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How to simulate the coordinated effect of a merger

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Current empirical methods to identify coordinated effects (check list) (1)

1) *number of competitors* (probability of cheating increases with the number of competitors; Tirole, 1990)
2) *demand* (high incentives to cheating with strong demand)
3) *parallelism* (indicator of pro-collusive behaviour; Colemann-Sheffmann, 2003)
4) *maverick firm* (pro-collusive effect of a merger involving an undisciplined firm; Baker, 2002)

Current empirical methods to identify coordinated effects (check list) (2)

5) *<u>symmetry of capacities</u> (uncertain effect on collusion: it depends on free capacity; Compte-Jenny-Rey, 2002)*

6) *<u>symmetry of product number</u> (low incentives to cheat and to punish by the firm owning many products; Motta-Khun,2000)*

7) *<u>cost symmetry</u> (different results according to the collusive agreement; Rothschild, 1999; Collie, 2003)*

8) *<u>product differentiation</u> makes the setting up of a cartel more difficult (Stigler). But differentiation enhances its stability (low incentives to cheat; Deneckere, 1983; Ross, 1992; Chang, 1991)*

Drawbacks of current methods

- It is not easy to obtain clear cut results from this multiplicity of indicators
- Differently from unilateral effect, we must predict a change of regime (from competition to collusion): very few of current methods are able to do it
- Poor use of available information

The two problems faced by cartels

1) Cartel <u>setting up</u>: what do cartels maximize?

2) Cartel <u>stability</u>: grim trigger strategies

- Critical discount ratio

$$d_i = ({}_i\square^s - {}_i\square^c) / ({}_i\square^s - {}_i\square^b)$$

where: ${}_i\square^c$ = collusive profit of firm *i*

${}_i\square^s$ = profit which firm *i* obtains by deviating from the collusive agreement

${}_i\square^b$ = competitive (Bertrand) profit of firm *I*

- Incentive compatibility constraint:

d_i < discount rate for the concerned industry

What does a cartel maximize?
1) Joint profit maximization (JPM)

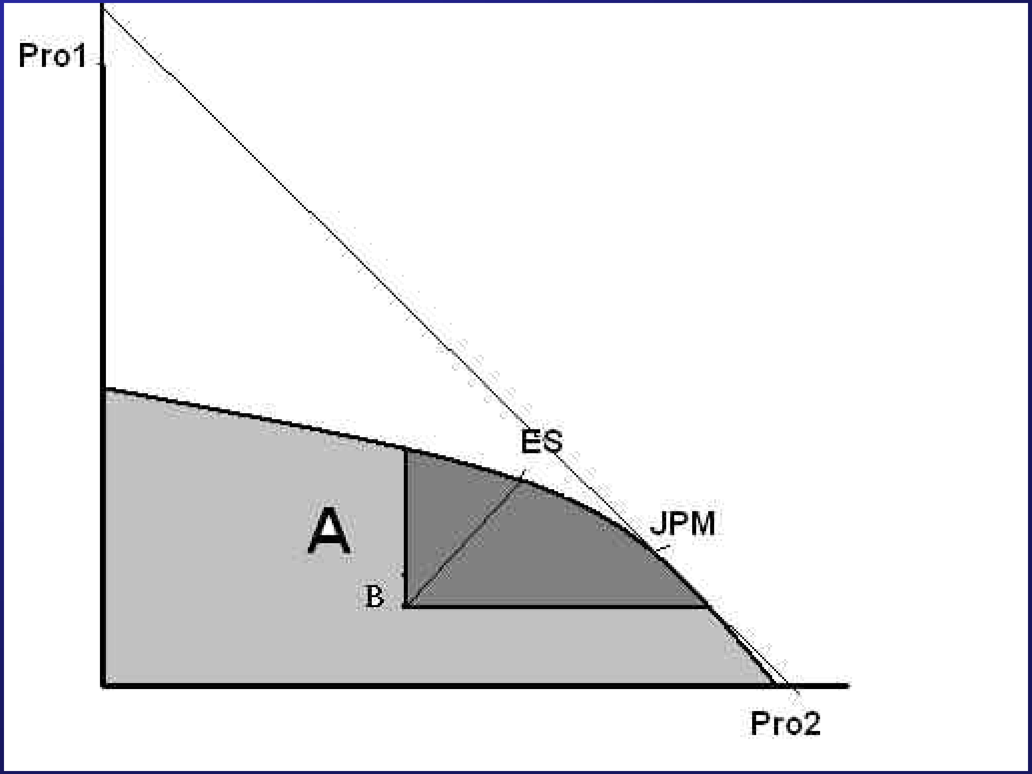
- JPM was assumed by Patinkin (1947) and criticized by Bain (1947) in case of asymmetry (unequal distribution of profits)
- Side payments not an option because:

