Market Shares, R&D Agreements, and the EU Block Exemption

R. Ruble & B. Versaevel

emlyon business school & GATE (UMR #5824 CNRS)

"GlaxoSmithKline plc (GSK) and Pfizer Inc (PFE) today announced they have entered into an agreement to create a new world-leading HIV company focused solely on research, development and commercialization of HIV medicines. The new HIV business will (...) hold *a 19% share of the growing market* and have an industry-leading pipeline."

(Press Release, Thursday 16 April 2009, London UK & Philadelphia, US, added emphasis)

Objectives

We examine the theoretical economic basis for a market share criterion in the EU legislation on horizontal technological agreements whereby firms in the same industry coordinate their research and development (R&D) operations and restrict *de facto* inter-firm competition in the discovery of new products or processes.

Results Preview

In a model of R&D cooperation by a subset of firms in a oligopolistic industry:

- With R&D output spillovers, ruling out the agreements with a high combined market share can hinder desirable cases;

Results Preview

In a model of R&D cooperation by a subset of firms in a oligopolistic industry:

- With R&D output spillovers, ruling out the agreements with a high combined market share can hinder desirable cases;

- With R&D input spillovers, cooperation is more likely to benefit consumers at higher rather than at lower combined market shares;

Results Preview

In a model of R&D cooperation by a subset of firms in a oligopolistic industry:

- With R&D output spillovers, ruling out the agreements with a high combined market share can hinder desirable cases;

- With R&D input spillovers, cooperation is more likely to benefit consumers at higher rather than at lower combined market shares;

- We argue that existing theory does not support limiting "safe harbour" to low market shares.

The EU legislation

Article 101(1) of the Treaty on the Functioning of the European Union (TFEU, 2007):

> "The following shall be prohibited as incompatible with the internal market:

The EU legislation

Article 101(1) of the Treaty on the Functioning of the European Union (TFEU, 2007):

> "The following shall be prohibited as incompatible with the internal market:
>
> all agreements between undertakings, decisions by associations of undertakings and concerted practices which (...) have as their object or effect the prevention, restriction or distortion of competition within the internal market (...)."

The EU legislation

Regulation (EC) No 1217/2010 (substitute to No 2659/2000):

> "Article 101(1) of the Treaty shall *not* apply to research and development *only if*, at the time the research and development agreement is entered into (...) the combined market share of the parties to a research and development agreement does not exceed 25% on the relevant product and technology markets."

(article 4.2(a), added emphasis)

The EU legislation

Beyond the 25% market share it must be demonstrated that the R&D agreement:

(i) "contributes to improving the production or distribution of goods or to promoting technical or economic progress"

for Article 101(1) (i.e., prohibition) to be declared inapplicable.

$\rightarrow$ parties to the agreement bear the burden of proof (self assessment).

The EU legislation

Beyond the 25% market share it must be demonstrated that the R&D agreement:

(i) "contributes to improving the production or distribution of goods or to promoting technical or economic progress"

(ii) "while allowing consumers a fair share of the resulting benefit"

for Article 101(1) (i.e., prohibition) to be declared inapplicable.

$\rightarrow$ parties to the agreement bear the burden of proof (self assessment).

The EU legislation

Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements:

> "If the parties have a low combined market share, the horizontal cooperation agreement is unlikely to give rise to restrictive effects on competition within the meaning of Article 101(1) (paragraph 44)."

The EU legislation

Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements:

> "If the parties have a low combined market share, the horizontal cooperation agreement is unlikely to give rise to restrictive effects on competition within the meaning of Article 101(1) (paragraph 44)."

> "(...) the higher the market power of the parties the less likely they are to pass on the efficiency gains to consumers (...) (paragraph 143)."

Related literature (1/2)

"[T]he introduction of new methods of production and new commodities is hardly conceivable with perfect competition from the start. And this means that the bulk of what we call economic progress is incompatible with it." (Schumpeter, 1942, p. 105).

"[U]nless a firm has a substantial share of the market it has no strong incentive to undertake a large expenditure on development." (Galbraith, 1952, p. 92).

"[T]he incentive to invent is less under monopolistic than under competitive conditions (...)." (Arrow, 1962, p. 619).

