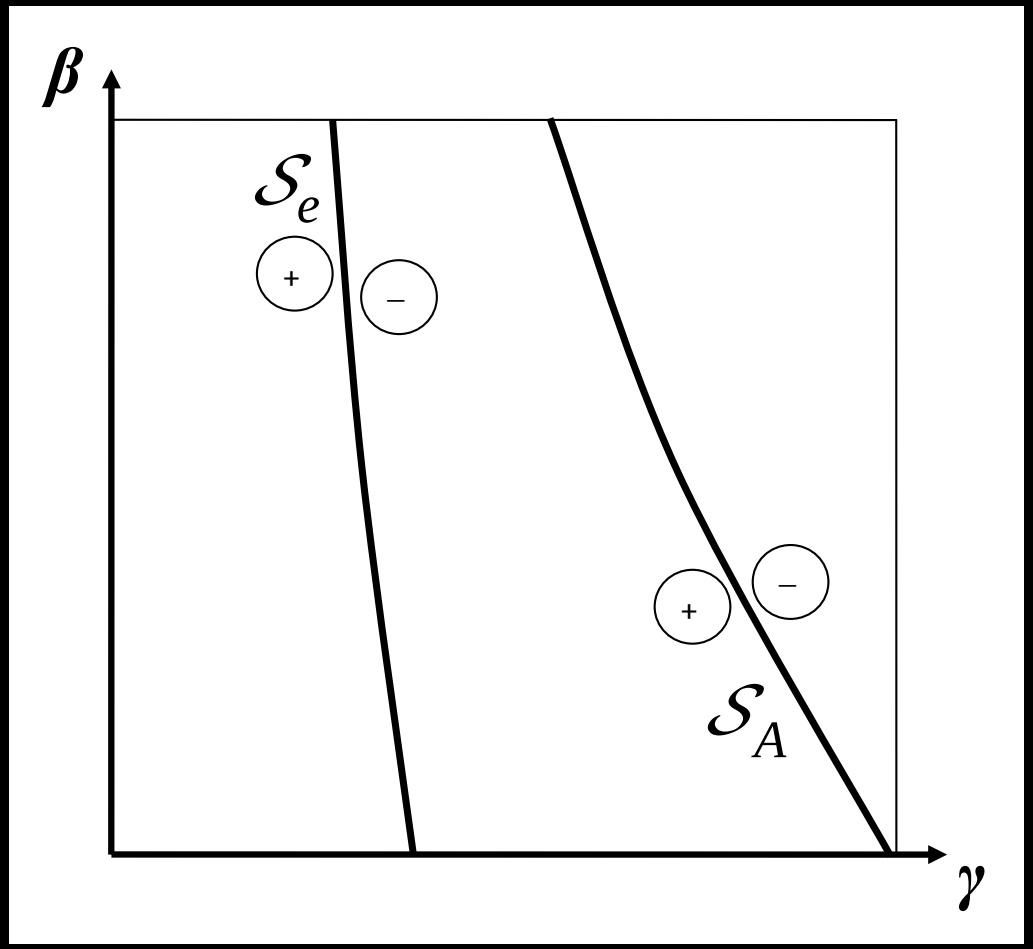



Figure: Impact of the Spillover Effect on Effort and Market Size

If products are sufficiently homogenous, then the spillover effect can make pooling undesirable:

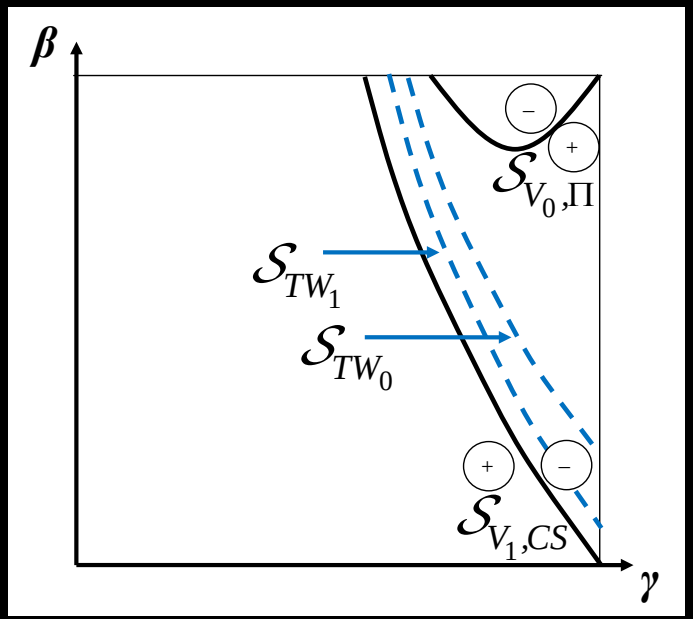



Figure: Impact of the Spillover Effect on Payoffs

Note subscripts: $1 \rightarrow R, 0 \rightarrow F$

# Differentiation Effects

Equilibrium effort, and hence equilibrium base market size, is decreasing in the degree of product homogeneity, *i.e.*,

$$\frac{de^*}{d\gamma} < 0 \qquad \Longrightarrow \qquad \frac{dA^*}{d\gamma} < 0, \qquad \forall \beta, \gamma.$$

Increases in the degree of product homogeneity adversely affect fee-charging patent-holders' and firms' interests. That is,

$$\frac{dV^*_{\mathbb{I}=0}}{d\gamma}, \frac{d\Pi^*}{d\gamma} \leq 0, \qquad \forall \beta, \gamma.$$

But consumers may benefit from the increased competition of reduced product differentiation:

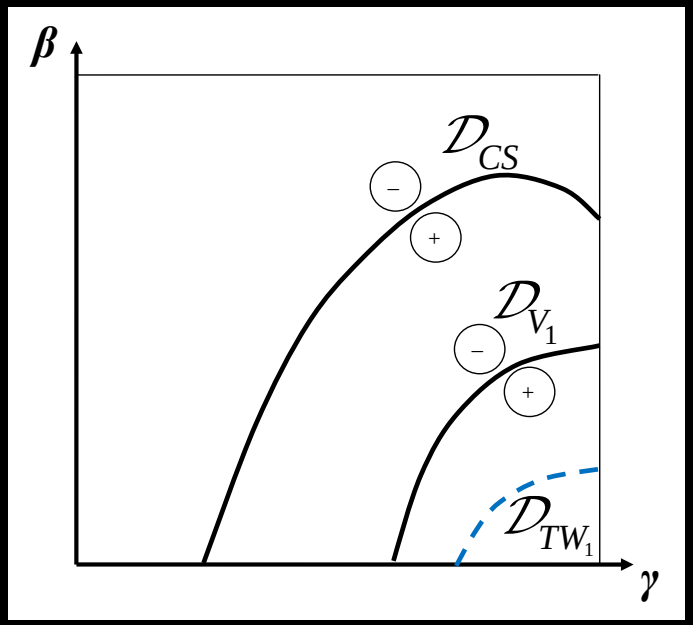



Figure: Impact of the Differentiation Effect on Royalty Revenue and Consumer Surplus

# Given Differentiation and Spillover Effects: Can Pooling of Perfectly Complementary Patents be Inefficient?

# Fees:

Theorem

*If the intrinsic degree of product differentiation is small (i.e., large $\gamma_n$); and spillovers in development are sufficiently high (large $\beta_n$), then firms, consumers, and patent holders are all worse off by the formation of a pool.*

But: Here patentholders/firms would never choose to pool

Pooling is undesirable, even for initially very differentiated goods, when spillover effects are small (*i.e.*, $\beta_n/\beta_p$ large) and differentiation effects are large (*i.e.*, $\gamma_n/\gamma_p$ small). In contrast, if differentiation effects are small, then all parties prefer the pooling outcome.

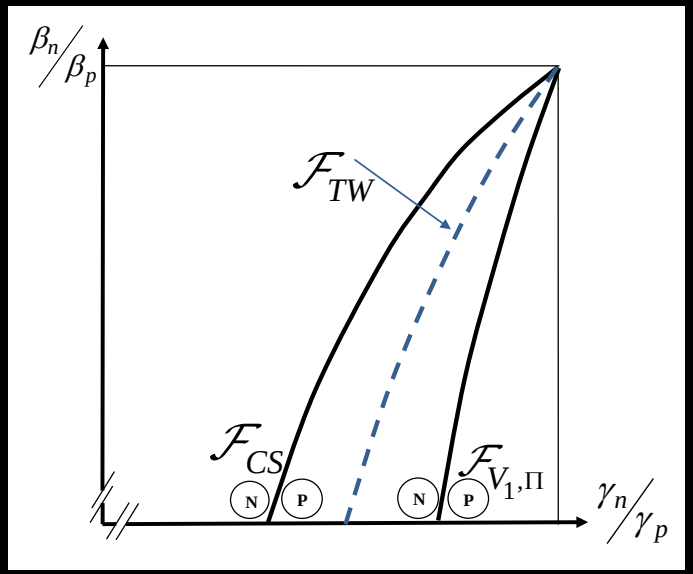



Figure: Pooling and Non-Pooling with Fees; $\beta_n = .7, \gamma_n = .2$.