1) Antitrust enforcement
2) Colluders know that a cartel must end (they don't want to be dependent on their competitor side payments)

What does a cartel maximize?
2) Egalitarian solution

- Equal shares of collusive gains
- Why should weaker (in terms of costs or quality of products) firms obtain the same share of collusive extra-profits than the most successful and efficient firm?

What does a cartel maximize?



What does a cartel maximize?
3) Nash bargaining solution (NBS)

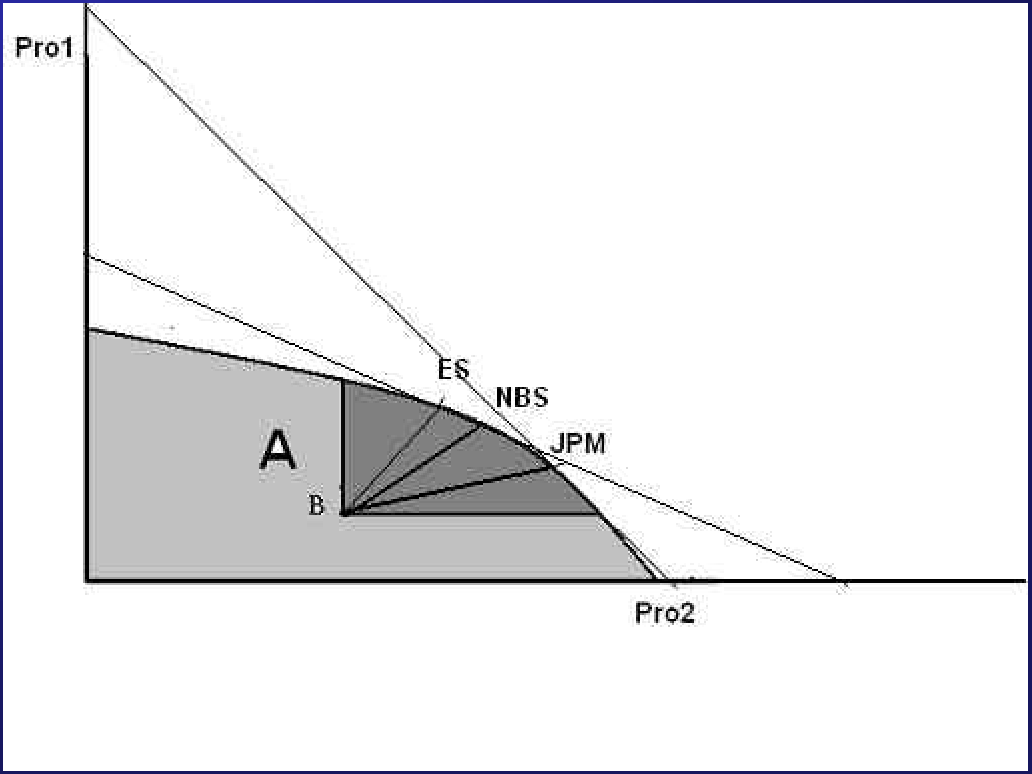
- $Max\ [\ ({}^{c}P_{i} - {}^{b}P_{i}) * ({}^{c}P_{j} - {}^{b}P_{ij})\ ]$