Related literature (2/2)

More specialized approaches:

- Non-monotone relation between intensity of market competition and R&D investments (Gilbert *NBER* 2006; Vives *JIE* 2008)

- Cooperation in R&D can facilitate collusion in product market stage (Martin *EJPE* 1995; Cabral *IJIO* 2000)

- R&D cooperation vs. R&D competition (d'Aspremeont and Jacquemin *AER* 1988; Kamien, Muller, Zang *AER* 1992; Amir *IJIO* 2000; Amir et al. *GEB* 2003)

The model

All n ex-ante identical firms in $N = \{1, \ldots, n\}$, $n \geq 2$, have the same positive marginal cost of production c and face the same inverse demand

$$P = \sup\{0, a - Q\},$$

where $Q = \sum_{i \in N} q_i$ is the total quantity supplied (with $\alpha = a - c > 0$).

- subset $M = \{1, \ldots, m\}$: the "cooperating innovators" (superscript I),

- subset $N \setminus M$: the "outsiders" (superscript O), with $m \leq n$.

The model

Timing:

- stage 1 (R&D): firms in M choose cooperatively $x_j \geq 0$, $j \in M$,

- stage 2 (market): firms in N choose non-cooperatively $q_j \geq 0$, $j \in N$.

Technological spillovers:

- each firm in M receives fraction $\beta \in [0, 1]$,

- each firm in $N \setminus M$ receives fraction $\mu \in [0, \beta]$ ("imitation"),

of the R&D decisions of the firms in M.

The model

Effective R&D:

$$X^I_{j\in M} = x_j + \beta \sum_{i\in M\setminus\{j\}} x_i$$

$$\text{and} \quad X^O_{k\in N\setminus M} = \mu \sum_{j\in M} x_j$$

with $\mathbf{x} = (x_1, \ldots, x_m)$.

Net profit functions:

$$\pi^I_j(\mathbf{q}, \mathbf{x}) = \left[\alpha + f\left(X^I_j\right) - Q\right] q_j - g(x_j)$$

$$\text{and} \quad \pi^O_k(\mathbf{q}, \mathbf{x}) = \left[\alpha + f\left(X^O_k\right) - Q\right] q_k$$

with $\mathbf{q} = (q_1, \ldots, q_n)$, and $f' > 0$, $f'' \leq 0$, $g' > 0$, $g'' \geq 0$, $f(0) = g(0)$.

The model

In stage 2 (market):

Each firm i in N chooses q_i to maximize $\pi_i(q_i, \mathbf{q}_{-i}, \mathbf{x})$, given $\mathbf{q}_{-i}$ and $\mathbf{x}$, for Cournot-Nash quantities

$$q_j^*(\mathbf{x}) = \alpha + f\left(X_j^I\right) - Q^*(\mathbf{x}) \quad \text{and} \quad q_k^*(\mathbf{x}) = \alpha + f\left(X_k^O\right) - Q^*(\mathbf{x}),$$

all $j \in M$ and $k \in N \setminus M$, with

$$Q^*(\mathbf{x}) = \frac{n\alpha + \sum_M f\left(X_j^I\right) + \sum_{N\setminus M} f\left(X_k^O\right)}{n+1}$$

for each firm's concentrated profit $\pi_i^*(\mathbf{x}) = \pi_i(\mathbf{q}^*(\mathbf{x}), \mathbf{x})$, all i in N.

The model

In stage 1 (R&D):

- R&D competition: firms in M non-cooperatively choose their own x_j to maximize $\pi_j^* (\mathbf{x})$, for a symmetric Nash equilibrium

$$\mathbf{x}^{\mathrm{n}} = (x^{\mathrm{n}}, \ldots, x^{\mathrm{n}});$$

- R&D cooperation: firms in M cooperatively choose $\mathbf{x}$ to maximize $\Pi (\mathbf{x}) = \sum_{j \in M} \pi_j^* (\mathbf{x})$, for a symmetric optimum

$$\mathbf{x}^{\mathrm{c}} = (x^{\mathrm{c}}, \ldots, x^{\mathrm{c}}).$$

A simple condition

The stated motivation of the European regulation for encouraging the agreements that result in more R&D is to enhance consumer satisfaction, that we formalise as

$$CS(\mathbf{x}) = \frac{1}{2}\left[Q^*(\mathbf{x})\right]^2,$$

which is increasing in firms' R&D.

$\rightarrow$ condition for $x^c > x^n$?