**Note: Here, if firms pool, this is welfare increasing.**

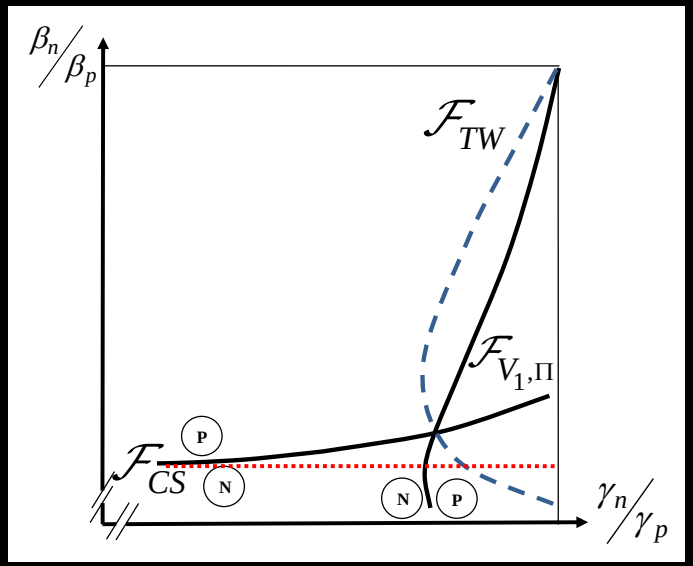



Figure: A Case of Profit-Maximizing Pooling that Reduces Total Welfare

Cause for policy concern:
Despite patents being perfect complements, there are constellations in which patent pools would be expected to form, yet pool formation is against the consumers' interests and also lowers total welfare.

# Royalties:

Theorem (Partial Corroboration of Cournot-Shapiro)

*Given per-unit-of-output royalties, the pooling of perfectly complementary patents always generate an increase in consumer surplus, i.e.,*

$$CS_p > CS_n, \quad \forall \beta_n, \beta_p, \gamma_n, \gamma_p.$$

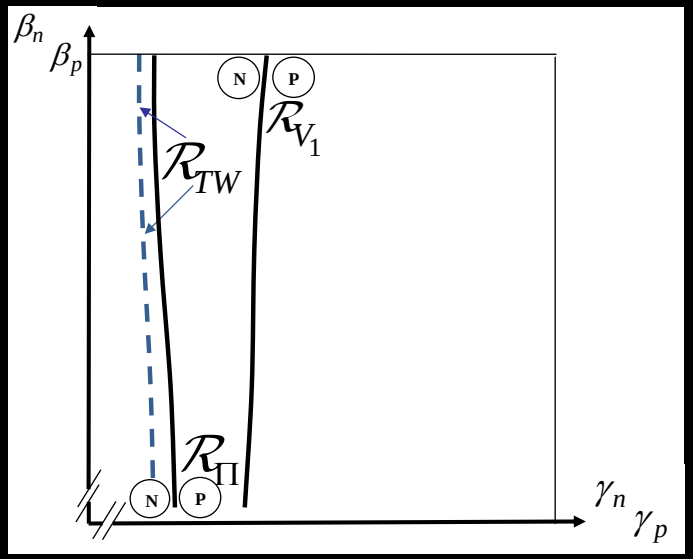



Figure: Reduction of Total Welfare due to Pooling with Royalties

Sufficient Condition for Efficient Pooling:
Since consumers always prefer pooling, a sufficient condition for efficient pooling is that industry desires to pool (in contrast to the example found with fees).

# Conclusion

- The notion of welfare-enhancing patent pools for perfectly complementary patents is a powerful one.
- However, once one considers how pooling may adversely affect subsequent development efforts, it becomes clear that the insight is not universal.
- This suggests that in some industries, notably bio-tech, patent pooling may not be as desirable as is often claimed.