  Where ${}^{c}P$ = collusive profit

  ${}^{b}P$ = Bertrand profit

- Cooperative equilibrium: no attention payed to the possibility of cheating
- Intermediate solution (between JPM and ES) on the Pareto frontier

Nash bargaining solution is between ES and JPM on the Pareto frontier



What does a cartel maximize?
4) Balanced temptation equilibrium

- Properties of the equilibrium:

1) Critical ratios of colluders are the same
2) Equilibrium is on the Pareto frontier

- Non-cooperative equilibrium:
- Intermediate solution (between ES and JPM) on the Pareto frontier
- Nice property: we can check the stability of a cartel looking at only one parameter (common critical discount ratio)

Assumptions employed in the procedure

1) Linear demands of differentiated products

2) Constant marginal costs

3) When firms don't collude:

Bertrand competition

4) When firms collude:

- Balanced Temptation Equilibrium
- Grim trigger strategies

5) Perfect information

Procedure for assessing the coordinated effect

- 1° stage: ex ante balanced temptation equilibrium (common critical discount ratio = $_{t}$♎*)
- 2° stage: unilateral effect of the merger
- 3° stage: ex post balanced temptation equilibrium (common critical discount ratio = $_{t+1}$♎*)
- Final assessment: a merger produces a coordinated effect if:

a) $_{t}$♎* > $_{t+1}$♎*

b) $_{t+1}$♎* < discount rate for that industry

Procedure for assessing the coordinated effect: 1° stage

- The profit function of the generic "j" firm (producing "n" goods) is:

$$\Pi_j = (p_{j1} - c_{j1}) * q_{j1} (p_1 ... p_N) + (p_{j2} - c_{j2}) * q_{j2} (p1 ... p_N) + ... + (p_{j\,nj} - c_{j\,nj}) * q_{j\,nj} (p_1 ... p_N)$$

- The weighted total profit function is:

$$\Pi_t = \Pi_1 * ?_1 + ... + \Pi_J * ?_J + ... + \Pi_m * (1 - ?_1 - ?_2 - \;..\; - ?_{m-1})$$

subject to: $?_J > 0$ and $0 < S\, ?_J < 1$

- FOC on the Pareto frontier (N equations)

  $d\, \Pi_t / dp_1 = 0$

  ....

  $d\, \Pi_t / dp_i = 0$

  ....

  $d\, \Pi_t / dp_N = 0$

- constraint of equal critical discount ratio (M equations)

  $d_1 = d^*$

  ....

  $d_j = d^*$

  ....

  $d_m = d^*$

- *m* + *n* unknown: (m-1) $?_j$ parameters, d^* and the *n* product prices
- *m* + *n* equations

Procedure for assessing the coordinated effect: 2° stage

- Profit function of the new firm:

$\Pi_c = \Pi_1 + \Pi_2$

- Prices, due to the unilateral effect, obtained by solving the following FOC system:

$d\Pi_c / dp_1 = 0$

$d\Pi_c / dp_2 = 0$

$d\Pi_3 / dp_3 = 0$

....

$d\Pi_i / dp_i = 0$

....

$d\Pi_N / dp_N = 0$

Procedure for assessing the coordinated effect: 3° stage

We re-estimate the balanced temptations equilibrium (procedure used in stage 1) with the new ownership structure, prices and quantities as calculated in stage 2 (expected to prevail as consequence of the merger unilateral effect)

Example

- *Demand system*

$Q_1 = 80 - 3\,p_1 + 2\,p_2 + p_3$

$Q_2 = 140 + 2\,p_1 - 4\,p_2 + p_3$

$Q_3 = 100 + p_1 + p_2 - 3.5\,p_3$

- *Costs*

$C_1 = 5\,Q_1$

$C_2 = 10\,Q_2$

$C_3 = 7\,Q_3$

- *Evaluation of two mergers:*

a) Between firm 1 and firm 2 ✹ asymmetric profit set (see ♑'s)

b) Between firm 2 and firm 3 ✹ more symmetric profit set (see ♑'s)