A simple condition

The total derivative of joint profit is:

$$\mathrm{d}\Pi(\mathbf{x}) = \sum_{i \in M} \left[\frac{\partial \pi_i^*}{\partial x_i} \mathrm{d}x_i + \sum_{j \in M \setminus \{i\}} \frac{\partial \pi_i^*}{\partial x_j} \mathrm{d}x_j \right],$$

and evaluated at $\mathbf{x}^{\mathrm{n}}$:

$$\mathrm{d}\Pi(\mathbf{x})|_{\mathbf{x}=\mathbf{x}^{\mathrm{n}}} = \sum_{i \in M} \left[\underbrace{\left. \frac{\partial \pi_i^*}{\partial x_i} \right|_{\mathbf{x}=\mathbf{x}^{\mathrm{n}}}}_{=0} \mathrm{d}x_i + \sum_{j \in M \setminus \{i\}} \left. \frac{\partial \pi_i^*}{\partial x_j} \right|_{\mathbf{x}=\mathbf{x}^{\mathrm{n}}} \mathrm{d}x_j \right].$$

A simple condition

By symmetry:

$$\left.\frac{\mathrm{d}\Pi(\mathbf{x})}{\mathrm{d}x_j}\right|_{\mathbf{x}=\mathbf{x}^{\mathrm{n}}} = m(m-1)\underbrace{\left.\frac{\partial \pi_i^*}{\partial x_j}\right|_{\mathbf{x}=\mathbf{x}^{\mathrm{n}}}}_{\equiv\chi},$$

and the concavity of Π implies that $x^{\mathrm{c}} > (<)\, x^{\mathrm{n}}$ if and only if $\chi > (<)\, 0$.

Proposition 1

With "cooperating innovators" and "outsiders", R&D agreements raise consumer surplus if and only if the incentive to increase R&D is positive ($\chi > 0$).

Cooperation with R&D output spillovers (AJ)

d'Aspremont and Jacquemin (*AER*, 1988): x_j is a direct reduction in each firm j's marginal cost or own-demand price intercept.

The R&D production function f simplifies to

$$f\left(X_j^I\right) = x_j + \beta \sum_{i \in M \setminus \{j\}} x_i, \quad \text{and} \quad f\left(X_k^O\right) = \mu \sum_{j \in M} x_j,$$

all $j \in M$, $k \in N \setminus M$, and the R&D cost function is

$$g\left(x_j\right) = K + \frac{\gamma}{2} x_j^2,$$

all $x_j > 0$ (with $g\left(0\right) = 0$), where γ and K are positive.

Cooperation with R&D output spillovers (AJ)

The frontier $\chi_{\mathrm{AJ}}(s,\beta)=0$ is defined by the condition

$$\frac{2s}{m+s}\left[2\beta-1+m\left(\frac{1}{s}-1\right)(\beta-\mu)\right]=0$$

Proposition 2

With "cooperating innovators" and "outsiders", if spillovers are in R&D outputs, then:

(i) if spillovers are large enough ($\beta>1/2$), R&D agreements are desirable at all market shares ($\chi_{\mathrm{AJ}}(s,\beta)>0$), and

(ii) for a given number of cooperating firms, R&D is more likely to be desirable when the market share is small ($\partial\beta/\partial s|_{\chi_{\mathrm{AJ}}=0}\geq 0$).

Cooperation with R&D output spillovers (AJ)

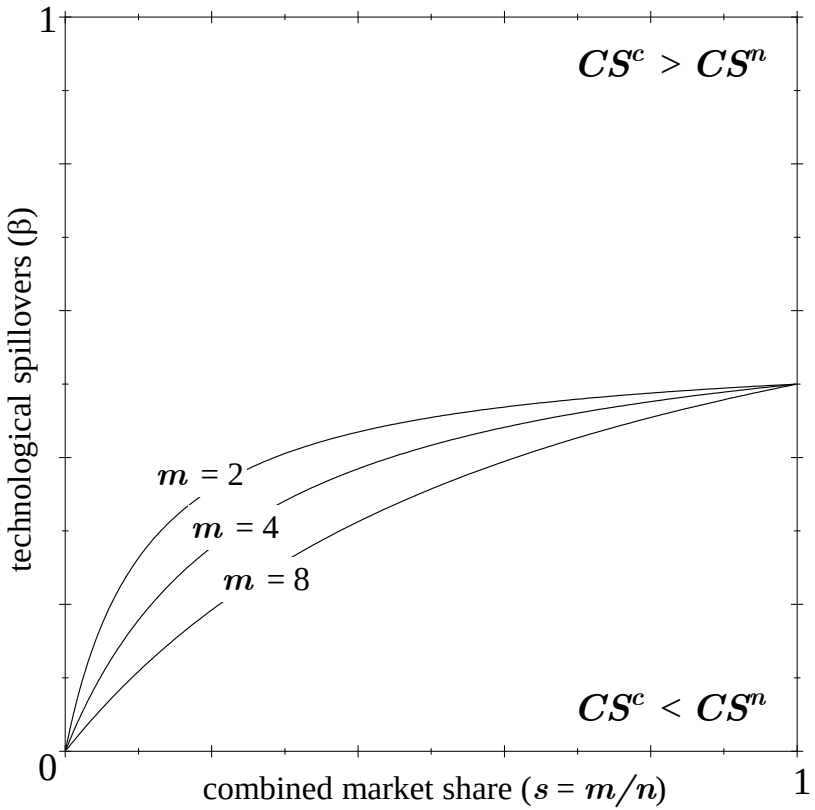

Figure 1: Frontiers $\chi_{\mathrm{AJ}} = 0$ in the plane (s, β). Above the frontiers, cooperation agreements are desirable, whereas below they are not (here for $\mu/\beta = 9/10$).

Cooperation with R&D input spillovers (KMZ & A)

Kamien, Muller, and Zang (*AER*, 1992) & Amir (*IJIO*, 2000): x_j is firm j's R&D expenditure measured in currency units.

The R&D production function f is

$$f\left(X_j^I\right) = \sqrt{\frac{2}{\gamma}\left(x_j + \beta \sum_{i \in M \setminus \{j\}} x_i\right)}, \quad \text{and} \quad f\left(X_k^O\right) = \sqrt{\frac{2}{\gamma}\mu \sum_{j \in M} x_j},$$

all $j \in M$, $k \in N \setminus M$, and the R&D cost function simplifies to

$$g\left(x_j\right) = x_j,$$

all $j \in M$.

Cooperation with R&D input spillovers (KMZ & A)

The frontier $\chi_{\mathrm{A}}(s,\beta)=0$ is defined by the condition

$$\frac{s}{m+s}\frac{1}{\sqrt{2\gamma X_j^I}}\left[2\beta-1+m\left(\frac{1}{s}-1\right)\left(\beta-\sqrt{\frac{((m-1)\beta+1)\mu}{m}}\right)\right]=0$$

Proposition 3

With "cooperating innovators" and "outsiders", if spillovers are in R&D inputs, then: (i) if spillovers are large enough ($\beta\approx 1$), R&D agreements are desirable at all market shares ($\chi_{\mathrm{A}}(s,1)>0$), and (ii) for a given number of cooperating firms, when the outsider effect is relatively strong (i.e., spillovers to outsiders are high, $\mu\geq\mu_0$) R&D is less likely to be desirable when the market share is small ($\partial\beta/\partial s|_{\chi_{\mathrm{A}}=0}\leq 0$).

Cooperation with R&D input spillovers (KMZ & A)

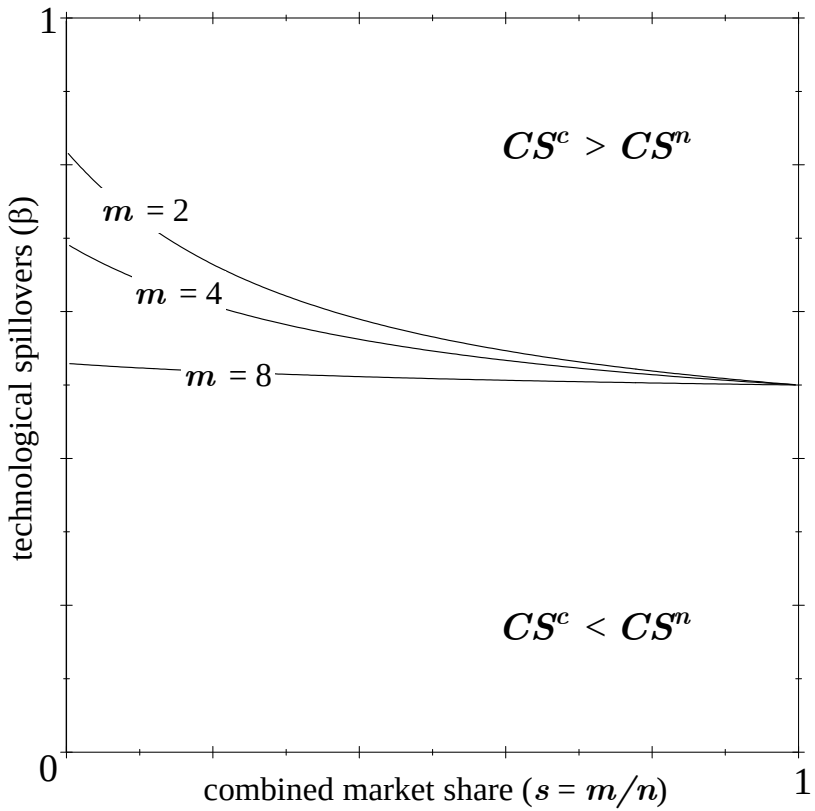

Figure 2: Frontiers $\chi_{\mathrm{A}} = 0$ in the plane (s, β). Above the frontiers, cooperation agreements are desirable, whereas below they are not (here for $\mu/\beta = 9/10$).