Ex ante competitive and collusive equilibria

	Prices			Profits			Critical discount ratios			Total profits weights		
	P_1	P_2	P_3	$\square_1$	$\square_2$	$\square_3$	♎$_1$	♎$_2$	♎$_3$	♑$_1$	♑$_2$	♑$_3$
Bertrand Equilibrium	31.62	33.8	27.1	2126	2265	1418	_	_	_	_	_	_
Joint Profit Maximization Equilibrium	83.7	77.6	61.7	3619	3957	2477	.67	.62	.59	.33	.33	.33
Nash Bargaining solution	84.2	78.6	60.4	3564	3729	2747	.68	.67	.50	.33	.32	.35
Balanced temptations equilibrium	83.1	77.7	62.3	3786	3905	2359	.63	.63	.63	.34	.33	.33

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Ex post competitive and collusive equilibria: A) merger between firms 1 and 2

	Prices			***Profits***		***Critical discount ratios***		***Total profits weights***	
	P_1	P_2	P_3	□$_{12}$	□$_{3}$	♎$_{12}$	♎$_{3}$	♑$_{12}$	♑$_{3}$
Bertrand Equilibrium	52.2	51.4	32.6	5731	2293	_	_	_	_
Joint Profit Maximization Equilibrium	83.7	77.6	61.7	7576	2477	.36	.89	.50	.50
Nash Bargaining solution	86.5	80.0	58.7	6817	3153	.57	.54	.44	.56
Balanced temptations equilibrium	86.3	79.8	58.8	6860	3119	.56	.56	.44	.56

Ex post competitive and collusive equilibria: A) merger between firms 2 and 3

	Prices			*Profits*		*Critical discount ratios*		*Total profits weights*	
	P_1	P_2	P_3	□$_{1}$	□$_{23}$	♎$_{1}$	♎$_{23}$	♑$_{1}$	♑$_{23}$
Bertrand Equilibrium	33.9	38.1	32.1	2504	3955	_	_	_	_
Joint Profit Maximization Equilibrium	83.7	77.6	61.7	3619	6434	.73	.51	.50	.50
Nash Bargaining solution	82.0	78.9	62.7	4204	5822	.60	.62	.52	.48
Balanced Temptations equilibrium	82.0	78.8	62.6	4168	5861	.61	.61	.52	.48

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Balanced temptations equilibrium and asymmetry

- Shubik-Levitan demand function:

$Q_x = 0.5(v - p_x (1+m/2) + m/2\ p_y)$

$Q_y = 0.5((1-v) - p_y (1+m/2) + m/2\ p_x)$

- *"m" parameter measures the differentiation degree* :

  min ✹ m = 0

- *"v" parameter measures the asymmetry degree (preference for the product x):*

  Symmetry ✹ v = 0.5

  Highest preference for product *x* ✹ v = 1

  Highest preference for product *y* ✹ v = 0

Cartel stability influenced by differentiation but not by asymmetry

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Critical discount ratios for different *v* (asymmetry) and *m* (differentiation)

V	.1	.3	.5
M			
1	.513	.511	.510
2	.534	.530	.529
3	.556	.552	.551
4	.577	.573	.571
5	.597	.593	.591
6	.615	.611	.610
7	.632	.628	.627
8	.648	.644	.643
9	.662	.659	.658
10	.676	.672	.671

How the probability of collusion could be modified by a merger

- Increase in the degree of <u>differentiation</u> (in case of a merger between two firms producing very similar goods)
- Decrease in <u>cheating profits</u> (one less firm on the market)

Final remarks

- Unilateral effect associated to coordinated effect
- A merger with a strong unilateral effect cannot pass the test of collective dominance (because we expect a strong coordinated effect)
- Was the change of the substantive standard in the European Merger Regulation necessary?