Extension

In Stage 1 firms in M ("insiders") cooperate in R&D while firms in $N \setminus M$ ("outsiders") compete in R&D, and in Stage 2 all firms behave as Cournot competitors in the product market, so effective R&D becomes:

$$X_j^I = x_j + \beta \sum_{M\setminus\{j\}} x_i + \mu \sum_{N\setminus M} x_k$$

$$\text{and} \quad X_k^O = x_k + \mu \sum_{N\setminus\{k\}} x_i,$$

with $\beta \in [0,1]$ and $\mu \in [0,\beta]$.

Extension

De Bondt and Wu (1997) solve the model numerically with R&D output spillovers, and we proceed the same way with R&D input spillovers:

$$f(X_j) = \sqrt{\frac{2}{\gamma}\left(x_j + \beta \sum_{M\setminus\{j\}} x_i + \mu \sum_{N\setminus M} x_k\right)}$$

$$\text{and} \quad f(X_k) = \sqrt{\frac{2}{\gamma}\left(x_k + \mu \sum_{N\setminus\{k\}} x_i\right)},$$

for all $j \in M$, and $k \in N \setminus M$.

Extension

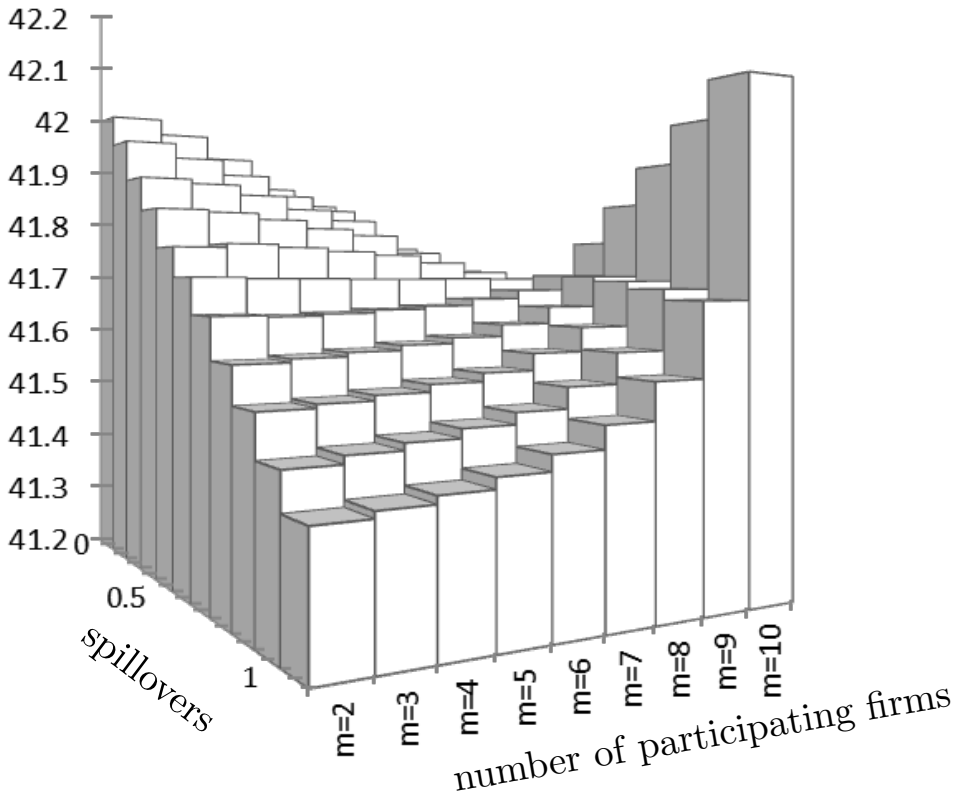

Figure 3: Consumer surplus with cooperation, with R&D input spillovers, for $\mu = \beta \in [0, 1]$ and $m = 2, ..., n$ (with $n = 10$, $\alpha = 10$, $\gamma = 20$).

Policy implications

According to our results:

(i) the innovators' combined market share is not a reliable predictor of the social desirability of agreements

(likelihood that cooperation benefits consumers can increase with combined market share);

Policy implications

According to our results:

(i) the innovators' combined market share is not a reliable predictor of the social desirability of agreements

(likelihood that cooperation benefits consumers can increase with combined market share);

(ii) simplification (withdraw market share criterion) and specialization (leave aside prosecution of collusion to other antitrust rules).